EURASIP

NEWS LETTER

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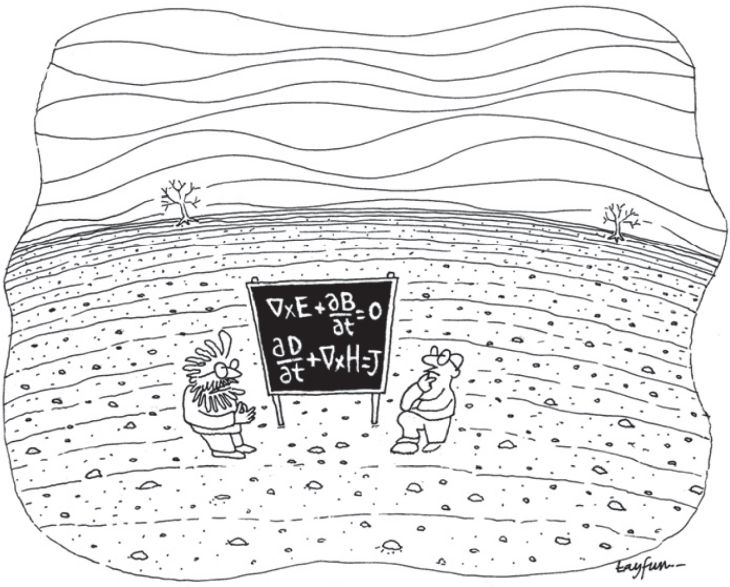

— LET'S CALL THEM "THE FIELD EQUATIONS."

European Association for Signal Processing

Newsletter, Volume 20, Number 4, December 2009

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President's Message

Now that EUSIPCO 2009 in Glasgow has ended with about 600 participants and a wonderful program, scientific as well as cultural wise, all is left for me is to thank Bob Stewart, Stephan Weiss, Patrick Naylor and all the members of the organizational committee for providing such a splendid job. Our concept of offering free tutorial has been shown successfully and will be continued in the future EUSIPCOs. While the number of participants has been steady, the exhibition has strongly increased. Currently many conferences suffer of the financial crisis; papers are withdrawn although being accepted. Many workshops I attended this year suffered the same fate. Let us hope that things become better in 2010.

Time to look back in the recent past. Inspired by the US American Universities, a lot of discussion is currently going on in Europe about Elite Universities. The European Institute of Technology is being formed, not in a specific location but dependent on topics distributed over many universities in different European countries. But also nationally much activity is being spent to concentrate resources and sharpen profiles. The idea is to attract as many outstanding people in specific fields as possible and become mostly visible. On the long run the positive impact on the European or national industry is expected. Strange though that much comparison is done on performance comparison with American Universities while they have funds in the area of several billions our universities are run at several hundred millions. Recently the Technical University in Munich became one of the first Elite Universities in Germany. For this they obtain about 30Mio Euro additionally; roughly the same amount of money is devoted in Austria to pay for an entire Elite University; not the right amount to keep up with Harvard or MIT.

What exactly does Elite mean? Looking into wikipedia you will find the following:

> **Elite** (occasionally spelled Élite) is taken originally from the Latin, *eligere*, "to elect." In sociology as in general usage, the elite is a relatively small dominant group within a large society, having a privileged status perceived as being envied by others of a lower line of order.

Thus, the term Elite is not simply the best, it is more than that. In a set, there is always the best, for example the 1% best, the 10% best or the 50% best. This does not include that there is Elite among them. Even the 1% best students can be very poor and do not necessarily show any sign of elite. It is very likely that there is some Elite to be found in every University but not at any time and certainly not at any subject. The term Elite University, that is a large set of subjects, is thus an oxymoron (coming from "sharply dull" in Greek

and is a figure of speech that combines two normally contradictory terms, not to be confused with the term paradoxon); the Elite University cannot exist. What is meant is merely "collecting of the best," given the various subjects to be filled. However, this is exactly what every University tries to achieve, given the money they can spent. True Elite doesn't care much about income as long as they do not starve. Lowering income at university moves the best limit towards the 50%, increasing income moves it towards the 1% line. But not only income defines a good university. Some subjects require a lot of money for equipment, in particular in Engineering, when working experimentally; a large amount of money is needed. In Signal Processing, surprisingly the so called Elite Universities do not necessarily spend much money on equipment. In this field the mathematical abstraction accounts more than experimental work. True Elite is thus not necessarily expensive.

I believe that the most important distinguishing element that defines a university is the work environment. As soon as the income is so low that professors have to find additional jobs to feed their family (this is the case in many countries in Europe today!) such a university is not the place to invent great things. But on the other hand, administrative tasks are taking over. Many Universities spend already more money on administration than on research. Worst of all, the researcher themselves still spend much of their time on administration. What novel ideas can be born in such an environment? Here the EU and the individual European nations have a long path ahead of them to set the right initiatives and reset the wrong ones. I believe that there is enough money around in the EU for research; it is just not spent for it.

The year 2009 is coming to an end and I'd like to take the opportunity to wish you all a good ending and an even better beginning of the coming year in which we hopefully will not see as much of the financial crisis any longer. All who have not attended EUSIPCO 2009, please renew your membership before year's end to keep being informed about all EURASIP news and participate in the many membership services we offer.

Markus Rupp
President

EURASIP One-Day Seminars

Two EURASIP one-day seminars have been held recently, that is, a seminar on Cubature Kalman Filters and a seminar on Radar Signal Processing.

Cubature Kalman Filters

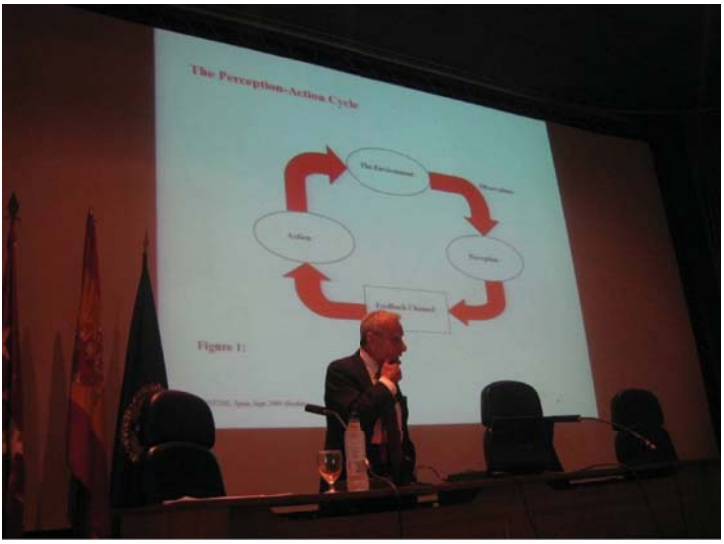
The EURASIP one-day seminar on Cubature Kalman Filters was presented by Professor Simon Haykin from McMaster University, Canada. The seminar was held on the 18th of September 2009 in Madrid, Spain, promoted by Marcos Faundez (UPMataro) and organized by Narciso García at UPM Telecom School.

The topic of the key talk was about the Cubature Kalman Filter (CKF), which is a new nonlinear filter for high-dimensional state estimation. Its heart is a spherical-radial cubature rule, which makes it possible to numerically compute multivariate moment integrals encountered in the nonlinear Bayesian filter. Specifically, it derive a third-degree spherical-radial cubature rule that provides a set of cubature points scaling linearly with the state-vector dimension. The CKF may therefore provide a systematic solution for high-dimensional nonlinear filtering problems. The CKF is tested experimentally in two nonlinear state estimation problems. In the first problem, the cubature rule is used to compute the second-order statistics of a nonlinearly transformed Gaussian random variable. The second problem addresses the use of the CKF for tracking a manoeuvring aircraft. The results of both experiments demonstrate the improved performance of the CKF over conventional nonlinear filters.

The key talk was attended by 60 people, being almost half of them lecturers and the other ones master and PhD students.

At the end of Prof. Haykin's talk, he received a large amount of questions from the audience and some people came with his most popular books in order to obtain his personal dedication and signature. After that, Professor Narciso García offered a visit to the telecommunication museum of UPM, which contains a large amount of telegraphs, telephones, valves, telephonic switching boards, radios, etc.).

The event was filmed and will be available, jointly with the slides, at EURASIP website.



A shot during Prof. Haykin's talk.

Radar Signal Processing: Hot Topics and New Trends

The EURASIP one-day seminar on Radar Signal Processing was held on the 25th of September 2009 in Pisa, Italy, organized by Maria Sabrina Greco, from the Department of Information Engineering of the University of Pisa. The aim of this event was to provide a flavour of the revolution that the radar world is living in nowadays. Continuing advances in device technologies combined to adaptive processing provide rich opportunities for new sensing methodologies and new challenges in signal processing; complex and integrated systems, waveform diversity and MIMO radars, multi-mission and multi-mode operation systems are nowadays the paradigms in radar theory and technology.

In this vein, the technical program of the day included four seminars of two hours each. The first seminar, co-authored by Dr. Antonio Graziano and Dr. Alfonso Farina, of SELEX Sistemi Integrati (SELEX Sistemi Integrati, a Finmeccanica company, designs and develops Large Systems for Homeland Protection, systems and radar for air defence, battlefield management, naval warfare, air traffic control, coastal and maritime surveillance.) (Italy) was a very interesting introduction to the concept of complex and integrated systems and their application to the problem of Homeland Protection.

Prof. Marco Lops, of the University of Cassino (Italy) and the University of Toulouse (France) focussed his talk on the many research challenges in MIMO radar waveform design. Dr. Stevan Baumgartner, of the DLR (Germany), presented an exhaustive overview on Synthetic Aperture Radar (SAR), with particular focus on new technologies and civil applications.

Dr. Paolo Cipollini, of the University of Southampton (UK), described the concept of satellite radar altimetry and its application to the study of oceans and climate.

This one-day event brought together about 40 people from academia, international research centres and industrial companies, from Europe, South Africa and Australia. Fruitful

discussions have been generated during each talk on the leading edge research on radar theory and technology. The seminar day has been introduced and chaired by the organizer Maria Sabrina Greco, Italian EURASIP liaison, in the framework of events promoting EURASIP activity.

A shot during Prof. Marco Lops' talk (Dr. Antonio Graziano is on the back, in the centre of the picture).

EURASIP Treasurer's Report 1st October, 2008–30th September, 2009

On 1st October 2008 the opening balance, in Euros (€), was as specified in the table below.

Opening balance (1st October, 2008)		
Current accounts:		
Fortis account	32247,53	
PayPal account	38,29	
total	**32285,82**	
Savings accounts:		
Fortis savings account	**105160,00**	
Total available		**137445,82**
Loans to be reimbursed:		
EUSIPCO'2008	15000,00	
total	**30000,00**	
Total		**152445,82**

The main EURASIP account movements during the financial period considered are documented in the following two tables, for income and expenses, respectively:

Income:	€	€
Membership (incl. Journal subscriptions)	40994,00	
Donations/review charges:		
Elsevier	10000,00	
EUSIPCO'2008	12182,00	
Total income		**63176,00**
Reimbursed loans:		
EUSIPCO'2008	15000,00	
Total		**78176,00**

Expenses:	€	€
Elsevier (various concepts)	562	
Hindawi (various concepts, incl. Newsletter)	8017	
EURASIP Awards and medals	2697	
EURASIP Workshop	1097	
Administrative expenses	3825	
Taxes, bank costs, interests	93	
Total expenses		**16291,00**

The closing balance on the 30th September 2009 was as specified in the table below:

Closing balance (30th September, 2009)		
Current accounts:		
Fortis account	58750	
PayPal account	968	
total	**59718**	
Savings accounts:		
Fortis savings accounts	**139413**	
Total available		**199131**
Total		**199131**

30th September, 2009

Speech Communication

Marc Swerts (Editor-in-Chief)

I am glad to be given the opportunity to introduce our journal Speech Communication to the EURASIP community. Apart from its link to EURASIP, this journal is also very much connected to the International Speech Communication Association (ISCA). The kinds of articles published in our journal closely match the topics of papers presented at major ISCA events, such as the yearly Interspeech conferences organised in different parts of the world. On such occasions, the journal regularly organises meetings for its editorial board members, given that many board members typically participate in these events. The journal is published by Elsevier, with 12 issues per year, and appears to be in good shape, as evidenced by the fact that, in 2009, its impact factor has increased to an all-time high 1.229 (and had a 5-year impact factor of 1.609).

Below I will give some general information about the journal, as well as specifics about latest developments.

General information

Speech Communication is an interdisciplinary journal whose primary objective is to fulfil the need for the rapid dissemination and thorough discussion of basic and applied research results. In order to establish frameworks to inter-relate results from the various areas of the field, emphasis is placed on viewpoints and topics of a transdisciplinary nature. The journal's primary objectives are to present a forum for the advancement of human and human-machine speech communication science, to stimulate cross-fertilization between different fields of this domain, and to contribute towards the rapid and wide diffusion of scientifically sound contributions in this domain.

Subject areas covered in this journal include:

- Basics of oral communication and dialogue: modelling of production and perception processes; phonetics and phonology; syntax; semantics and pragmatics of speech communication; cognitive aspects.
- Models and tools for language learning: functional organisation and developmental models of human language capabilities; acquisition and rehabilitation of spoken language; speech & hearing defects and aids.

- Speech signal processing: analysis, coding, transmission, enhancement, robustness to noise.
- Models for automatic speech communication: speech recognition; language identification; speaker recognition; speech synthesis; oral dialogue.
- Development and evaluation tools: monolingual and multilingual databases; assessment methodologies; specialised hardware and software packages; field experiments; market development.
- Multimodal human computer interface: using speech I/O in combination with other modalities, for example, gesture and handwriting.

Latest developments

New editorial structure:

As of 2009, Elsevier has followed recommendations from various people and looked at the experiences of other journals to introduce a new editorial structure for the journal, with one editor-in-chief, a number of subject editors, and a larger editorial board. Until recently, we used to have a structure with 3 editors-in-chief and a large editorial board, and no intermediate layer. The benefit of having the new structure with the introduction of a number of subject editors is that this would guarantee a smoother handling of manuscripts, and would generate better and more expert feedback to authors. While the new structure as such was well received at the last editorial board meeting during Interspeech 2009, various board members did recommend to broaden the subject coverage of the structure, in particular to strengthen the broader area of human speech perception. Consequently, we have started to seek for 2 more subject editors, preferably with a background in phonetics or psycholinguistics, to better cover that important field. We are still reflecting on the status of the editorial board within that new structure, that is, whether we want a very active editorial board (e.g. to do reviews, to give advice on special issues, to recommend topics for review papers or tutorials,. . .) or whether we consider membership of the board to be mainly honorific.

Procedures to solicit good papers:

Whereas the majority of published articles in our journal appear to be regular submissions that report on latest results of research in the broader area of speech communication, we have also started to more actively encourage experts in the field to write tutorials or review papers on a specific theme. Recently, this has for instance led to some exciting publications by Heiga Zen, Keiichi Tokuda, and Alan W. Black on "Statistical parametric speech synthesis" (Speech Communication, Volume 51, Issue 11, November 2009, Pages 1039–1064) and by M. Benzeghiba, R. De Mori, O. Deroo, S. Dupont, T. Erbes, D. Jouvet, L. Fissore, P. Laface, A. Mertins, C. Ris, R. Rose, V. Tyagi, and C. Wellekens on "Automatic speech recognition and speech variability" (Speech Communication, Volume 49, Issues 10-11, October-November 2007, Pages 763–786). Apart from their obvious scientific value as overview papers that give a view on latest developments within a specific subfield, such articles also have the potential that they increase the impact factor of our journal, as they tend to be well-cited. In addition, we are also considering to encourage authors of papers that were well received at interspeech conferences and selected by area chairs at these events to submit extended versions of their manuscripts to our journal.

Policy for special issues:

On a yearly basis, we receive quite a few proposals for special issues, intended as thematically organised collections of papers, usually on topics that may deviate somewhat from what is considered to be mainstream in our field. In principle, we of course welcome such initiatives from the speech community, but given the increasing number of proposals we receive, we feel we should limit the number of special issues per year (in the order of 2 or 3), partly not to delay the publication of regular papers. We are therefore considering to implement a yearly call for special issues, where we select the best proposals for a specific year. The new procedure also implies that special issues are always based on open calls for papers to which anyone can submit, and it will be made clear to prospective guest editors that a special issue can still be cancelled if it has not attracted a sizeable amount of good papers, in which case the papers that did get good reviews could be published as regular papers, or could fill a special section within a regular issue. In line with our previous point, we also intend to invite guest editors to include at least one review or tutorial paper in the special issue which introduces the topic of the issue to the broader speech community. To guarantee that contributions to such issues are properly reviewed, we will continue our best practice from the past to have one subject editor (different from the guest editors) supervise the whole process.

Workshop and Conference Activities

EUSIPCO, The European Signal Processing Conference is the flagship conference of EURASIP. The 17th EUSIPCO was held in Glasgow on 24–28 August 2009. I had the pleasure to attend the conference and benefit from the numerous good quality papers that were presented. Experts in the areas of signal and image processing gave several well-attended tutorials and plenary talks. This conference was also a good opportunity to meet old and new friends; this was great pleasure indeed. I hope that you too enjoyed the conference. A very exciting banquet was organised in the Kelvingrove Art Gallery and Museum. We all had the chance to admire so many world-famous pieces of artwork. I wish to thank the organisers for their efforts to set up such high-quality technical programme and an exciting social event.

The 18th EUSIPCO will be held in Aalborg, Denmark from 23 to 27 August 2010. I am confident that the General Chair, Søren Holdt Jensen, and his General Co-Chair, Mats Viberg, together with their team will organise a memorable event. Eminent researchers have already committed to give plenary talks. I encourage you to submit papers, tutorial or special session proposals, and to attend the conference. You will find details and deadlines for submissions at the following address: http://www.eusipco2010.org/.

In this issue of the newsletter you will find a calendar of events, which lists forthcoming workshops or conferences that are co-sponsored by EURASIP. Some Calls for Papers are also included. I wish to mention that EURASIP carefully assesses co-sponsoring applications based on criteria, such as the quality of the organising committee of the workshop or of the conference, as well as that of the international Technical Program Committee, the history of the workshop or conference, and the quality of plenary and tutorial speakers. Most importantly, EURASIP ensures that an international peer review system is in place and that a certain rejection rate, depending on the expected number of submissions, is reached.

I would like to bring to your attention the fact that a member of EURASIP is entitled to a 10% registration fee discount for any EURASIP co-sponsored conference or workshop. Please, do not forget to claim your discount when you attend your next EURASIP co-sponsored workshop or conference.

I encourage you to take part in these events and hope that you have a stimulating and most productive time. EURASIP would be delighted to receive comments about your experience with the conferences and workshops you attended.

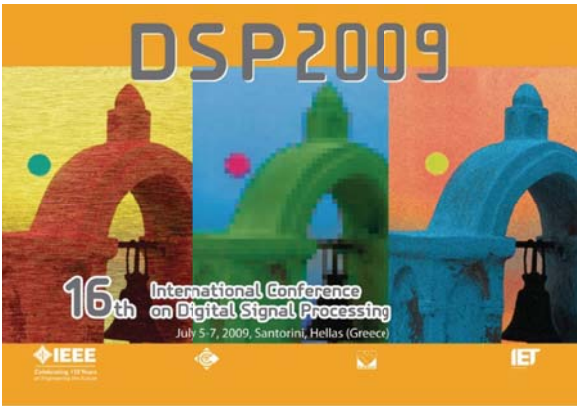
Abdelhak Zoubir
EURASIP Event Coordinator

Calendar of Events

Year	Date	Event	Location	EURASIP Involvement	Chairperson/Information
2009	December 13–16	The 3rd International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP09)	Aruba, Dutch Antilles	Co-sponsor	Marina Sabrina Greco http://www.conference.iet.unipi .it/camsap09/
2010	March 3–5	The 4th International Symposium on Communications, Control and Signal Processing (ISCCSP 2010)	Limassol, Cyprus	Co-sponser	Stavros Zenios http://www.cut.ac.cy/isccsp2010/
	April 12–14	The 11th International Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS 2010)	Desenzano del Garda, Italy	Co-Sponsor	Pierangelo Migliorati http://www.wiamis2010.org/
	May 10–13	The 10th International Conference on Information Sciences, Signal Processing and their Applications (ISSPA 2010)	Kuala Lumpur, Malaysia	Co-Sponsor	Boualem Boashash http://www.isspa2010.com/
	June 14-15	The 2nd IAPR International Workshop on Cognitive Information Processing (CIP 2010)	Elba Island, Italy	Co-Sponsor	Fulvio Gini http://www.conference.iet.unipi .it/cip2010/
	June 20–23	The 11th IEEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC 2010)	Marrakech, Morocco	Co-Sponsor	Mounir Ghogho http://www.spawc2010.org/
	June 23–25	The 8th International Workshop on Content-Based Multimedia Indexing (CBMI 2010)	Grenoble, France	Co-Sponsor	Franck Thollard http://mrim.imag.fr/cbmi2010/
	June 30 July 2	The 4th International Conference on Image and Signal Processing (ICISP 2010)	Trois-Rivières, Québec, Canada	Co-Sponsor	Olivier Lezoray http://www.uqtr.ca/ icisp/
	July 5-6	The 2nd European Workshop on Visual Information Processing	Paris, France	Co-Sponsor	Azeddine Beghdadi http://www-l2ti.univ-paris13.fr/ ~euvip/
	July 21–23	The 7th International Symposium on Communication Systems, Networks and Digital Signal Processing (CSNDSP 2010)	Newcastle, UK	Co-Sponsor	Fary Ghassemlooy http://www.csndsp.com/
	August 23-27	The 18th European Signal Processing Conference (EUSIPCO 2010)	Aalborg, Denmark	Sponsor	Søren Holdt Jensen http://www.eusipco2010.org/
2011	August 29 September 2	The 19th European Signal Processing Conference (EUSIPCO 2011)	Barcelona, Spain	Sponsor	Ana Perez Neira http://www.eusipco2011.org

Abdelhak Zoubir; *EURASIP Event Coordinator*

Report on the 16th International Conference on Digital Signal Processing (DSP 2009)



The 16th International Conference on Digital Signal Processing (DSP 2009), the most long-standing conference in the area of DSP, was held 5–7 July 2009 on the Aegean island of Santorini, Greece. DSP 2009 was technically co-sponsored by EURASIP, IEEE and IET.

The DSP Conference has truly come a long way! It was 41 years ago, in 1968, when the first International meeting on Digital Signal Processing was organised by Prof. A. G. Constantinides in London. Since then, this scientific journey continues by stopping over at London (UK), Florence (Italy), Nicosia (Cyprus), Lemessos (Cyprus), Santorini (Greece) and Cardiff (UK) to reach this year again Santorini.

DSP 2009 drew a large number of excellent contributions, from 48 countries around the world. These contributions were reviewed by two of our 229 reviewers, who selected 232 of them (i.e., approx 70 percent) as appropriate for presentation. They have been arranged in lecture or poster sessions, as follows: 50 papers in 10 special sessions, 117 papers in 23 oral sessions and 65 papers in 8 poster sessions. Accepted papers are published in IEEE Xplore (http://ieeexplore.ieee.org/xpl/RecentCon.jsp?punumber=5176123&conhome=1001228).

The successful scheme of the earlier events was followed again, namely a significant number of special sessions was organised by internationally recognised experts in their own areas. Indicative special session subjects were: Compressed Sensing and Sub-Nyquist Sampling; Social Media; Biometric Recognition for Video Surveillance; DSP for Navigation and Positioning; Multimedia Security and Forensics; Fusion of Heterogeneous Data for Robust Estimation and Classification.

The technical program was highlighted by plenary lectures of four distinguished scientists. Specifically, Prof. Michael Unser (EPFL, Switzerland) discussed about "Sampling: 60 Years After Shannon;" Prof. Athanasios Fokas (U of Cambridge, UK) presented novel "Analytical Techniques for PET, SPECT, MEG and EEG and their Numerical Implementation;"

Prof. Alexandre Xavier Falcão (U of Campinas, Brazil) reported on the "Recent Advances and Perspectives of the Image Foresting Transform;" and Dr. Byung K. Yi (LG Electronics, USA) presented significant "Signal Processing Techniques in Wireless Communications." Plenary lectures stimulated with visionary thoughts and emphasized that each of the participants is part of a larger community of scholars having common interests.

The event was well attended. Over 220 researchers from academia and industry were actively participating in the lecture and poster presentations in the "P. M. Nomikos Conference Centre" in Santorini for the three days of the conference.

The next event is scheduled for 2011. The exact venue and dates are to be specified by the Steering Committee early next year. All relevant info about DSP 2009 and DSPs to come is available at www.dsp-conferences.org. We sincerely hope that this Conference will keep on leading the way to high quality Digital Signal Processing research worldwide.

A. N. Skodras
General Chair, DSP 2009

Report on the 17th European Signal Processing Conference (EUSIPCO 2009) 24–28 August 2009, Glasgow, Scotland

The Processing Conference was held from August 24–28, 2009 in Glasgow. Around 600 attendees mostly from academia and 100 industrial exhibitors and guests participated in a lively event that was enjoyed by everyone.

A tutorial day free for registered EUSIPCO participants took place on Monday 24th August within the University of Strathclydes premises. Around 250 attendees took the opportunity to listen to 6 academic tutorials instructed by world-leading experts such as Bernd Girod and others, as well as two industrial demonstrations. Free tutorials were first introduced at EUSIPCO 2008 in Lausanne, and the attendance numbers and feedback in Glasgow gave evidence of a replication of this success.

The core technical programme took place from Tuesday 25 to Friday 28 of August in the Glasgow Royal Concert Hall, which enjoys a prominent central location in Glasgow at the intersection of the two main pedestrian areas. Around 550 papers were presented by authors from almost 60 countries, which were distilled from almost 800 submissions. The review process was organised by 50 area chairs, and supported by 350 members of the technical programme committee (TPC) as well as over 1200 expert reviewers from outside the TPC. Excluding invited papers that were submitted as part of 16 special sessions on topical developments in signal processing, the acceptance ratio was around 68%. For the first time, the technical committee has operated a shepherding process for papers with a clear contribution but a lack in presentational clarity. Approximately 8% of the submitted papers were admitted into this shepherding process after the first review cycle, and following successful major revisions were in their majority included into the technical programme.

The technical programme was underpinned by seven keynote presentations by Tariq Durrani (Strathclyde), Anthony Magrath (Wolfson Microelectronics), Mauricio Omologo (Fondazione Bruno Kessler), Chris Dick (Xilinx), Kenneth Stewart (Motorola), Josef Kittler

(University of Surrey), and Roger Woods (University of Belfast). These plenaries presented a generally accessible backdrop and strong motivation for the technical papers, which were organised in 10 specialist tracks and ran in 8 parallel (6 oral and 2 poster) sessions across the 4 day technical programme.

The City of Glasgow, a major supporter of this conference, had invited the participants on Tuesday 25th of August into its magnificent City Chambers for a civic reception. Welcomed by representatives of Glasgow, the conference theme was related to Scotlands rich scientific heritage, including James Maxwell and Lord Kelvin.

The conference banquet on Thursday night took participants to the Kelvingrove Museum and Art Gallery in Glasgows cosmopolitan West End, were everyone enjoyed to mingle with both famous signal processing colleagues and the Kelvingroves exhibits from around the world. The Gallery provided a suitable stage for the EURASIP award ceremony that saw a number of outstanding individuals honoured.



(Left) Glasgow City Chambers,(middle) Glasgow Royal Concert Hall, and(right) Kelvingrove Art Gallery and Museum.

The EUSIPCO 2009 organising committee would like to thank the many organisations and individuals that contributed towards the success of this conference i many ways, from generously donating their time and expertise to providing sponsorship. We would also like to warmly thank all the participants of the conference, without whose contribution a strong technial programme and lively event would not have been possible. We hope you experienced the warmth and hospitality of the City of Glasgow and Scotland as well as the family ties that exist within EURASIP and its flagship conference, and thoroughly enjoyed EUSIPCO 2009!

Bob Stewart and Stephan Weiss
(On behalf of the EUSIPCO 2009 organising committee)

Report on the 16th IEEE Workshop on Statistical Signal Processing Cardiff, Wales, UK, August 31-September 3, 2009

The 16th IEEE Workshop on Statistical Signal Processing (SSP 2009) was held in Cardiff, Wales, United Kingdom. The workshop was indeed successful in achieving its goals and objectives. Over 250 researchers from more than 35 countries gathered to contribute into the meeting.

Cardiff, the capital of Wales, in the proximity of where the first wireless communication by Marconi took place, has been the host for many international and social events, conferences, and workshops recently for its attractive natural resources and many constitutional developments. In 2009 delegates were brought right up to date in an area of rebirth, Cardiff Bay, the heart of Europes youngest capital. The history of Cardiff, however, goes back to the days of the Roman Empire; the remains of the Roman stone fortifications can be seen within the walls of Cardiff Castle. Cardiff's reputation as one of Britain's six cities of elegance arises from its remarkable civic centre, regarded as being world-ranking. All these provided a suitable ground for the SSP 2009.

Approximately 330 regular papers and 10 papers for special sessions were submitted, 198 regular papers were accepted, and 208 papers were presented in both oral and poster sessions. Six very rich keynote talks (by Pierre Comon, Lajos Hanzo, Athina Petropulu, Jean-Philippe Thiran, Deliang Wang, and Abdelhak Zoubir), two special sessions, and two tutorials were the other highlights of the meeting. The meeting was co-sponsored by Cardiff University, Cardiff Neuroscience Centre, EURASIP, and Loughborough University.

The participants enjoyed free access to both wired and wireless networks, free welcome reception, free three-course hot lunches in cosy environment, and a memorable banquet in Celtic Manor Golf Club in New Port, Wales, overlooking a beautiful scenery and countryside while listening to Welsh harp rhythms.




Saeid Sanei
October 22, 2009

Report on ISPA 2009, Salzburg, Austria, September 16–18, 2009

The 6th Intl Symposium on Image and Signal Processing and Analysis (ISPA 2009) was held in Salzburg, Austria, from September 16–18, 2009 (www.isispa.org). ISPA 2009 was co-sponsored by EURASIP and by IEEE Region 8 and was jointly organized by University of Salzburg, Austria and by University of Zagreb, Croatia. The Program Committee members selected 121 out of 218 received submissions presenting research and applications of signal and image processing. The papers were organized into three parallel program tracks. There were 61 regular papers in the area of image processing and 33 papers in signal processing received, with acceptance rates of 52% and 5%, respectively. The special sessions received 124 submissions and after review had an acceptance rate of 60% overall. There were 169 participants attending the symposium.

The following distinguished researchers presented plenary lectures at ISPA 2009:

1 Professor H. Vincent Poor, Princeton University, NJ, USA
Collaborative Signal Processing in Wireless Sensor Networks

2 Dr. Henning Puder, Siemens, Germany
Hearing aids: An overview of the state-of-the-art, challenges, and future trends of an interesting audio signal processing application

3 Professor Stefan Katzenbeisser, TU Darmstadt, Germany
Signal Processing in the Encrypted Domain: Analyzing signals privately

4 Professor John Daugman, University of Cambridge, UK
Recognising persons by their iris patterns

ISPA 2009 program included 13 special sessions presenting state-of-the-art on various aspects of image and signal processing. The special sessions were organized and chaired by distinguished researchers from academia and industry: "Image and Signal Analysis in Psychophysiomatics," "Image and Signal Processing in Wood Science and Technology", "Stereo Analysis and 3D Video/TV," "Digital Shape Analysis: Theory and Applications," "Multimedia Security and Watermarking," "Image and Signal Processing in Biometrics," "Analysis and Visualization of Dynamic Images in Medical Applications," "Parallel and Distributed Computing in Image Processing, Video Processing, and Multimedia," "Advanced Algorithms for Automotive Multimedia Applications," "Forensic Image and Video Processing," "Endoscopic Image Processing and Analysis," "New Advances in Vascular Imaging and Modelling", and "Recent Advances in Designing and Implementing Computationally-Efficient Digital "Filters and Filter Banks." Conference publications included the abstract book and the CD proceedings. All accepted papers will be published in IEEE Xplore digital

library. Participants enjoyed social events including a welcome reception party, a gala dinner, and a sightseeing tour of Salzburg.

Peter Zinterhof and Sven Loncaric
ISPA 2009 General Co-Chairs
Andreas Uhl and Alberto Carini
ISPA 2009 Program Co-Chairs

Report on the 51st International Symposium ELMAR-2009, 28–30 September 2009, Zadar, Croatia

The 51st International Symposium ELMAR-2009 was organized by the Croatian Society Electronics in Marine—ELMAR, Zadar, Croatia, together with the Department of Wireless Communications, Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia, during 28th, 29th and 30th of September 2009.

ELMAR-2009 symposium was organized in cooperation with The European Association for Signal, Speech and Image Processing—EURASIP. Symposium took place under the technical co-sponsorship of IEEE Region 8 and IEEE Croatia Section. As every year, ELMAR-2009 symposium was supported by its gold sponsor Tankerska plovidba Zadar.

The ELMAR-2009 symposium programme consists of three keynote talks, and 13 sessions, where 79 papers written by 182 authors were presented. The authors of the papers presented in ELMAR-2009 symposium are prominent researchers from 20 different countries.

The keynote talks were: Mr. *David Wood*, Deputy Director, EBU Technical Department, Switzerland—"What strategy and research agenda for Europe in 'new media'?;" Professor *Borivoj Modlic*, University of Zagreb, Faculty of Electrical Engineering and Computing, Croatia—"Digital Dividend—Opportunities for New Mobile Services," and Professor *Gregor Rozinaj*, Slovak University of Technology, Slovakia—"The Role of Multimedia in Intelligent Human Machine Interface."

As every year, social events were organized to offer a further opportunity to discuss both technical and non-technical subjects between attendees. First event was a guided Zadar city sightseeing. Second event was cocktail, small concert (singer was Professor *Viljem Jeric*, Secretary of the ELMAR Society, together with Dalmatian klapa "Galija"), and symposium dinner. Third event was our traditional excursion by ship. This year, participants visited small town of Sali on Dugi otok island (one of the many beautiful islands on the Adriatic coast).

Mislav Grgic
ELMAR-2009 Program Chair

Report on the Non-Linear Speech Processing Workshop (NOLISP 2009)

NOLISP (Non-Linear Speech Processing) 2009 Workshop was held in Vic (Catalonia, Spain) during 25–27th June, with the support of the University of Vic, Ministerio de Ciencia e Innovación of Spanish Government, ISCA and EURASIP. It is the sixth event in non-linear speech processing after NOLISP'03 (Le Croisic, France), NOLISP'04 Summer School (Vietri Sul Mare, Italy), NOLISP'05 (Barcelona, Spain), WNSP'05 (Heraklion, Greece) and NOLISP'07 (Paris, France). The first four previous events were organized jointly with the European action COST-277 "Non-Linear Speech Processing," and after the end of the COST action the NOLISP Workshop continues with the idea to keep researchers in contact and keep on opening the community to other countries (USA, China, Canada, Tunisia, . . .).

35 people from all around the world attended the workshop, where 3 days with oral presentations were made with no parallel sessions, in a classical ISCA tutorial workshop. Three Invited talks were scheduled, first one done by Prof. Jonathon Chambers (Loughborough University, UK), second one by Dr. Emmanuel Vincent (IRISA-INRIA, Université Rennes 1, France) and third one by Dr. Jesús Malo (Human Vision, Image Models and Image Processing, Universitat de València, Spain)

The goal of the workshop was to discuss about many specificities of the speech signal that are not well addressed by conventional models currently used in the field of speech processing. The purpose of the workshop was to present and discuss novel ideas, works and results, related to alternative techniques for speech processing, which depart from mainstream approaches. We had papers devoted to speech synthesis, speaker recognition, speech recognition, pattern recognition and feature extraction, speech enhancement, signal processing and speech analysis.

The social program consisted of:

- A guided visit to the historical down town of Vic and Welcome Reception by the City Council, on Thursday evening.
- A guided visit to the Sant Pere de Casserres Romanesc Monastery, on Friday afternoon, followed by a Gala Dinner in a Noble House of Vic.

Next workshop will be held in Tunisia in 2011. We are now soliciting journal papers not only from workshop participants but also other researchers for a special issue of Speech Communication on "Non-Linear and Non-Conventional Speech Processing."

Dr. Jordi Solé-Casals
Dr. Vladimir Zaiats
Co-Chairmen, NOLISP'09

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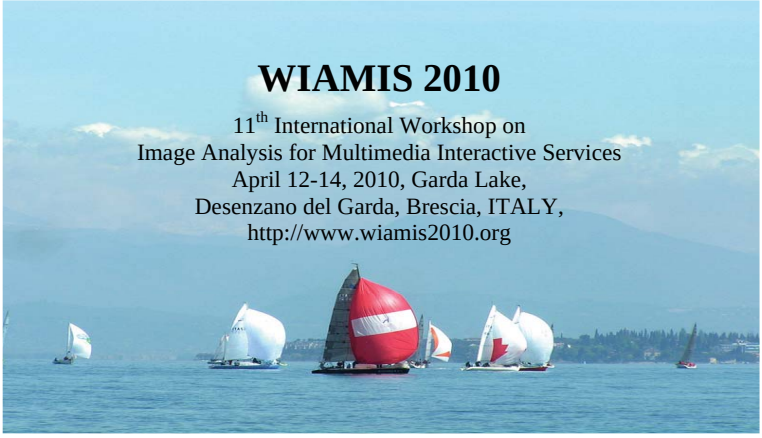

WIAMIS 2010 Call for Papers

The International Workshop on Image Analysis for Multimedia Interactive Services is one of the main international events for the presentation and discussion of the latest technological advances in interactive multimedia services. The objective of the workshop is to bring together researchers and developers from academia and industry working in the areas of image, video and audio applications, with a special focus on analysis. After a series of successful meetings starting in 1997 in Louvain, WIAMIS 2010 will be held in Desenzano del Garda, by the beautiful Garda Lake, Italy.

Topics of interest include, but are not limited to:

- Multimedia content analysis and understanding
- Content-based browsing, indexing and retrieval of images, video and audio
- Content-based copy detection
- Emotional based content classification and organization
- 2D/3D feature extraction
- Advanced descriptors and similarity metrics for audio and video
- Relevance feedback and learning systems
- Segmentation of objects in 2D/3D image sequences
- Motion analysis and tracking
- Video analysis and event recognition
- Analysis for coding efficiency and increased error resilience
- Analysis and tools for content adaptation
- Multimedia content adaptation tools, transcoding and transmoding
- Content summarization and personalization strategies
- End-to-end quality of service support for Universal Multimedia Access
- Semantic mapping and ontologies
- Multimedia analysis for new and emerging applications
- Multimedia analysis hardware and middleware
- Semantic web and social networks
- Advanced interfaces for content analysis and relevance feedback
- Applications

Paper Submission
All submissions will be handled electronically. Submission instructions are posted on the workshop website (http://www.wiamis2010.org). The authors are requested to send their original submissions, 4 pages, double column in English. All submissions will be peer reviewed by at least three members of the technical program committee.
The conference proceedings will be available in IEEExplore.
An extended version of selected papers will be published in the Springer's Lecture Notes in Computer Science Series.

WIAMIS 2010 schedule	
Proposal of Special Sessions:	October 30, 2009
Conditional Acceptance of Special Sessions:	November 10, 2009
Paper Submission:	November 20, 2009
Special Session Paper Submission:	November 30, 2009
Notification of Acceptance:	January 15, 2010
Camera–ready Papers:	February 15, 2010

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Final Call for Papers

ISSPA 2010 is the tenth event in the series of conferences, which since 1985 has brought together leading researchers and practitioners from academia and industry engaged in research and development related to signal processing theory and applications. In 2007, ISSPA extended its coverage to include the complementary field of Information Sciences.

ISSPA 2010 is co-organized by the Faculty of Biomedical & Health Science Engineering and Faculty of Electrical Engineering, Universiti Teknologi Malaysia(UTM) in cooperation with University Malaya (UM), Universiti Malaysia Perlis(UniMAP), MIMOS Berhad and with the support of several other bodies and international universities around the world including the University of Queensland, Australia, University Paris tech(ENST), University of Paris 12&13, Qatar university and KFUPM, KSA.

The regular technical program will run for three days along with an exhibition of signal processing products and research. In addition, a number of tutorial sessions will be scheduled one day before the conference starts.

Prospective authors are invited to submit full length (four pages) papers via the conference website for presentation in any of the areas listed below. We also encourage the submission of proposals for tutorial sessions on the related topics. All submitted papers will be subjected to a blind peer-review process.

1. Theory & Methods
2. Multirate Filtering & Wavelets
3. Adaptive Signal Processing
4. Time-Frequency/Time-Scale Analysis
5. Statistical Signal & Array Processing
6. Radar & Sonar Processing
7. Speech Processing & Recognition
8. Soft Computing & Pattern Recognition
9. Machine Learning
10. VLSI for Signal and Image Processing
11. Signal Processing for Bioinformatics
12. Biometrics Systems and Security
13. Fractals and Chaos Signal Processing
14. Image & Multidimensional Signal Processing
15. Signal Processing for Communications
16. Image and Video Processing
17. Visual Signal Processing
18. Biomedical Signal and Image Processing
19. Natural Language Processing
20. Nonlinear Signal Processing
21. Multimedia Signal Processing
22. Image Sequence Analysis & Processing
23. Photonic & Optical Signal Processing
24. Signal Processing in Networking
25. Signal Processing for Geo-informatics
26. Sensor Networks and Sensor Fusion
27. Data Mining
28. Special Sessions and Others (please specify area)

All accepted papers will be included in the ISSPA 2010 Conference Proceedings. All papers accepted will be included in IEEE Xplore. For more details, please visit our website:

www.isspa2010.com

Important Deadlines:

Full paper Submission: 20th November 2009
Tutorials & Special Sessions Submission: 25th November 2009
Notification of Acceptance: 15th February 2010
Camera Ready Paper: 1st March 2010

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Petroleum Institute, UAE

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Sup' Com, Tunisia

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CIP2010

The second IAPR international workshop on

Cognitive Information Processing

14-15-16 June 2010, Elba Island, Italy

In cooperation with EURASIP, IET, IEEE-AESS, and IEEE-SP

CALL FOR PAPERS

Following the success of the first edition of the workshop on *Cognitive Information Processing* (CIP), we are pleased to announce the second one in this series. This workshop aims at bringing together researchers from the machine learning, pattern recognition, statistical signal processing, communications and radar communities in an effort to promote and encourage cross-fertilization of ideas and tools.

CIP2010 will take place in Italy, in the beautiful Tuscan island of Elba, at the **Grand Hotel Elba International** (*www.elbainternational.it*), which dominates the Bay of Naregno.

The workshop will feature keynote addresses and technical presentations, oral and poster, all of which will be included in the workshop proceedings.

Papers are solicited for the following areas in theory and applications:

THEORY:

- Learning theory and modelling
- Bayesian learning and models
- Information theoretic learning
- Graphical and kernel methods
- Adaptive learning algorithms
- Ensembles: committees, mixtures, boosting, etc.
- Data representation and analysis
- Collaborative sensing techniques
- Other topics for cognitive information processing

APPLICATIONS:

- Cognitive radio networks
- Cognitive radio modulation techniques
- Dynamic spectrum management
- Opportunistic resource allocation
- Cognitive radar and sonar
- Knowledge based target detection, estimation, tracking and identification
- Waveform agility design
- Blind source separation
- Cognitive dynamic systems
- Distributed, cooperative and adaptive processing
- Remote sensing

KEYNOTE SPEAKERS

Christopher Bishop (Microsoft Research Cambridge, UK)
Nello Cristianini (University of Bristol, UK)
Alfonso Farina (SELEX-SI, Italy)
Georgios B. Giannakis (University of Minnesota, USA)
Marco Luise (University of Pisa, Italy)
Joseph Mitola (Stevens Institute of Technology, USA)

IMPORTANT DATES

Full four-page paper submission:
January 10, 2010

Notification of acceptance:
March 10, 2010

Final camera-ready papers and author registration:
April 10, 2010

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For more information visit the website at: *www.conference.iet.unipi.it/cip2010*

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Technical Program

SPAWC 2010, the eleventh IEEE International Workshop on Signal Processing Advances for Wireless Communications is devoted to recent advances in signal processing for wireless and mobile communications.

This workshop brings together members of the signal processing, communications, information and network theory communities, working in universities, government and industrial research centers. The meeting will feature keynote addresses by leading researchers, as well as invited and contributed papers. SPAWC 2010 will be held from June 20, 2010 to June 23, 2010 in Marrakech, Morocco.

Conference URL: http://www.spawc2010.org

Paper Submission

Prospective authors are invited to submit papers in the following areas:

- Smart antennas, MIMO systems, and space-time coding
- Single-carrier, multi-carrier, and multi-rate systems
- Multiple access and broadcast channels, multi-user receivers
- Fundamental limits on capacity and performance analysis
- Cross-layer issues: from physical to networking and application layers
- Signal processing tools for ad hoc, multi-hop, and sensor networks
- Cooperative transmission and reception schemes
- Cognitive networking
- Distributed resource allocation and scheduling
- Ultra-wideband radio and RFID
- Time, frequency, spatial, multi-user diversity in fading channels
- Modeling, estimation and equalization of time-varying channels
- Acquisition, synchronization, and tracking (data aided or blind)
- Signal separation, and interference rejection
- Spread-spectrum systems
- Source-channel coding
- Low-complexity implementations
- Novel communication modalities

Important Dates

Submission deadline: February 1, 2010

Notification of acceptance: March 30, 2010

Final paper due: April 10, 2010

IEEE

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Rong Yan, IBM TJ Watson Research Center, US

Call For Papers

Following the seven successful previous events of CBMI (Toulouse 1999, Brescia 2001, Rennes 2003, Riga 2005, Bordeaux 2007, London 2008 and Chania 2009), the Laboratoire d'Informatique de Grenoble will organize the next CBMI event. CBMI 2010 aims at bringing together the various communities involved in the different aspects of Content-Based Multimedia Indexing. The scientific program of CBMI 2010 will include the presentation of invited plenary talks, special sessions as well as regular sessions with contributed research papers.

Topics of interest include, but are not limited to:

- Multimedia indexing and retrieval (image, audio, video, text)
- Matching and similarity search
- Construction of high level indices
- Multimedia index extraction
- Identification and tracking of semantic regions in scenes
- Multi-modal and cross-modal indexing
- Content-based search
- Multimedia data mining
- Metadata generation, coding and transformation
- Large scale multimedia database management
- Summarization, browsing and organization of multimedia content
- Presentation and visualization tools
- User interaction and relevance feedback
- Personalization and content adaptation
- Evaluation and metrics

Paper submission

Authors are invited to submit full papers at the conference web site www.cbmi2010.org. Style files (Latex and MS Word) will be provided.

Important Dates

Submission of full papers	January 7, 2010
Notification of acceptance	February 26, 2010
Submission of camera-ready papers	March 12, 2010
Early registration until	June 1, 2010
Main workshop	June 23-25, 2010

Venue

CBMI 2010 will be hosted by the LIG, Grenoble, France.

www.cbmi2010.org

INTERNATIONAL CONFERENCE

IMAGE & SIGNAL PROCESSING

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Abderrahim Elmoataz (France)
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Fathallah Nouboud (Canada)
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Invited Speakers
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(University of Amsterdam - Netherlands)
Leo Grady
(Siemens, Princeton, NJ – United States)
Yan LeCun
(New York University – United States)

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A. Argyros, University of Crete and FORTH-ICS (Greece)
L. Badri, UQTR (Canada)
M. Badri, UQTR (Canada)
S. Battiato, University Of Catania (Italy)
A. Belaid, Univ. Vand.-Les-Nancy (France)
M. Bellafkih, INPT- Rabat (Morocco)
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C. Beumier, Royal Military Academy (Belgium)
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J. Darbon, UCLA (United States of America)
M. de Bruijne, University of Copenhagen (Denmark)
F. Deravi, University of Kent (United Kingdom)
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L. Duval, Ifp (France)
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Fourth International Conference on Image and Signal Processing

ICISP 2010

June 30 - July 2, Trois-Rivières, Québec, Canada

CALL FOR PAPERS

Following the two successful previous editions of ICISP (Agadir 2001, Agadir 2003, Cherbourg 2008), the *Université du Québec à Trois-Rivières* will organize the next ICISP event. ICISP aims to provide researchers and practitioners from academia and industry with a forum on the last developments in image and signal processing, multimedia and computer graphics. The conference will also provide a unique opportunity for sharing experiences from different backgrounds with the common interest in advanced methods in the above-mentioned fields. The scientific program of ICISP 2010 will include the presentation of invited plenary talks, poster and regular sessions with contributed research papers.

Best papers will be published in a special issue of the International Journal of Future Generation Communication and Networking IJFGCN
http://www.sersc.org/journals/IJFGCN

Topics of interest for submission include, but are not limited to:

- Image and video processing: image filtering, restoration and enhancement, image segmentation, video segmentation and tracking, morphological processing, feature extraction and analysis, interpolation and super-resolution, motion detection and estimation, computer vision, pattern recognition, content-based image retrieval.
- Signal Processing: spectral analysis, time-frequency and time-scale representation, statistical signal processing, filtering, detection and estimation, nonlinear signal processing, radar, antennas, telecommunications systems, acoustics.
- Computer graphics: algorithms, visualization, animation, virtual reality.
- Applications: biomedical sciences, biometry, document image processing and authentication, other applications.

PAPER SUBMISSION

Prospective authors are invited to submit full papers of not more than eight (8) pages including results, figures and references. All the papers will be handled and reviewed electronically through the conference web site.

Submission of full paper	**January 22, 2010**
Notification of acceptance	**March 12, 2010**
Submissions of camera-ready papers	**April 12, 2010**

CONFERENCE VENUE

ICISP'2010 will be held in Trois-Rivières, Québec, Canada from June 30 to July 2, 2010.

For further information: http://www.uqtr.ca/icisp

Université de Caen Basse-Normandie

Université du Québec à Trois-Rivières

2nd European Workshop on Visual Information Processing – EUVIP 2010

July 5th - 6th, 2010

Université Paris 13, Paris, France

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First Call For Papers

The extensive use of digital visual media in our everyday life and their inherent presence around us; urges for the development of smarter and more efficient approaches for modeling, analyzing, processing and communication of visual information. Machine vision techniques have gone so far and are able to perform tasks that one could only dream of a few years ago; thanks to smarter algorithms, large increase in processing power, storage capabilities and communication bandwidth available in today's computers and networks. Nevertheless, they fall short of our expecting when compared to the ease with which the human visual system (HVS) deals with complex scenes analysis, processing and abstraction. Therefore, we are witnessing a growing interest in approaches inspired from the HVS for digital visual information modeling, analysis, processing and communication.

To cover recent advances in these approaches EUVIP 2010, tries to bring together prominent experts to exchange ideas and explore the frontiers of this research field.

This is the second instance of the workshop which follows up on the success achieved by the first one (called VISPA 2008). The first workshop attracted prominent speakers from around the world and provided a platform for fruitful discussions on different applications of signal and image processing techniques to emerging and challenging problems. Carrying on this tradition EUVIP 2010, will offer a forum for researchers and industrialists to exchange ideas and discuss the recent advances in Human Visual System (HVS) inspired techniques for image and video processing with applications to multimedia, visual pattern recognition, surveillance, and visual information security. It will be organized as a series of invited pedagogical talks, and technical papers presentations dealing with state of the art visual information modeling, analysis, processing and communication methods. The workshop aims to promote exchanges between established researchers as well as to provide graduate students with an opportunity to have substantive interaction with experts in the field.

Topics of particular interest to EUVIP 2010 include, but are not limited to:

Computational Vision Models	Video Analysis
Image and Video Quality Assessment	Visual Tracking
Image and Video Enhancement	Visual Data Mining
Color Image Understanding	Biometrics
Color Image Processing	Perceptual Digital Watermarking
Perceptual Image & Video Retrieval	Perceptual coding
Multimedia Communication	Multiview Processing

Submission

Perspective authors are invited to submit full length (four pages) papers at www.euvip2010.org (*to be updated*). Formatted according to the guidelines in the author guide.

Important dates

Submission Deadline: 15 February 2010
Notification of acceptance: 15 March 2010
Camera Ready Deadline: 15 April 2010

Temporary website: http://www-l2ti.univ-paris13.fr/~euvip/index.htm

For additional information, send your request to: euvip@univ-paris13.fr

7th IEEE, IET International Symposium on
COMMUNICATION SYSTEMS, NETWORKS & DIGITAL SIGNAL PROCESSING (*CSNDSP'10*)

21-23 July 2010, Northumbria University at Newcastle, U.K

Hosted by: School of Computing, Engineering and Information Sciences

www.csndsp.com, First Call for Papers

IEEE UK-RI Computer Chapter

IEEE Communications Chapter - UKRI

IEEE Signal Processing Society - UKRI Chapter

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Dr T Kamalakis (*University of Athens, Greece*)
Prof. K Kawashima (*Tokyo Univ. TUAT, Japan*)

City of Newcastle upon Tyne



CSNDSP has now been recognised as a forum for the exchange of ideas among engineers, scientists and young researchers from all over the world on advances in communication systems, communications networks, digital signal processing and other related areas and to provide a focus for future research and developments. The organising committee invites you to submit original high quality papers addressing research topics of interest for presentation at the 7th symposium which be held in the beautiful city of Newcastle in U.K. For the second time we also have dedicated colloquiums and number of special sessions on selected topics.

- **Colloquiums on**
  - ***Photonic Communications Systems and Networks***
  - ***Optical Wireless Communications***
  - ***Satellite and Space Communications***
- ***Special Sessions on***
  - **Antenna Technology for Satellites and Terrestrial Wireless Systems**
  - **Channel Coding and Equalization for Wireless Broadband Communication Systems**
  - **Chaos in Communication Systems**
  - **Contactless Technologies;**
  - **Embedded Mixed-Signal Systems and Sensor Networks**
  - **Optimization Techniques for Signal Processing and Communication Systems**
  - **Signal and Image Processing for Medical Monitoring and Diagnosis: new Developments and Applications**
  - **Teletraffic Models and Traffic Engineering**
  - **Legal, Social and Technical Issues in Future Network Infrastructure**
  - QoS, Reliability and Performance Modelling
  - Entropy, Complexity, and their Applications
  - Measurement / Analysis of 3G Cellular Networks
  - IP Multimedia Subsystem and Next Generation Services

Papers are solicited from, but not limited to the following topics:

- Ad-Hoc networks
- Adaptive signal processing
- ATM systems and networks
- Chip design for Communications
- Communication theory
- Coding and error control
- Communication protocols
- Communications for disaster management
- Crosslayer design
- Digital and multirate signal processing
- DSP algorithms and applications
- E-commerce and e-learning applications
- Implementation of signal processing and communications systems
- Intelligent systems/networks
- Internet communications
- High performance networks
- MEMO and FORM based communications systems
- Microwave communications
- Mobile communications, networks, mobile computing for e-commerce
- Mobility management
- Modulation and synchronisation
- Modelling and simulation techniques
- Multidimensional signal processing
- Multimedia communications and broadband services
- Nano-technology in communications
- New techniques in RF-design and modelling
- Network management & operation
- Optical communications
- Optical MEMS for lightwave networks
- RF/optical wireless communications
- Photonic network
- Quality of service, reliability and performance modelling
- 3G/4G network evolution
- Radio, satellite and space communications
- RFID & near field communications
- Satellite & space communications
- Sensor networks
- Signal processing for communications and sensor networks
- Signal processing for storage
- Speech technology
- Teletraffic models and traffic engineering
- VLSI for communications and DSP
- Vehicular and mesh networks
- Wireless LANs and ad hoc networks
- Ultra-wide band mobile networks
- *Any other related topics*

Prof. C Knutson (*Brigham Young Univ., USA*)
Dr W Kogler (*Graz Univ. of Tech. Austria*)
Prof. G Kubin, (*Graz Univ. of Tech., Austria*)
Dr Erich Leitgeb (*Graz Univ. Austria*)
Dr Hoa Le Minh (*Univ. of Oxford, UK*)
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Dr S Shioda (*Chiba Univ. Japan*)
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Dr I Viniotis (*N. Caroline State Univ., USA*)
Dr V Vitsas (*TEI of Thessaloniki, Greece*)
Dr J Walewski (*Siemens AG, Germany*)
Dr P Xiao (*ECIT, Queen's Univ., Belfast, UK*)
Dr Yang Yang (*UCL, UK*)
Prof. M N Zervas (*Southampton Univ., UK*)

For further information visit: **http://www.csndsp.com**

- Papers may be presented in the form of **Oral presentation and/or Poster**
- Contributions by **MPhil/PhD** research **students** are particularly encouraged.

Submission Dates:

• **Full Paper due:**	3rd **Feb. 2010**
• Notification of acceptance by:	1st April 2010
• Camera ready paper due:	5th May 2010

- Submission is ONLY possible via the website http://www.csndsp.com. For more information please visit the website or contact the Local Committee via email csndsp10@norhumbria.ac.uk

All papers will be reviewed by at least three referees. Only papers presented at the conference will be available in the IEEE-Xplore, once it is confirmed by the IEEE. More information to follow on this.

Selected best papers presented will be published in the special issue of selected journals.

- **Once again CSNDSP will offer a number of travel grants and registration fee waivers**.

Fees:

£300.0/person (2 papers), £550.0 for two persons (4 papers), £750.0 for 3 persons (6 papers)
It includes: ***A copy of the Symposium Proceedings, Lunches, Lord Mayer's Reception on 21 July, Day trip to the Cragside on 23 July, Symposium Dinner at Hilton Hotel on 22 July 2010.***

CSNDSP'10 General Information:

Contact: Professor Z Ghassemlooy - *Local Organising Committee Chair:* School of CEIS, Northumbria University, Newcastle upon Tyne, NE1 8ST, U.K., Tel.: ++44 191 227 4902, Fax.: ++44 191 227 3684.
Email: fary@ieee.org,
Web-site: http://www.csndsp.com

EUSIPCO 2010



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CALL FOR PAPERS

2010 European Signal Processing Conference (EUSIPCO-2010), August 23-27 2010, Aalborg, Denmark

The 2010 European Signal Processing Conference (EUSIPCO-2010) is the 18th of its kind organized by the European Association for Signal, Speech, and Image Processing (EURASIP). The conference will be held at Aalborg Congress & Culture Centre in Aalborg, Denmark and is organized by Aalborg University. The focus will be on signal processing theory, algorithms, and applications. Papers will be accepted based on quality, relevance, and novelty and accepted papers will be published in the proceedings of EUSIPCO-2010 as well as presented at the conference.

Areas of Interest

Submissions are invited in, but not limited to, the following areas:

* Audio and electroacoustics
* Design and implementation of signal processing systems
* Multimedia signal processing
* Speech processing
* Image and video processing
* Signal estimation and detection
* Sensor array and multi-channel processing
* Signal processing for communications
* Nonlinear signal processing
* Signal processing applications

Submission

Procedures to submit a paper, proposal for special sessions and tutorials are detailed at www.eusipco2010.org. Submitted papers must be camera-ready, no more than five pages long, and conforming to the format specified on the EUSIPCO-2010 website.

Important Dates

* Proposals for special sessions December 4, 2009
* Proposals for tutorials February 5, 2010
* Electronic submission of papers February 5, 2010
* Notification of acceptance April 30, 2010
* Submissions of camera-ready papers May 28, 2010

www.eusipco2010.org

EURASIP

Preliminary call for papers

The 2011 European Signal Processing Conference (EUSIPCO-2011) is the nineteenth in a series of conferences promoted by the European Association for Signal Processing (EURASIP, www.eurasip.org). This year edition will take place in Barcelona, capital city of Catalonia (Spain), and will be jointly organized by the Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) and the Universitat Politècnica de Catalunya (UPC).

EUSIPCO-2011 will focus on key aspects of signal processing theory and applications as listed below. Acceptance of submissions will be based on quality, relevance and originality. Accepted papers will be published in the EUSIPCO proceedings and presented during the conference. Paper submissions, proposals for tutorials and proposals for special sessions are invited in, but not limited to, the following areas of interest.

Areas of Interest

- Audio and electro-acoustics.
- Design, implementation, and applications of signal processing systems.
- Multimedia signal processing and coding.
- Image and multidimensional signal processing.
- Signal detection and estimation.
- Sensor array and multi-channel signal processing.
- Sensor fusion in networked systems.
- Signal processing for communications.
- Medical imaging and image analysis.
- Non-stationary, non-linear and non-Gaussian signal processing.

Submissions

Procedures to submit a paper and proposals for special sessions and tutorials will be detailed at www.eusipco2011.org. Submitted papers must be camera-ready, no more than 5 pages long, and conforming to the standard specified on the EUSIPCO 2011 web site. First authors who are registered students can participate in the best student paper competition.

Important Deadlines:

Proposals for special sessions
Proposals for tutorials
Electronic submission of full papers
Notification of acceptance
Submission of camera-ready papers

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Yonina Eldar (Technion)

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- *Mickaël Duquenoy, Jean-Philippe Ovarlez, Laurent Ferro-Famil and Eric Pottier:* Supervised Classification of Scatterers on SAR Imaging based on Incoherent polarimetric time-frequency signatures.
- *Wallace Alves Martins, Paulo Diniz:* Minimum Redundancy Multicarrier and Single-Carrier systems based on Hartley Transforms.
- *Yifei Wang, Naim Dahnoun, Alin M Achim):* A Novel Lane Feature Extraction Algorithm Based on Digital Interpolation.

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SUPERVISED CLASSIFICATION OF SCATTERERS ON SAR IMAGING BASED ON INCOHERENT POLARIMETRIC TIME-FREQUENCY SIGNATURES

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ABSTRACT

This paper deals with the analysis of the non-stationary behavior of scatterers in polarimetric SAR imaging . A method based on continuous wavelet and incoherent polarimetric decompositions is proposed to extract the polarimetric time-frequency signatures of scatterers. These signatures characterize scatterers according to their polarimetric /or energetic behavior versus the emitted frequency and the observation angle. Then, signatures from reference targets are used to train a multi-layer perceptron (MLP). All in all, SAR imaging data are classified by the MLP. The efficiency of this method is demonstrated, for the deterministic targets (manmade targets). It can be explained by the fact that the manmade targets present a strong non-stationary behavior. But for the vegetation and canopy the results are not convincing. It can be interpreted by the fact that the behavior of vegetation is stationary.

1. INTRODUCTION

This paper suggests a classification based on polarimetric time-frequency signatures for wideband and strong angular excursion SAR imaging. Indeed, in this case the model of bright point is not valid. Time-frequency analysis allows to build HyperImages [1], [2], [3] to correct this main drawback. Polarimetry is another information source to characterize scatterers. The aim of this paper is to use jointly time-frequency analysis and polarimetry incoherent decomposition to extract polarimetric time-frequency signatures and use them in a neural network to classify scatterers.

2. CONSTRUCTION OF THE HYPER-SCATTERING MATRIX BASED ON THE CONTINUOUS WAVELET

2.1 Classical radar imaging

The model usually used in radar imaging is the model of bright points [4]. The object under analysis can be seen as a set of bright points, i.e. a set of independent sources that reflect in the same way for all frequencies (white points) and all directions of presentation (isotropic points). Let $S(\mathbf{r})$ be the complex amplitude of the bright point response located at $\mathbf{r} = (x,y)^T$ in a set of cartesian axes related to the object. Under far field conditions (decomposition into planes waves), the complex backscattering coefficient for the whole object is then given by the in-phase summation of each reflector contribution:

$$H(\mathbf{k}) = \int S(\mathbf{r})\, e^{-2i\pi \mathbf{k}.\mathbf{r}}\, d\mathbf{r}. \tag{1}$$

After a Fourier Transform of (1), one can obtain the spatial distribution $I(\mathbf{r})$ of the reflectors complex amplitude for a mean frequency (the center frequency) and for a mean angle of presentation:

$$S(\mathbf{r}) = \int H(\mathbf{k})\, e^{2i\pi \mathbf{k}.\mathbf{r}}\, d\mathbf{k}. \tag{2}$$

The spatial distribution of the scatterers energy will be denoted in the following by:

$$\tilde{I}(\mathbf{r}) = |S(\mathbf{r})|^2 \tag{3}$$

A full polarimetric radar is generally designed to transmit and receive microwave radiations horizontally (h) or vertically (v) polarized. The polarimetric generalization of the scattering coefficient is called the scattering matrix $[\mathbf{S}]$ or Sinclair matrix:

$$[\mathbf{S}(\mathbf{r})] = \begin{bmatrix} S_{hh}(\mathbf{r}) & S_{hv}(\mathbf{r}) \\ S_{vh}(\mathbf{r}) & S_{vv}(\mathbf{r}) \end{bmatrix}. \tag{4}$$

When a target is illuminated by a broad-band signal and/or for a large angular extent, it is realistic to consider that the spatial distribution $\tilde{I}(\mathbf{r})$ of the reflectors energy (or the Sinclair complex image $S(\mathbf{r})$) depends on frequency f and on illumination angle θ. These two amplitude and energy distributions depending on the vector $\mathbf{k}$, they will be denoted respectively by $S(\mathbf{r},\mathbf{k})$ and $\tilde{I}(\mathbf{r},\mathbf{k})$ in the sequel.

2.2 Extended radar imaging

Let $\phi(\mathbf{k})$ be a mother wavelet supposed to represent the signal reflected by a reference target. This target is supposed

located around $\mathbf{r} = \vec{0}$ and backscatters the energy in the direction $\theta = 0$ and at the frequency f given by $k = \frac{2f}{c} = 1$. A family of function is built $\Psi_{\mathbf{r}_0,\mathbf{k}_0}$ from $\phi(\mathbf{k})$ by the similarity group S [1], [2]:

$$\Psi_{\mathbf{r}_o,\mathbf{k}_o}(\mathbf{k}) = \frac{1}{k_o}\, e^{-j2\pi\mathbf{k}.\mathbf{r}_o} \phi\left(\frac{1}{k_o}\mathscr{R}_{\theta_o}^{-1}\mathbf{k}\right) \quad (5)$$

$$= \frac{1}{k_o}\, e^{-j2\pi\mathbf{k}.\mathbf{r}_o}\, \phi\left(\frac{k}{k_o}, \theta - \theta_o\right). \quad (6)$$

The wavelet coefficient $S_{xx}(\mathbf{r}_o, \mathbf{k}_o)$ is defined as the scalar product between the complex backscattering coefficient H_{xx} and the wavelet $\Psi_{\mathbf{r}_o,\mathbf{k}_o}$:

$$S_{xx}(\mathbf{r}_o, \mathbf{k}_o) = < H_{xx}, \Psi_{\mathbf{r}_o,\mathbf{k}_o} > \quad (7)$$

The scalar product is defined following [5]:

$$S_{xx}(\mathbf{r}_o, \mathbf{k}_o) = \int_0^{2\pi} d\theta \int_0^{+\infty} k\, H_{xx}(k,\theta)\, \frac{1}{k_o}\, e^{+j2\pi\mathbf{k}.\mathbf{r}_o} \phi^*\left(\frac{k}{k_o}, \theta - \theta_o\right) dk \quad (8)$$

The scalogram which is the square modulus of the wavelet coefficients defines the hyperImage $\tilde{I}(\mathbf{r}, \mathbf{k})$.

2.3 Properties

The continuous wavelet transform has two interesting properties. The first is the reconstruction: it is possible to rebuild the complex backscattering coefficient $H_{xx}(\mathbf{k})$ from the wavelet coefficient $S_{xx}(\mathbf{r}_o, \mathbf{k}_o)$:

$$H_{xx}(\mathbf{k}) = \frac{1}{K_\phi} \int_S d\mathbf{r}_o \int S_{xx}(\mathbf{r}_o, \mathbf{k}_o)\, \Psi_{\mathbf{r}_o,\mathbf{k}_o}(\mathbf{k})\, d\mathbf{k}_o \quad (9)$$

with K_ϕ defined as the *admissibility coefficient* of the mother wavelet which must, to build $H_{xx}(\mathbf{k})$ from the wavelet coefficients, check:

$$K_\phi = \int |\phi(\mathbf{k})|^2\, \frac{d\mathbf{k}}{k^2} < +\infty \quad (10)$$

The second property is the isometry:

$$\frac{1}{K_\phi} \int_S d\mathbf{r}_o \int |S_{xx}(\mathbf{r}_o, \mathbf{k}_o)|^2\, d\mathbf{k}_o = \|H_{xx}\|^2 \quad (11)$$

2.4 Limitations

The continuous wavelet is limited by the Heisenberg principle. Indeed, this concept tells that we cannot obtain a spatial good resolution with a good resolution in the frequency domain and reciprocally. However, the continuous wavelet offers a resolution which changes with the frequency and the spatial domain. It allows multiresolution analysis [6].

2.5 Hyper-Scattering matrix definition and extended Span

The wavelet transform is applied on each of the four polarimetric channels. The resulting Sinclair scattering matrix now depends on the frequency and on the illumination angle and is called hyper-scattering matrix:

$$[\mathbf{S}](\mathbf{r}, \mathbf{k}) = \begin{bmatrix} S_{hh}(\mathbf{r}, \mathbf{k}) & S_{hv}(\mathbf{r}, \mathbf{k}) \\ S_{vh}(\mathbf{r}, \mathbf{k}) & S_{vv}(\mathbf{r}, \mathbf{k}) \end{bmatrix}. \quad (12)$$

The span is generally defined as the sum of the squared modulus of each element of the matrix (4). The extended span is now defined as the sum of the squared modulus of each element of the hyper-scattering matrix (12).

$$P(\mathbf{r}, \mathbf{k}) = |S_{hh}(\mathbf{r}, \mathbf{k})|^2 + |S_{hv}(\mathbf{r}, \mathbf{k})|^2 + |S_{vh}(\mathbf{r}, \mathbf{k})|^2 + |S_{vv}(\mathbf{r}, \mathbf{k})|^2. \quad (13)$$

The extended span provides a first polarimetric time-frequency signatures. Indeed, if one scatterer is selected at the position $\mathbf{r}_0$, $P(\mathbf{r}_0, \mathbf{k})$ describes the polarimetric energetic behavior of this scatterer versus the emitted frequency and the observation angle.

3. CONSTRUCTION OF THE INCOHERENT POLARIMETRIC TIME-FREQUENCY SIGNATURES

3.1 Definition of the covariance and coherency matrix

A scattering vector can be obtained by the projection of the Sinclair matrix on an orthogonal basis of special unitary group [7]. The two bases which are the most used, are the the lexicographic basis and the Pauli basis. In monostatic scenario, the reciprocity theorem holds and hence: $S_{hv} = S_{vh}$. So, by projecting the hyper-scattering matrix on the two bases, two hyper-scattering vectors which contain all polarimetric information can be obtained:

$$k_L(\mathbf{r}, \mathbf{k}) = [S_{hh}(\mathbf{r}, \mathbf{k}), \sqrt{2}S_{hv}(\mathbf{r}, \mathbf{k}), S_{vv}(\mathbf{r}, \mathbf{k})]^T \quad (14)$$

$$k_P(\mathbf{r}, \mathbf{k}) = \frac{1}{\sqrt{2}}[S_{hh}(\mathbf{r}, \mathbf{k}) + S_{vv}(\mathbf{r}, \mathbf{k}), S_{hh}(\mathbf{r}, \mathbf{k}) - S_{vv}(\mathbf{r}, \mathbf{k}), 2S_{hv}(\mathbf{r}, \mathbf{k})]^T \quad (15)$$

where ^{T} is the transpose operator.

From these targets vectors, the covariance hyper-matrix $[C(\mathbf{r}, \mathbf{k})]$ and the coherency hyper-matrix $[T(\mathbf{r}, \mathbf{k})]$ can be defined:

$$[C(\mathbf{r}, \mathbf{k})] = \langle k_L(\mathbf{r}, \mathbf{k}) k_L^{*T}(\mathbf{r}, \mathbf{k}) \rangle \quad (16)$$

$$[T(\mathbf{r}, \mathbf{k})] = \langle k_P(\mathbf{r}, \mathbf{k}) k_P^{*T}(\mathbf{r}, \mathbf{k}) \rangle \quad (17)$$

where * and $\langle\rangle$ are respectively the conjugate and the statistical mean operators.

The aim of this part is to use incoherent decompositions to obtain polarimetric time-frequency signatures. Hence, The objective of the incoherent decompositions is to separate the covariance or coherency matrices as the combination of second order descriptors corresponding to simpler or canonical objects, presenting an easier physical interpretation [8].

$$[C(\mathbf{r}, \mathbf{k})] = \sum_{i=1}^{k} p_i(\mathbf{r}, \mathbf{k})[C(\mathbf{r}, \mathbf{k})]_i \quad (18)$$

$$[T(\mathbf{r}, \mathbf{k})] = \sum_{i=1}^{k} q_i(\mathbf{r}, \mathbf{k})[T(\mathbf{r}, \mathbf{k})]_i \quad (19)$$

where the canonical responses are represented by $C[(\mathbf{r},\mathbf{k})]_i$ and $T[(\mathbf{r},\mathbf{k})]_i$, and $p_i(\mathbf{r},\mathbf{k})$ and $q_i(\mathbf{r},\mathbf{k})$ denote the coefficients of these components.

3.2 The Freeman-Durden Decomposition

3.2.1 Construction of the polarimetric time-frequency signatures

By applying the Freeman-Durden decomposition [9] on the covariance hyper-matrix, we obtain the three components scattering mechanism model:

$$\begin{aligned}[C(\mathbf{r},\mathbf{k})] &= f_s(\mathbf{r},\mathbf{k})[C(\mathbf{r},\mathbf{k})]_s + f_d(\mathbf{r},\mathbf{k})[C(\mathbf{r},\mathbf{k})]_d \\ &\quad + f_v(\mathbf{r},\mathbf{k})[C(\mathbf{r},\mathbf{k})]_v \end{aligned} \tag{20}$$

where $f_s(\mathbf{r},\mathbf{k})[C(\mathbf{r},\mathbf{k})]_s$ represents the single scattering, $f_d(\mathbf{r},\mathbf{k})[C(\mathbf{r},\mathbf{k})]_d$ is the double scattering and $f_v(\mathbf{r},\mathbf{k})[C(\mathbf{r},\mathbf{k})]_v$ the volume scattering. To calculate the different parameters, there are four observed equations for five unknown real coefficients:

$$\begin{aligned}
[C(\mathbf{r},\mathbf{k})]_{1,1} &= f_s(\mathbf{r},\mathbf{k})\beta(\mathbf{r},\mathbf{k})^2 + f_d(\mathbf{r},\mathbf{k})\alpha(\mathbf{r},\mathbf{k})^2 \\ &\quad + f_v(\mathbf{r},\mathbf{k}) \\
[C(\mathbf{r},\mathbf{k})]_{1,3} &= f_s(\mathbf{r},\mathbf{k})\beta(\mathbf{r},\mathbf{k}) - f_d(\mathbf{r},\mathbf{k})\alpha(\mathbf{r},\mathbf{k}) \\ &\quad + \frac{f_v(\mathbf{r},\mathbf{k})}{3} \\
[C(\mathbf{r},\mathbf{k})]_{2,2} &= \frac{2f_v(\mathbf{r},\mathbf{k})}{3} \\
[[C(\mathbf{r},\mathbf{k})]_{3,1} &= f_s(\mathbf{r},\mathbf{k})\beta(\mathbf{r},\mathbf{k}) - f_d(\mathbf{r},\mathbf{k})\alpha(\mathbf{r},\mathbf{k}) \\ &\quad + \frac{f_v(\mathbf{r},\mathbf{k})}{3} \\
[[C(\mathbf{r},\mathbf{k})]_{3,3} &= f_s(\mathbf{r},\mathbf{k}) + f_d(\mathbf{r},\mathbf{k}) + f_v(\mathbf{r},\mathbf{k})
\end{aligned} \tag{21}$$

So, an assumption is made [9]:

- if $\mathscr{R}e\{\langle S_{hh}(\mathbf{r},\mathbf{k})S(\mathbf{r},\mathbf{k})^*_{vv}\rangle - \frac{f_v(\mathbf{r},\mathbf{k})}{3}\} > 0 \rightarrow \alpha(\mathbf{r},\mathbf{k}) = 1$
- if $\mathscr{R}e\{\langle S_{hh}(\mathbf{r},\mathbf{k})S(\mathbf{r},\mathbf{k})^*_{vv}\rangle - \frac{f_v(\mathbf{r},\mathbf{k})}{3}\} < 0 \rightarrow \beta(\mathbf{r},\mathbf{k}) = 1$

Consequently the different parameters can be processed.

3.2.2 Interpretation of the polarimetric time-frequency signatures

The term $f_v(\mathbf{r},\mathbf{k})$ corresponds to the contribution of the volume scattering of the final hyper-covariance matrix. Hence, the scattered power by this component can be written as follows:

$$P_v(\mathbf{r},\mathbf{k}) = \frac{8f_v(\mathbf{r},\mathbf{k})}{3} \tag{22}$$

The power scattered by the double-bounce component of the hyper-covariance matrix has the expression:

$$P_d(\mathbf{r},\mathbf{k}) = f_d(\mathbf{r},\mathbf{k})(1+|\alpha(\mathbf{r},\mathbf{k})|^2) \tag{23}$$

Finally, the power scattered by the surface-like component is:

$$P_s(\mathbf{r},\mathbf{k}) = f_s(\mathbf{r},\mathbf{k})(1+|\beta(\mathbf{r},\mathbf{k})|^2) \tag{24}$$

For a scatterer located at $\mathbf{r_0}$, $P_v(\mathbf{r_0},\mathbf{k})$ (respectively, $P_d(\mathbf{r_0},\mathbf{k})$, and $P_s(\mathbf{r_0},\mathbf{k})$) represents the polarimetric behavior of volume scattering (respectively double scattering and simple scattering) versus the emitted frequency and the observation angle. These representations are called polarimetric time-frequency signatures.

3.3 The H/A/Alpha decomposition

3.3.1 Construction of the polarimetric time-frequency signatures

An Hermitian matrix 3×3 can be factorized according to [7], [10]:

$$T(\mathbf{r},\mathbf{k}) = P(\mathbf{r},\mathbf{k})D(\mathbf{r},\mathbf{k})P(\mathbf{r},\mathbf{k})^{-1} \tag{25}$$

The matrix $D(\mathbf{r},\mathbf{k})$ is diagonal with three real eigenvalues $\lambda_1(\mathbf{r},\mathbf{k}) > \lambda_2(\mathbf{r},\mathbf{k}) > \lambda_3(\mathbf{r},\mathbf{k})$ The unitary matrix is composed with eigenvectors whose the form is:

$$\begin{aligned}P_k(\mathbf{r},\mathbf{k}) = [&\cos(\alpha_k(\mathbf{r},\mathbf{k})), \sin(\alpha_k(\mathbf{r},\mathbf{k}))\cos(\beta_k(\mathbf{r},\mathbf{k})) \\ &\exp(j\delta_k(\mathbf{r},\mathbf{k})), \sin(\alpha_k(\mathbf{r},\mathbf{k}))\cos(\beta_k(\mathbf{r},\mathbf{k}))\exp(j\gamma_k(\mathbf{r},\mathbf{k}))]^T\end{aligned}$$

So, the decomposition can be written according to:

$$[T(\mathbf{r},\mathbf{k})] = \sum_{k=1}^{3} \lambda_k(\mathbf{r},\mathbf{k})P_k(\mathbf{r},\mathbf{k})P_k(\mathbf{r},\mathbf{k})^{*T} \tag{26}$$

From these eigenvectors and eigenvalues, secondary characteristics parameters can be extracted. Indeed, the eigenvalues show the power of each mechanism of the decomposition. The eigenvalues can be normalized following [8]:

$$p_k(\mathbf{r},\mathbf{k}) = \frac{\lambda_k(\mathbf{r},\mathbf{k})}{\sum_{k=1}^{3}\lambda_k(\mathbf{r},\mathbf{k})} \tag{27}$$

So, the entropy can be processed to determine the degree of randomness of the scattering process, which can be also interpreted as the degree of statistical disorder:

$$H(\mathbf{r},\mathbf{k}) = -\sum_{k=1}^{3} p_k(\mathbf{r},\mathbf{k})\log_3(p_k(\mathbf{r},\mathbf{k})) \tag{28}$$

The anisotropy can be defined to describe the secondary mechanisms:

$$A(\mathbf{r},\mathbf{k}) = \frac{p_2(\mathbf{r},\mathbf{k}) - p_3(\mathbf{r},\mathbf{k})}{p_2(\mathbf{r},\mathbf{k}) + p_3(\mathbf{r},\mathbf{k})} \tag{29}$$

The last parameter of the decomposition indicates the nature of the mechanism:

$$\alpha(\mathbf{r},\mathbf{k}) = \sum_{k=1}^{3} p_k(\mathbf{r},\mathbf{k})\alpha_k(\mathbf{r},\mathbf{k}) \tag{30}$$

3.3.2 Interpretation of the polarimetric time-frequency signatures

For a scatterer located at $\mathbf{r_0}$, $H(\mathbf{r_0},\mathbf{k})$ (respectively, $A(\mathbf{r_0},\mathbf{k})$, and $\alpha(\mathbf{r_0},\mathbf{k})$) represents the entropy (anisotropy and the α parameter) versus the emitted frequency and the observation angle. These representations are called polarimetric time-frequency signatures.

4. SUPERVISED CLASSIFICATION USING NEURAL NETWORKS

Neural networks are non-linear statistical data modeling tools. They can be used to find pattern data [11].

4.1 Architecture of the multi-layer perceptron (MLP)

A multi-layer perceptron is a feedforward artificial neural network model that maps sets of input data onto a set of appropriate output. The structure of our multi-layer perceptron is described figure (1). It is composed of nodes whose the processing is [12]:

$$a_j^{(1)} = \sum_{i=1}^{d} w_{ij}^{(1)} x_i + b_j^{(1)}, \tag{31}$$

where $a_j^{(1)}$ associated input with each hidden unit. Here $w_{ij}^{(1)}$ represents the elements of the first-layer weight matrix and b_j are the bias parameters associated with the hidden unit.

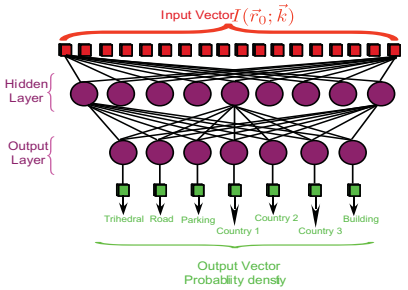

Figure 1: Architecture of the multi-layer perceptron

The variables $a_j^{(1)}$ are then transformed by the non-linear activation function of the hidden layer. The activation function is tanh(.). The outputs of the hidden units are given by:

$$z_j = \tanh(a_j^{(1)}) \tag{32}$$

which has the property that:

$$\frac{dz_j}{da_j^{(1)}} = 1 - z_j^2 \tag{33}$$

The z_j are then transformed by the second layer of weights and biases to give second-layer activation values $a_k^{(2)}$:

$$a_k^{(2)} = \sum_{j=1}^{M} w_{ij}^{(2)} z_j + b_k^{(2)} \tag{34}$$

Finally, these values are passed through the output-unit activation function to give output values y_k. For the more usual kind of classification problem in which we have of c mutually exclusive classes, we use the softmax activation function of the form [12]:

$$y_k = \frac{\exp(a_k^{(2)})}{\sum_{k'} a_{k'}^{(2)}} \tag{35}$$

Our multi-layer perceptron is a three layers whose the number of nodes of the input layer is equal to the number of input, the output layer is equal to the number of class to obtain a probability density whose the maximum defines the class which the scatterer is and the number of nodes of the hidden-layer is calculated following:

$$N_{Hidden-Layer} = \sqrt{N_{input} N_{output}} \tag{36}$$

4.2 Learning Basis

In supervised learning, a set of known signatures is given and the aim is to find a function in the allowed class of functions that matches the examples. The cost function is related to the mismatch between the mapping and the data and it implicitly contains prior knowledge about the pattern recognition problem.

The choice of the mother wavelet is moving toward a Gaussian shape. Indeed, a Gaussian have good properties and it has proved itself [13]. The spreading band of the Gaussian is chosen to $\frac{1}{6}$ band because it represents the best compromise of resolution between spatial and frequency domains. Indeed, we want a good resolution on frequency domain.

The polarimetric time-frequency signatures of manually selected scatterers are extracted as explained in the former part. On the image, the scatterers selected are the trihedral, the parking, the building, the road and three countries.

An example of Freeman-Durden learning basis is presented on the figure 2. The three contributions are coded respectively: P_d in red, P_v in green and P_s in blue. The image in the center is the image full resolution of the Freeman-Durden decomposition.

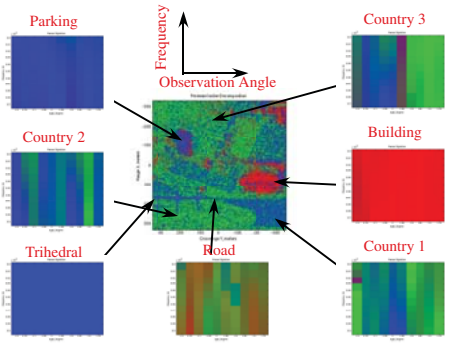

Figure 2: Learning basis obtained by the Freeman Durden polarimetric time-frequency signatures

5. RESULTS

The data under study is the full resolution image, (see Fig. 2). It is a X band image with an angular excursion of two degrees. The polarimetric time-frequency signatures are processed as explained in the former part. Then, these signatures are sent to the neural networks.

5.1 Freeman-Durden polarimetric time-frequency signatures

The results of the Freeman-Durden time-frequency signatures are represented on the figure 3. The trihedrals are classified as trihedral. The parking is identified by a melting pot of parking and trihedral contributions. It can be explained by their signatures. The three buildings are identified as a building. For the vegetation the results show that time-frequency analysis is not sufficient for these behaviors.

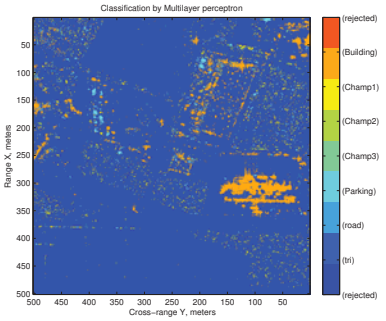

Figure 3: Classification results obtained by the Freeman Durden polarimetric time-frequency signatures

5.2 H/alpha polarimetric time-frequency signatures

The results of the H/Alpha time-frequency signatures are described on the figure 4. The trihedrals are classified as trihedral. The parking is identified by a melting pot of parking and trihedral contributions. It can be explained by their signatures. The three buildings are identified as a building. For the vegetation the results show that time-frequency analysis is not sufficient for these behaviors.

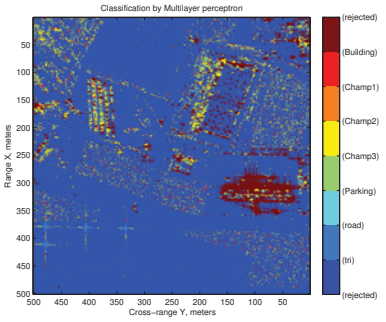

Figure 4: Classification results obtained by the H/A/Alpha polarimetric time-frequency signatures

6. CONCLUSION

A new method to classify scatterers on SAR imaging is proposed. This method is designed to work in wideband and strong angular excursion: Very High Resolution image (VHR). Indeed, it is based on stationary or non-stationary behavior of scatterers during the SAR integration. So, time-frequency analysis and polarimetric incoherent decompositions highlight this point of view. The results show that the information from polarimetric time-frequency signatures is valuable for deterministic targets (man-made targets) like trihedral, building and parking. However, this information does not allow to characterize the vegetation or the canopy.

REFERENCES

[1] J. Bertrand and P. Bertrand, "The concept of hyperimage in wide-band radar imaging," *IEEE Trans. Geosci. Remote Sensing*, vol. 34, no. 5, pp. 1144–1150, Sep. 1996.

[2] J. P. Ovarlez, L. Vignaud, J. C. Castelli, M. Tria, and M. Benidir, "Analysis of sar images by multidimensional wavelet transform," *IEE Proc. Radar. Sonar. Navig.*, vol. 150, no. 4, pp. 234–241, Aug. 2003.

[3] M. Tria, J. P. Ovarlez, L. Vignaud, J. Castelli, and M. Benidir, "Sar imaging using multidimensional continuous wavelet transform," in *Proc. EURASIP XII European Signal Processing Conference (EUSIPCO'04)*, Wien, Austria, Sep. 6–10, 2004, pp. 1179–1182.

[4] D. Mensa, *High Resolution Radar Imaging*. USA: Artech House, 1981.

[5] M. Tria, "Imagerie radar synthése d'ouverture par analyse en ondelettes continues multidimensionnelles," Ph.D. dissertation, Univ. of Paris-Sud, Paris, France, Nov. 2005.

[6] V. C. Chen and H. Ling, *Time-Frequency Transforms for Radar Imaging and Signal Analysis*. Boston: Artech House, 2002.

[7] S. R. Cloude and E. Pottier, "A review of target decomposition theorems in radar polarimetry," *IEEE Trans. Geosci. Remote Sensing*, vol. 34, no. 2, pp. 498–518, Mar. 1996.

[8] C. Lopez-Martinez, L. Ferro-Famil, and E. Pottier, "Polarimetric decompositions," Institut d'Electronique et de Télécommunication de RENNES (IETR), Tutorial, Jan. 2005.

[9] A. Freeman and S. Durden, "A three component scattering model for polarimetric sar data," *IEEE Trans. Geosci. Remote Sensing*, vol. 36, no. 3, May 1998.

[10] S. R. Cloude and E. Pottier, "An entropy based classification scheme for land applications of polarimetric sar," *IEEE Trans. Geosci. Remote Sensing*, vol. 35, no. 1, pp. 68–78, Jan. 1997.

[11] B. Ripley, *Pattern Recognition and neural networks*. Oxford, 1995.

[12] I. Nabney, *Netlab : Algorithms for pattern recognition*. Springer, 2002.

[13] L. Vignaud, "Wavelet-relax feature extraction in radar images," *IEE Proc. Radar. Sonar. Navig.*, vol. 150, no. 4, pp. 242–246, Aug. 2003.

MINIMUM REDUNDANCY MULTICARRIER AND SINGLE-CARRIER SYSTEMS BASED ON HARTLEY TRANSFORMS

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ABSTRACT

Four efficient block-based transceivers exploiting the displacement structure approach are proposed. In terms of computational burden, the resulting systems are asymptotically as simple as orthogonal frequency-division multiplex (OFDM) and single-carrier with frequency-domain (SC-FD) equalization transceivers. Even though the effective channel impulse response must be symmetric, the novel schemes are appealing since they only use discrete Hartley transforms (DHTs) and diagonal matrices in their structures, which results in numerically efficient algorithms for the equalization process. The key feature of the proposed transceivers is their higher throughput, since they require only half the number of symbols of redundancy in comparison to the standard OFDM and SC-FD systems.

1. INTRODUCTION

OFDM and SC-FD are the simplest and most widely used implementations of fixed and memoryless multicarrier and single-carrier transceivers. The standard design of these systems requires, at least, L elements for redundancy, where L stands for the channel order. The redundancy eliminates the inherent interblock interference (IBI), which is part of all block-based transceivers, and turns the channel matrix circulant. This property allows the use of *superfast*[1] algorithms for designing intersymbol-interference-free (ISI-free) or zero-forcing (ZF), and minimum mean squared error (MMSE) equalizers, by means of the spectral decomposition of the circulant channel matrix using the discrete Fourier transform (DFT) [1]. Other alternative real-valued transforms may also be successfully employed by inducing a Toeplitz–plus–Hankel structure in the effective channel matrix [2].

The role of redundancy in quite general transceivers was extensively studied in [1], [3], [4], and [5]. When dealing with block-based or memoryless[2] systems it was shown in [4] that the minimum required redundancy for IBI-free designs is $\lceil L/2 \rceil$. However, the solution relies on inversion of matrices, which in general requires $\mathcal{O}(n^3)$ operations.

So far, the only effective and practical solutions employing minimum redundancy were proposed in [6]. The referred solutions require $\mathcal{O}(n \log n)$ computations for equalization since they are based on standard DFT and diagonal matrices. This paper complements those recent results by solving the problem of designing fixed and memoryless transceivers with minimum redundancy for frequency-selective channels, utilizing DHTs and diagonal matrices.

When compared to OFDM and SC-FD, the proposed multicarrier and single-carrier transceivers have comparable computational complexity for the equalization process, i.e., $\mathcal{O}(n \log n)$, and substantially higher throughput for channels with long impulse responses due to their minimum required redundancy. *However, as a drawback of the proposed transceivers, the finite impulse response (FIR) filter that models the effective channel is constrained to be symmetric.*

In order to achieve our goals, this paper discusses the properties of structured matrices [7], [8] required to derive superfast transceivers with minimum redundancy. The Sylvester and Stein displacements [7] are utilized to exploit the structural properties of channel matrix representations. By using adequate displacement properties it is possible to conceive DHT-based representations of Bezoutians [8], which are the key to reach solutions for block-based transceivers requiring minimum redundancy. Some structured matrix properties are presented in the paper, where those directly available from the literature include no proof, whereas those adapted or modified are presented along with their proofs.

2. SYSTEM MODEL

Assume that we transmit a vector $\mathbf{s} \in \mathbb{C}^{M\times 1}$, with $M \in \mathbb{N}$, through an $(L+1)$-tap channel whose discrete-time block model is given by the pseudo-circulant matrix $\mathbf{H}(z) = \mathbf{H}_{\text{ISI}}(z) + z^{-1}\mathbf{H}_{\text{IBI}}(z)$ [4]. It is possible to eliminate the IBI caused by the matrix $\mathbf{H}_{\text{IBI}}(z) \in \mathbb{C}^{N\times N}$, where $N = M + K \in \mathbb{N}$, by using at least $K \geq L/2$ elements for redundancy [4]. This can be achieved by the following transmitter and receiver matrices, respectively [4]: $\mathbf{F} = [\,\mathbf{F}_0^T \quad \mathbf{0}_{M\times K}]^T$, with $\mathbf{F}_0 \in \mathbb{C}^{M\times M}$, and $\mathbf{G} = [\,\mathbf{0}_{M\times(L-K)} \quad \mathbf{G}_0\,]$, with $\mathbf{G}_0 \in \mathbb{C}^{M\times(M+2K-L)}$. Thus, the transfer matrix of this transceiver model is given by $\mathbf{T}(z) = \mathbf{G}\mathbf{H}(z)\mathbf{F} = \mathbf{G}_0\mathbf{H}_0\mathbf{F}_0 = \mathbf{T}$, in which $\mathbf{H}_0$ is a Toeplitz matrix, whose ijth coefficient is given by $h(K+i-j), \forall i,j \in \mathcal{M} = \{0, 1, \cdots, M-1\}$ such that $0 \leq K+i-j \leq L$, and otherwise $h(K+i-j) = 0$. We will assume that $\mathbf{H}_0$ is already symmetric, that is $K = L/2$ (even order) and $h(K+i-j) = h(K+j-i)$.[3] Notice that we considered the special case where the noise $\mathbf{v}$ is null, motivated by the design of ZF systems [4].

The aim of this work is to design the matrices $\mathbf{F}_0$ and $\mathbf{G}_0$ by using only DHTs and diagonal matrices. The following definitions for the orthogonal DHTs and the unitary DFTs [8] are employed in this work.

Definition 1. Given $\theta_{\text{I}}(i,j) = 2ij\pi/M$, $\theta_{\text{II}}(i,j) = i(2j+1)\pi/M$, $\theta_{\text{III}}(i,j) = (2i+1)j\pi/M$, and $\theta_{\text{IV}}(i,j) = (2i+1)(2j+1)\pi/2M$, for $(i,j) \in \mathcal{M}^2$, we define the orthogonal DHT-X matrix as $[\boldsymbol{\mathcal{H}}_X]_{ij} = (\sin[\theta_X(i,j)] + \cos[\theta_X(i,j)])/\sqrt{M}$, and the unitary DFT-$X$ matrix as $[\mathbf{W}_X]_{ij} = (\sin[\theta_X(i,j)] - \jmath\cos[\theta_X(i,j)])/\sqrt{M}$, where $X \in \{\text{I}, \text{II}, \text{III}, \text{IV}\}$ and $\jmath^2 = -1$.

3. DISPLACEMENT STRUCTURE

There are ways to measure the degree of structure of a matrix, such as through the *displacement operator*. Defi-

[1] That is, it requires $\mathcal{O}(n \log^d n)$ operations, for $d \leq 3$ [7].

[2] We do not distinguish between these terms as done in [4].

[3] When L is not even, we can consider the channel model zero padded with one zero in order to achieve an even order. Besides, the symmetric channel can be approximated by using a front-end prefilter [9], [2].

nition 2 contains a formal statement about displacement operators [7].

Definition 2. For $\mathbf{A}, \mathbf{B}, \mathbf{C} \in \mathbb{C}^{M\times M}$, the operators $\nabla_{\mathbf{A},\mathbf{B}}, \Delta_{\mathbf{A},\mathbf{B}} : \mathbb{C}^{M\times M} \to \mathbb{C}^{M\times M}$, defined by $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C}) = \mathbf{AC} - \mathbf{CB}$ and $\Delta_{\mathbf{A},\mathbf{B}}(\mathbf{C}) = \mathbf{C} - \mathbf{ACB}$, are the *displacement linear operator of Sylvester and Stein types*, respectively.

The rank of the resulting matrices $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C})$ and $\Delta_{\mathbf{A},\mathbf{B}}(\mathbf{C})$ are the so-called *displacement ranks*. It is very important to choose correctly the *operator matrices* $\mathbf{A}$ and $\mathbf{B}$ in order to obtain a relatively small displacement rank. The most common operator matrices are the λ-circulant matrix $\mathbf{Z}_\lambda = [\,\mathbf{e}_2 \cdots \mathbf{e}_M \ \lambda\mathbf{e}_1\,]$ and the diagonal matrix $\mathbf{D}_{\boldsymbol{\nu}} = \mathrm{diag}\{\boldsymbol{\nu}\}$, where $\lambda \in \mathbb{C}$, $\mathbf{e}_m$ is a vector having its mth element equal to 1 and all others equal to 0, and $\boldsymbol{\nu} = [\,\nu_0 \ \nu_1 \cdots \nu_{M-1}\,]^T$, with $\nu_m^M = \nu \in \mathbb{C}, \forall m \in \mathcal{M}$. Note that $\mathbf{Z}_\lambda^{-1} = \mathbf{Z}_{1/\lambda}^T, \forall \lambda \in \mathbb{C} \setminus \{0\}$ [7].

The proposed design for block-based transceivers relies on the displacement rank approach, which is characterized by the following key features [7]: (*i*) *Compression*: the displacement rank of a structured matrix $\mathbf{C}$ must be small compared to the dimension of $\mathbf{C}$. In this case, the displacement can be *compressed* by using the so-called *displacement generator* for the matrix $\mathbf{C}$. The displacement generator, given by the pair $(\mathbf{P}, \mathbf{Q})$, has the following characteristic: by considering that we are dealing with a Sylvester operator, being R its rank, we have that $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C}) = \sum_{r=1}^{R} \mathbf{p}_r\mathbf{q}_r^T = \mathbf{PQ}^T$, where $\mathbf{P} = [\,\mathbf{p}_1 \cdots \mathbf{p}_R\,] \in \mathbb{C}^{M\times R}$ and $\mathbf{Q} = [\,\mathbf{q}_1 \cdots \mathbf{q}_R\,] \in \mathbb{C}^{M\times R}$, with $\mathbf{p}_r = [\,p_{0r} \ p_{1r} \cdots p_{(M-1)r}\,]^T$ and $\mathbf{q}_r = [\,q_{0r} \ q_{1r} \cdots q_{(M-1)r}\,]^T$, $\forall r \in \{1, \cdots, R\}$; (*ii*) *Operation*: once compressed, operations with structured matrices can be performed much faster by using their displacements; and (*iii*) *Decompression*: after the operation stage, the original matrices can be recovered through *decompression* from their displacement.

The first important result employing displacement operators is the equivalence of the Sylvester and Stein displacements when at least one of the two operator matrices, $\mathbf{A}$ or $\mathbf{B}$, is non-singular [7].

Proposition 1. *If the operator matrix* $\mathbf{B}$ *is invertible, then* $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C}) = -\Delta_{\mathbf{A},\mathbf{B}^{-1}}(\mathbf{C})\mathbf{B}$.

The second result relates a Sylvester displacement of a matrix with a Sylvester displacement of its inverse [7]. This result shows that the compression of the inverse of a matrix can be achieved through operation on the compressed representation of the original matrix.

Proposition 2. *For an invertible matrix* $\mathbf{C} \in \mathbb{C}^{M\times M}$*, we have that* $\nabla_{\mathbf{B},\mathbf{A}}(\mathbf{C}^{-1}) = -\mathbf{C}^{-1}\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C})\mathbf{C}^{-1}$*, where* $\mathbf{A}, \mathbf{B} \in \mathbb{C}^{M\times M}$.

Propositions 3 and 4 describe how traditional operations, such as linear combinations and products of matrices, transform the displacement generators of the original matrices [7].

Proposition 3. *For* $\alpha \in \mathbb{C}$, $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C}) = \mathbf{PQ}^T$*, and* $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{D}) = \mathbf{P}'\mathbf{Q}'^T$*, we have that* $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C} + \alpha\mathbf{D}) = \bar{\mathbf{P}}\bar{\mathbf{Q}}^T$*, where* $\bar{\mathbf{P}} = [\,\mathbf{P} \ \ \alpha\mathbf{P}'\,]$ *and* $\bar{\mathbf{Q}} = [\,\mathbf{Q} \ \ \mathbf{Q}'\,]$.

Proposition 4. *For* $\nabla_{\mathbf{A},\mathbf{B}}(\mathbf{C}) = \mathbf{PQ}^T$ *and* $\nabla_{\mathbf{B},\mathbf{D}}(\mathbf{E}) = \mathbf{P}'\mathbf{Q}'^T$*, we have that* $\nabla_{\mathbf{A},\mathbf{D}}(\mathbf{CE}) = \bar{\mathbf{P}}\bar{\mathbf{Q}}^T$*, where* $\bar{\mathbf{P}} = [\,\mathbf{P} \ \ \mathbf{CP}'\,]$ *and* $\bar{\mathbf{Q}} = [\,\mathbf{E}^T\mathbf{Q} \ \ \mathbf{Q}'\,]$.

Now, it is possible to apply the displacement operators on Toeplitz matrices in order to verify if they can be compressed. Consider the Sylvester operator $\nabla_{\mathbf{Z}_\eta,\mathbf{Z}_\xi}$ applied to a symmetric Toeplitz matrix $\boldsymbol{T} = (t_{|i-j|})_{i,j=0}^{M-1}$, with $\xi, \eta \in \mathbb{R}$:

$$\begin{aligned}
\nabla_{\mathbf{Z}_\eta,\mathbf{Z}_\xi}(\boldsymbol{T}) &= \mathbf{Z}_\eta\boldsymbol{T} - \boldsymbol{T}\mathbf{Z}_\xi \\
&= \underbrace{\mathbf{e}_1}_{\hat{\mathbf{p}}_1}\underbrace{[\,\eta t_{M-1} - t_1 \ \ \cdots \ \ \eta t_1 - t_{M-1} \ \ \eta t_0\,]}_{\hat{\mathbf{q}}_1^T} \\
&\quad + \underbrace{[\,-\xi t_0 \ \ t_{M-1} - \xi t_1 \ \ \cdots \ \ t_1 - \xi t_{M-1}\,]^T}_{\hat{\mathbf{p}}_2}\underbrace{\mathbf{e}_M^T}_{\hat{\mathbf{q}}_2^T} \\
&= \hat{\mathbf{p}}_1\hat{\mathbf{q}}_1^T + \hat{\mathbf{p}}_2\hat{\mathbf{q}}_2^T = [\,\hat{\mathbf{p}}_1 \ \hat{\mathbf{p}}_2\,]\begin{bmatrix}\hat{\mathbf{q}}_1^T \\ \hat{\mathbf{q}}_2^T\end{bmatrix} = \hat{\mathbf{P}}\hat{\mathbf{Q}}^T. \qquad (1)
\end{aligned}$$

Hence, it is obvious that *a symmetric Toeplitz matrix can be compressed*, when $M \gg R = 2$.

Proposition 5 contains an important result: the relationship between the displacement generators of a Toeplitz matrix and its inverse [6]. The inverse of a Toeplitz matrix is called a *T-Bezoutian matrix* [8].

Proposition 5. *For a invertible Toeplitz matrix* $\boldsymbol{T} \in \mathbb{C}^{M\times M}$ *such that its displacement generator pair related to the Sylvester displacement operator* $\nabla_{\mathbf{Z}_\eta,\mathbf{Z}_\xi}$*, with* $\xi, \eta \in \mathbb{C}$*, is given by* $(\hat{\mathbf{P}}, \hat{\mathbf{Q}})$*, we have that the displacement generator pair* $(\mathbf{P}, \mathbf{Q})$ *related to the Sylvester displacement operator* $\nabla_{\mathbf{Z}_\xi,\mathbf{Z}_\eta}$ *applied to the T-Bezoutian* $\boldsymbol{B} = \boldsymbol{T}^{-1}$ *is given by* $(-\boldsymbol{B}\hat{\mathbf{P}}, \boldsymbol{B}^T\hat{\mathbf{Q}})$.

4. DHT REPRESENTATION OF BEZOUTIANS

In this section, we develop the mathematical background required for deriving the main contribution of this work related to the design of practical block-based transceivers with minimum redundancy. Inspired by traditional ZF-OFDM and ZF-SC-FD systems that decompose inverses of circulant matrices by using DFT, IDFT, and diagonal matrices, we now describe some results related to the decomposition of a *Bezoutian matrix* by using DHTs and diagonal matrices. A matrix $\mathbf{C} \in \mathbb{C}^{M\times M}$ is a Bezoutian matrix if $R = \mathrm{rank}\{\nabla_{\mathbf{Z}_\xi,\mathbf{Z}_\eta}(\mathbf{C})\} \ll M$ [6]. Notice that a T-Bezoutian matrix has rank two.

Proposition 6 is our first contribution. It is based on a similar result of [8]. Unlike the polynomial approach adopted in [8], we use a matrix approach based on the Sylvester and Stein displacement operators. Our approach allows us to derive transformations without requiring extension with zeros of the involved matrices as in [8]. This eventually allows us to design multicarrier transceivers (see Section 5), which is not possible by using the same formulation presented in [8].

Proposition 6. *Given a centro-symmetric matrix* $\mathbf{C} \in \mathbb{C}^{M\times M}$*, i.e.,* $\mathbf{C} = \mathbf{JCJ}$*, with* $\mathbf{J} = [\,\mathbf{e}_M \ \mathbf{e}_{M-1} \ \cdots \ \mathbf{e}_2 \ \mathbf{e}_1\,]$*, and given that* $\nabla_{\mathbf{Z}_1,\mathbf{Z}_{-1}}(\mathbf{C}) = \mathbf{PQ}^T$*, where* $(\mathbf{P}, \mathbf{Q}) \in \mathbb{C}^{M\times R} \times \mathbb{C}^{M\times R}$ *and* $R \in \mathbb{N}$*, then* $\boldsymbol{\mathcal{H}}_{\mathrm{II}}\mathbf{C}\boldsymbol{\mathcal{H}}_{\mathrm{IV}} = \tilde{\mathbf{C}}$ *is such that* $\Delta_{\mathbf{D}_1,\mathbf{D}_{-1}}(\tilde{\mathbf{C}}) = \tilde{\mathbf{P}}\tilde{\mathbf{Q}}^T$*, with* $(\tilde{\mathbf{P}}, \tilde{\mathbf{Q}}) = (-\jmath\mathbf{W}_{\mathrm{II}}\mathbf{P}, \mathbf{W}_{\mathrm{IV}}\mathbf{Z}_{-1}\mathbf{Q})$*. Furthermore,* $\tilde{\mathbf{C}}$ *can be expressed as* $[\tilde{\mathbf{C}}]_{ij} = [(-\mathbf{W}_{\mathrm{I}}\mathbf{P})(\mathbf{W}_{\mathrm{III}}\mathbf{Z}_{-1}\mathbf{Q})^T]_{ij}/2\sin\left(\frac{(2i+2j+1)\pi}{2M}\right)$.

Proof. See the appendix. □

Proposition 7 is our second contribution. It is also based on a similar result of [8]. However, our approach allows us to work with complex matrices, which is not possible in [8].

Proposition 7. *Given* $(\mathbf{P}, \mathbf{Q}) \in \mathbb{C}^{M\times R} \times \mathbb{C}^{M\times R}$*, with* $R \in \mathbb{N}$*, we have that* $-\mathbf{W}_{\mathrm{I}}\mathbf{P} = \boldsymbol{\mathcal{H}}_{\mathrm{I}}(-\mathbf{P}_+ + \jmath\mathbf{P}_-) = \bar{\mathbf{P}}$ *and* $\mathbf{W}_{\mathrm{III}}\mathbf{Z}_{-1}\mathbf{Q} = \boldsymbol{\mathcal{H}}_{\mathrm{III}}(-\jmath\mathbf{Q}_+ + \mathbf{Q}_-) = \bar{\mathbf{Q}}$*, where* $\mathbf{P}_\pm = (\mathbf{P} \pm \mathbf{J}'\mathbf{P})/2$*,* $\mathbf{Q}_\pm = (\mathbf{Z}_{-1}\mathbf{Q} \pm \mathbf{J}''\mathbf{Z}_{-1}\mathbf{Q})/2$*,* $\mathbf{J}' = [\,\mathbf{e}_1 \ \mathbf{e}_M \ \cdots \ \mathbf{e}_3 \ \mathbf{e}_2\,]$*, and* $\mathbf{J}'' = [\,-\mathbf{e}_1 \ \mathbf{e}_M \ \cdots \ \mathbf{e}_3 \ \mathbf{e}_2\,]$.

Proof. See the appendix. □

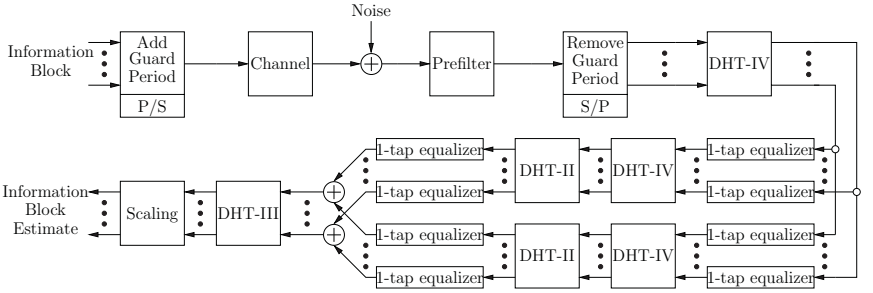

Figure 1: Single-carrier minimum redundancy block transceiver: ZF-SC-MRBT.

Proposition 8 is a result taken from [8] that is required to prove the main mathematical contribution of this work, Theorem 1. Once again, Theorem 1 is based on a similar result of [8], but only with our solution it is possible to design multicarrier transceivers for complex channel models.

Proposition 8. *The Hartley transforms $\mathcal{H}_{\rm II}$ and $\mathcal{H}_{\rm IV}$ obey the following relationship:* $[\mathcal{H}_{\rm II}\mathcal{H}_{\rm IV}]_{ij} = 1/M \sin\left(\frac{(2i+2j+1)\pi}{2M}\right)$.

Theorem 1. *Given* $\mathbf{C}$ *as in Proposition 6 and* $(\bar{\mathbf{P}}, \bar{\mathbf{Q}})$ *as in Proposition 7, it follows that:*

$$\mathbf{C} = \frac{M}{2}\mathcal{H}_{\rm III}\left(\sum_{r=1}^{R}\mathbf{D}_{\bar{\mathbf{p}}_r}\mathcal{H}_{\rm II}\mathcal{H}_{\rm IV}\mathbf{D}_{\bar{\mathbf{q}}_r}\right)\mathcal{H}_{\rm IV}, \qquad (2)$$

where $\bar{\mathbf{p}}_r$ *is the* rth *column vector of* $\bar{\mathbf{P}}$ *and* $\bar{\mathbf{q}}_r$ *is the* rth *column vector of* $\bar{\mathbf{Q}}$.

Proof. See the appendix. □

5. DESIGN OF SUPERFAST TRANSCEIVERS

5.1 ZF Solution

5.1.1 Single-Carrier System

As in SC-FD, let us define $\mathbf{F}_0 = \mathbf{I}_M$, in such a way that we must have $\mathbf{G}_0 = \mathbf{H}_0^{-1}$ in order to achieve the ZF solution. Of course, this ISI-free solution can only be implemented if $\mathbf{H}_0$ is square and invertible.

Since $\mathbf{H}_0^{-1} = \mathbf{J}\mathbf{H}_0^{-1}\mathbf{J}$ is a centro-symmetric T-Bezoutian, we can apply Theorem 1, in such a way that

$$\mathbf{G}_0 = \mathbf{H}_0^{-1} = \frac{M}{2}\mathcal{H}_{\rm III}\left(\sum_{r=1}^{2}\mathbf{D}_{\bar{\mathbf{p}}_r}\mathcal{H}_{\rm II}\mathcal{H}_{\rm IV}\mathbf{D}_{\bar{\mathbf{q}}_r}\right)\mathcal{H}_{\rm IV}, \qquad (3)$$

where $\bar{\mathbf{p}}_r, \bar{\mathbf{q}}_r$ can be easily found from $\hat{\mathbf{p}}_r, \hat{\mathbf{q}}_r$ by using Propositions 7 and 5. The generator vectors $\hat{\mathbf{p}}_r, \hat{\mathbf{q}}_r$ can be determined by using eq. (1), with $\xi = 1$, $\eta = -1$, and, $\forall m \in \mathcal{M}$, $t_m = h(L/2 \pm m)$, for $0 \le m \le L/2$, otherwise $t_m = 0$.

Figure 1 depicts the resulting single-carrier transceiver structure. In this transceiver, the guard period consists of $L/2$ zeros. The prefilter turns the channel symmetric [9]. After removing the guard period, the DHT-IV is applied to the received vector. The first equalization step on the data vector is performed, that is, the resulting data vector is simultaneously processed by two different branches of the transceiver. The 1-tap equalizers in this stage are the elements of the vectors $\bar{\mathbf{q}}_1$ and $\bar{\mathbf{q}}_2$. A final equalization step is performed in each branch, after the application of the DHT-IV and DHT-II. The 1-tap equalizers in this stage are the elements of the vectors $\bar{\mathbf{p}}_1$ and $\bar{\mathbf{p}}_2$.

5.1.2 Multicarrier System

Similarly, it is also possible to design the ZF solution for a multicarrier minimum redundancy block transceiver (ZF-MC-MRBT). This system is characterized by the following matrices: $\mathbf{F}_0 = \mathcal{H}_{\rm III}$ and $\mathbf{G}_0 = \mathcal{H}_{\rm III}^T\mathbf{H}_0^{-1}$, that is:

$$\mathbf{G}_0 = \frac{M}{2}\left(\sum_{r=1}^{2}\mathbf{D}_{\bar{\mathbf{p}}_r}\mathcal{H}_{\rm II}\mathcal{H}_{\rm IV}\mathbf{D}_{\bar{\mathbf{q}}_r}\right)\mathcal{H}_{\rm IV}. \qquad (4)$$

5.2 MMSE Solution

5.2.1 Single-Carrier System

Given the equivalent model $\mathbf{y} = \mathbf{H}_0\mathbf{u} + \mathbf{v}$, with $\mathbf{u} = \mathbf{F}_0\mathbf{s}$, the linear MMSE solution $\mathbf{K}_{\rm MMSE} \in \mathbb{C}^{M\times M}$ is given by $\mathbf{K}_{\rm MMSE} = \mathbf{H}_0^*\left[\mathbf{H}_0\mathbf{H}_0^* + (\sigma_v^2/\sigma_s^2)\mathbf{I}\right]^{-1} = \mathbf{J}\mathbf{K}_{\rm MMSE}\mathbf{J}$ (centro-symmetric), where we considered that the transmitted symbols and the noise are i.i.d., drawn from white zero-mean stochastic processes, and mutually independent. Besides, it was considered that $\mathsf{E}[ss^*] = \sigma_s^2$ and $\mathsf{E}[vv^*] = \sigma_v^2$.

Consider that $\nabla_{\mathbf{Z}_{1/\eta},\mathbf{Z}_\xi}(\mathbf{H}_0) = \hat{\mathbf{P}}\hat{\mathbf{Q}}^T$ and $\nabla_{\mathbf{Z}_\xi,\mathbf{Z}_\rho}(\mathbf{H}_0^*) = \hat{\mathbf{P}}'\hat{\mathbf{Q}}'$, for $(\rho,\xi,\eta) \in \mathbb{C}^3$ and $\eta \neq 0$. Now, by applying Proposition 4, we have that $\nabla_{\mathbf{Z}_{1/\eta},\mathbf{Z}_\rho}(\mathbf{H}_0\mathbf{H}_0^*) = \mathring{\mathbf{P}}\mathring{\mathbf{Q}}^T$, with $\mathring{\mathbf{P}} = [\,\hat{\mathbf{P}} \quad \mathbf{H}_0\hat{\mathbf{P}}'\,]$ and $\mathring{\mathbf{Q}} = [\,\mathbf{H}_0^*\hat{\mathbf{Q}} \quad \hat{\mathbf{Q}}'\,]$.

Define $\mathbf{A} = \mathbf{H}_0\mathbf{H}_0^* + (\sigma_v^2/\sigma_s^2)\mathbf{I}$. Thus, by supposing that $\nabla_{\mathbf{Z}_{1/\eta},\mathbf{Z}_\rho}(\mathbf{I}) = \mathring{\mathbf{p}}\mathring{\mathbf{q}}^T$ and employing Proposition 3, we obtain: $\nabla_{\mathbf{Z}_{1/\eta},\mathbf{Z}_\rho}(\mathbf{A}) = \check{\mathbf{P}}\check{\mathbf{Q}}^T$, with $\check{\mathbf{P}} = [\,\mathring{\mathbf{p}} \quad (\sigma_v^2/\sigma_s^2)\hat{\mathbf{p}}\,]$ and $\check{\mathbf{Q}} = [\,\mathring{\mathbf{q}} \quad \mathring{\mathbf{q}}\,]$. In addition, from Proposition 2, we have $\nabla_{\mathbf{Z}_\rho,\mathbf{Z}_{1/\eta}}\left(\mathbf{A}^{-1}\right) = \check{\mathbf{P}}'\check{\mathbf{Q}}'^T$, with $\check{\mathbf{P}}' = -\mathbf{A}^{-1}\check{\mathbf{P}}$ and $\check{\mathbf{Q}}' = \mathbf{A}^{-T}\check{\mathbf{Q}}$.

Thus, by again applying Proposition 4, we obtain $\nabla_{\mathbf{Z}_\xi,\mathbf{Z}_{1/\eta}}(\mathbf{K}_{\rm MMSE}) = \mathbf{P}\mathbf{Q}^T$, with $\mathbf{P} = [\,\hat{\mathbf{P}}' \quad \mathbf{H}_0^*\check{\mathbf{P}}'\,]$ and $\mathbf{Q} = [\,\mathbf{A}^{-T}\hat{\mathbf{Q}}' \quad \check{\mathbf{Q}}'\,]$.

Hence, the displacement generator of the MMSE solution is given by the pair

$$\begin{aligned}\mathbf{P} &= \left[\hat{\mathbf{P}}' \quad -\mathbf{K}_{\rm MMSE}\hat{\mathbf{P}} \quad -\mathbf{K}_{\rm MMSE}\mathbf{H}_0\hat{\mathbf{P}}' \quad -\frac{\sigma_v^2}{\sigma_s^2}\mathbf{K}_{\rm MMSE}\check{\mathbf{p}}\right]_{M\times 7},\\ \mathbf{Q} &= [\,\mathbf{A}^{-T}\hat{\mathbf{Q}}' \quad \mathbf{K}_{\rm MMSE}^T\hat{\mathbf{Q}} \quad \mathbf{A}^{-T}\hat{\mathbf{Q}}' \quad \mathbf{A}^{-T}\check{\mathbf{q}}\,]_{M\times 7}.\end{aligned}$$

By applying the matrix inversion lemma, it is possible to show that $\mathbf{P}\mathbf{Q}^T$ can be expressed as

$$\frac{\sigma_v^2}{\sigma_s^2}\left(\mathbf{A}^*\right)^{-1}\hat{\mathbf{P}}'\hat{\mathbf{Q}}'^T\mathbf{A}^{-1} - \mathbf{K}_{\rm MMSE}\hat{\mathbf{P}}\hat{\mathbf{Q}}^T\mathbf{K}_{\rm MMSE} - \frac{\sigma_v^2}{\sigma_s^2}\mathbf{K}_{\rm MMSE}\check{\mathbf{p}}\check{\mathbf{q}}^T\mathbf{A}^{-1}.$$

A more compact definition for $\mathbf{P}$ and $\mathbf{Q}$ is:

$$\mathbf{P} = \left[\frac{\sigma_x^2}{\sigma_s^2}(\mathbf{A}^*)^{-1}\hat{\mathbf{P}}' \quad -\mathbf{K}_{\text{MMSE}}\hat{\mathbf{P}} \quad -\frac{\sigma_x^2}{\sigma_s^2}\mathbf{K}_{\text{MMSE}}\mathring{\mathbf{p}}\right]_{M\times 5} \tag{5}$$

$$\mathbf{Q} = \left[\mathbf{A}^{-T}\hat{\mathbf{Q}}' \quad \mathbf{K}_{\text{MMSE}}^T\hat{\mathbf{Q}} \quad \mathbf{A}^{-T}\mathring{\mathbf{q}}\right]_{M\times 5}. \tag{6}$$

Hence, by using the result in Theorem 1 and by considering that $(\rho, \xi, \eta) = (0, 1, -1)$, we have that

$$\mathbf{K}_{\text{MMSE}} = \frac{M}{2}\boldsymbol{\mathcal{H}}_{\text{III}}\left(\sum_{r=1}^{5}\mathbf{D}_{\bar{\mathbf{p}}_r}\boldsymbol{\mathcal{H}}_{\text{II}}\boldsymbol{\mathcal{H}}_{\text{IV}}\mathbf{D}_{\bar{\mathbf{q}}_r}\right)\boldsymbol{\mathcal{H}}_{\text{IV}}. \tag{7}$$

The displacement generator pairs $(\hat{\mathbf{P}}, \hat{\mathbf{Q}}), (\hat{\mathbf{P}}', \hat{\mathbf{Q}}') \in \mathbb{C}^{M\times 2} \times \mathbb{C}^{M\times 2}$ are easily found by using eq. (1). Moreover, $\mathring{\mathbf{p}} = [1 \;\; 0 \;\; \cdots \;\; 0]^T$ and $\mathring{\mathbf{q}} = [0 \;\; 0 \;\; \cdots \;\; -2]^T$.

Thus, in the single-carrier transmission, we can define $\mathbf{F}_0 = \mathbf{I}_M$ and

$$\mathbf{G}_0 = \frac{M}{2}\boldsymbol{\mathcal{H}}_{\text{III}}\left(\sum_{r=1}^{5}\mathbf{D}_{\bar{\mathbf{p}}_r}\boldsymbol{\mathcal{H}}_{\text{II}}\boldsymbol{\mathcal{H}}_{\text{IV}}\mathbf{D}_{\bar{\mathbf{q}}_r}\right)\boldsymbol{\mathcal{H}}_{\text{IV}} \tag{8}$$

in order to achieve the linear MMSE solution.

Note that the equalization process of the MMSE-SC-MRBT requires almost the same processing time of the ZF solution, since the structures of the receivers are very similar. It is also possible to take advantage of the inherent parallel structures (the MMSE entails five parallel branches instead of only two. See Figure 1).

5.2.2 *Multicarrier System*

In the multicarrier transmission (MMSE-MC-MRBT), we can define $\mathbf{F}_0 = \boldsymbol{\mathcal{H}}_{\text{III}}$ and

$$\mathbf{G}_0 = \frac{M}{2}\left(\sum_{r=1}^{5}\mathbf{D}_{\bar{\mathbf{p}}_r}\boldsymbol{\mathcal{H}}_{\text{II}}\boldsymbol{\mathcal{H}}_{\text{IV}}\mathbf{D}_{\bar{\mathbf{q}}_r}\right)\boldsymbol{\mathcal{H}}_{\text{IV}}. \tag{9}$$

6. SIMULATION EXPERIMENTS

In this section, we present two simulation examples in order to compare the performance of our proposed designs against the standard OFDM and SC-FD systems.

Example 1 (Symmetric Random Rayleigh Channel). In this example, it is transmitted 100 blocks, each one containing $M = 32$ BPSK data symbols (without taking redundancy into account), and it is computed the throughput by using a Monte-Carlo averaging process with 1000 simulations. These symbols are sampled at a frequency $f_s = 1.0$ MHz and they are transmitted through a channel with a model operating at the same frequency as the symbols and with impulse response of order $L = 8$. Both the imaginary and real parts of the channel are independently drawn from a white and Gaussian process. Besides, the channels are already considered symmetric. The throughput performance of the proposed transceivers is much better than the traditional ones, as illustrates Figure 2. Such favorable result originates from the choices for M and L (delay constrained applications in quite dispersive environments). These types of applications are suitable for the proposed transceivers. In the cases where $M \gg L$, the traditional OFDM and SC-FD solutions are more adequate.

Example 2 (ADSL Shortened Channel). In this example, it was transmitted 1000 blocks, each one containing $M = 256$ QPSK data symbols (without taking redundancy into account), and we compute the resulting BER for such transmission. The symbols are also sampled at a frequency $f_s = 1.0$ MHz and they are transmitted through an ADSL channel[4] whose model operates at the same frequency. This channel is represented by the FIR approximation with 93 coefficients of the transfer function $H(z) = (0.1z^{-2} - 0.1)/(z^{-2} - 1.5z^{-1} + 0.54)$ [10].

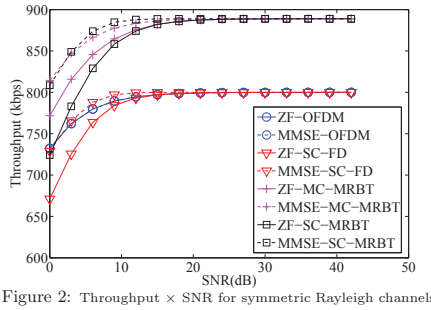

Figure 2: Throughput × SNR for symmetric Rayleigh channels.

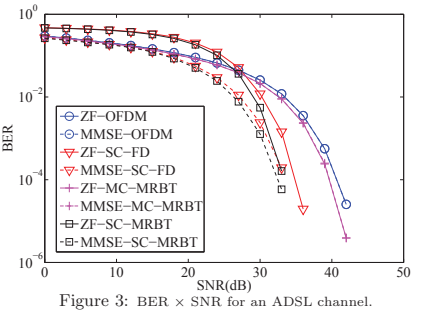

Figure 3: BER × SNR for an ADSL channel.

Considering delay constrained applications with very dispersive environment, it is mandatory for OFDM and SC-FD systems to employ a front-end prefilter in order to shorten the channel [9], [2]. Thus, in order to have a fair comparison in terms of throughput, we designed a shortening FIR filter of order 64, considering the SNR fixed at 30 dB for the design of this filter. The length of the TIR (target impulse response) was set to $L/2 + 1 = 47$, in such a way that the amount of redundancy for both the traditional and the proposed systems was $L/2$. On the other hand, the length of the TIR for the proposed systems was set the same of the channel length $L + 1 = 93$, but with symmetry constraint[5]. Figure 3 depicts a BER curve for all the systems, considering the existence of the prefilter. It is possible to observe that the proposed transceivers outperform their related pairs for both ZF and MMSE designs.

7. CONCLUDING REMARKS

In this paper we proposed transceivers with minimum redundancy for block data transmission. The ZF and MMSE solutions employ only DHTs and diagonal matrices. This feature makes the new transceivers computationally efficient. Our approach relied on the properties of structured matrices using the concepts of Sylvester and Stein displacements.

[4] In practice, an ADSL system applies bit and power loading to the subchannels, rather than transmitting equal power signals on every subchannel as done here. But, the problem of power loading when using the proposed transceivers has not been addressed and appears to be more complex than in the traditional DMT schemes, since the effective channel matrix is not diagonalized.

[5] Additional details about the degrees of freedom required by the front-end prefilter in order to shorten the channel and to make it symmetric can be found in [9], [2].

These concepts aimed at exploiting the structural properties of typical channel matrix representations. It was derived new DHT-based representations of centro-symmetric Bezoutians, which were the key tools to reach the proposed solutions for the multicarrier and single-carrier systems. A possible future work is to verify if the channel capacity can be achieved as the number of subcarries increases (with ideal Gaussian codes). This is a desirable feature inherent to OFDM-based schemes.

Acknowledgment

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APPENDIX

Before demonstrating Proposition 6, it will be helpful to state some results, as follows:

Lemma 1. *The four DFT matrices obey the following identities:* $\mathbf{Z}_1 = \mathbf{W}_{\rm I}^H \mathbf{D_1} \mathbf{W}_{\rm I} = \mathbf{W}_{\rm II}^H \mathbf{D_1} \mathbf{W}_{\rm II}$ *and* $\mathbf{Z}_{-1} = \mathbf{W}_{\rm II}^H \mathbf{D_{-1}} \mathbf{W}_{\rm III} = \mathbf{W}_{\rm IV}^H \mathbf{D_{-1}} \mathbf{W}_{\rm IV}$, *where* $\mathbf{D_1} = \text{diag}\left\{W_M^m\right\}_{m=0}^{M-1}$ *contains all the* Mth *unit roots, and* $\mathbf{D_{-1}} = \text{diag}\left\{W_M^m \exp\left(-\jmath\frac{\pi}{M}\right)\right\}_{m=0}^{M-1}$ *contains all the* Mth *roots of* -1, *with* $W_M = \exp(-\jmath\frac{2\pi}{M})$.

Proof. First, consider that $j \in \mathcal{M} \setminus \{M-1\}$. Thus, $[\mathbf{D_1}\mathbf{W_I}]_{ij} = W_M^i W_M^{ij} = W_M^{i(j+1)} = [\mathbf{W_I}]_{i(j+1)} = [\mathbf{W_I}\mathbf{Z_1}]_{ij}$. Second, consider that $j = M-1$. In this case, we have $[\mathbf{D_1}\mathbf{W_I}]_{i(M-1)} = W_M^i W_M^{i(M-1)} = W_M^{iM} = 1 = [\mathbf{W_I}]_{i0} = [\mathbf{W_I}\mathbf{Z_1}]_{i(M-1)}$. The other three identities can be analogously proved. □

As discussed in [8], it is possible to verify that $\mathbf{W}_{\rm II} = \text{diag}\{\exp(-\jmath m\pi/M)\}_{m=0}^{M-1}\mathbf{W}_{\rm I}$ and $\mathbf{W}_{\rm IV} = \text{diag}\{\exp(-\jmath(2m+1)\pi/2M)\}_{m=0}^{M-1}\mathbf{W}_{\rm III}$. In addition, Lemma 2 holds [8].

Lemma 2. *Given that* $\mathbf{C} \in \mathbb{C}^{M\times M}$ *is a centro-symmetric matrix, we have that* $\boldsymbol{\mathcal{H}}_{\rm II}\mathbf{C}\boldsymbol{\mathcal{H}}_{\rm IV} = \jmath\mathbf{W}_{\rm II}\mathbf{C}\mathbf{W}_{\rm IV}$.

Proof of Proposition 6. By applying the results of Lemma 1, Lemma 2, Proposition 1, and the fact that $\mathbf{Z}_{\lambda}^{-1} = \mathbf{Z}_{1/\lambda}^T, \forall\lambda \in \mathbb{C}\setminus\{0\}$, we have that the Stein displacement $\Delta_{\mathbf{D_1},\mathbf{D_{-1}}}$ applied to $\tilde{\mathbf{C}}$ is given by $\Delta_{\mathbf{D_1},\mathbf{D_{-1}}}(\boldsymbol{\mathcal{H}}_{\rm II}\mathbf{C}\boldsymbol{\mathcal{H}}_{\rm IV}) = \Delta_{\mathbf{D_1},\mathbf{D_{-1}}}(\jmath\mathbf{W}_{\rm II}\mathbf{C}\mathbf{W}_{\rm IV}) = \jmath\mathbf{W}_{\rm II}\mathbf{C}\mathbf{W}_{\rm IV} - (\mathbf{W}_{\rm II}\mathbf{Z}_1\mathbf{W}_{\rm II}^H)(\jmath\mathbf{W}_{\rm II}\mathbf{C}\mathbf{W}_{\rm IV})(\mathbf{W}_{\rm IV}^*\mathbf{Z}_{-1}^T\mathbf{W}_{\rm IV}^T) = \jmath\mathbf{W}_{\rm II}(\mathbf{C} - \mathbf{Z}_1\mathbf{C}\mathbf{Z}_{-1}^T)\mathbf{W}_{\rm IV} = \jmath\mathbf{W}_{\rm II}\Delta_{\mathbf{Z_1},\mathbf{Z}_{-1}^T}(\mathbf{C})\mathbf{W}_{\rm IV} = -\jmath\mathbf{W}_{\rm II}\nabla_{\mathbf{Z_1},\mathbf{Z_{-1}}}(\mathbf{C})\mathbf{Z}_{-1}^T\mathbf{W}_{\rm IV} = (-\jmath\mathbf{W}_{\rm II}\mathbf{P})(\mathbf{W}_{\rm IV}\mathbf{Z_{-1}}\mathbf{Q})^T$. Thus, by using this fact, it is straightforward to verify that

$$[\tilde{\mathbf{C}}]_{ij} = \frac{[(-\jmath\mathbf{W}_{\rm II}\mathbf{P})(\mathbf{W}_{\rm IV}\mathbf{Z_{-1}}\mathbf{Q})^T]_{ij}}{\left(1 - e^{-\jmath\frac{(2i+2j+1)\pi}{M}}\right)} \quad (10)$$

$$= \frac{e^{\jmath\frac{\pi}{M}}[(-\jmath\mathbf{W}_{\rm II}\mathbf{P})(\mathbf{W}_{\rm IV}\mathbf{Z_{-1}}\mathbf{Q})^T]_{ij}e^{\jmath\frac{(2j+1)\pi}{2M}}}{e^{\jmath\frac{(2i+2j+1)\pi}{2M}} - e^{-\jmath\frac{(2i+2j+1)\pi}{2M}}} \quad (11)$$

$$= \frac{[(-\mathbf{W_I}\mathbf{P})(\mathbf{W_{III}}\mathbf{Z_{-1}}\mathbf{Q})^T]_{ij}}{2\sin\left(\frac{(2i+2j+1)\pi}{2M}\right)}. \quad (12)$$

□

Now, we state some useful equalities related to Proposition 7. A vector $\boldsymbol{\nu}$ is *even* if $\mathbf{J}'\boldsymbol{\nu} = \boldsymbol{\nu}$, it is *odd* if $\mathbf{J}'\boldsymbol{\nu} = -\boldsymbol{\nu}$, it is *quasi-even* if $\mathbf{J}''\boldsymbol{\nu} = \boldsymbol{\nu}$, and it is *quasi-odd* if $\mathbf{J}''\boldsymbol{\nu} = -\boldsymbol{\nu}$. The definitions of quasi-even and quasi-odd were necessary in order to correct a slip in the following lemma stated in [8]. The authors of the referred paper did not distinguish between quasi-even/odd and even/odd vectors.

Lemma 3. *Given an even vector* $\boldsymbol{\nu}_e \in \mathbb{C}^{M\times 1}$, *an odd vector* $\boldsymbol{\nu}_o \in \mathbb{C}^{M\times 1}$, *a quasi-even vector* $\boldsymbol{\nu}_{qe} \in \mathbb{C}^{M\times 1}$, *and a quasi-odd vector* $\boldsymbol{\nu}_{qo} \in \mathbb{C}^{M\times 1}$, *we have that* $\mathbf{W_I}\boldsymbol{\nu}_e = \boldsymbol{\mathcal{H}}_{\rm I}\boldsymbol{\nu}_e$, $\mathbf{W_I}\boldsymbol{\nu}_o = -\jmath\boldsymbol{\mathcal{H}}_{\rm I}\boldsymbol{\nu}_o$, $\mathbf{W_{III}}\boldsymbol{\nu}_{qe} = -\jmath\boldsymbol{\mathcal{H}}_{\rm III}\boldsymbol{\nu}_{qe}$, *and* $\mathbf{W_{III}}\boldsymbol{\nu}_{qo} = \boldsymbol{\mathcal{H}}_{\rm III}\boldsymbol{\nu}_{qo}$.

Proof of Proposition 7. Since $\mathbf{P}_{\pm} = (\mathbf{P} \pm \mathbf{J}'\mathbf{P})/2$ and $\mathbf{Q}_{\pm} = (\mathbf{Z_{-1}}\mathbf{Q} \pm \mathbf{J}''\mathbf{Z_{-1}}\mathbf{Q})/2$, then each column vector of $\mathbf{P}_+$ is an even vector, whereas each column vector of $\mathbf{Q}_+$ is a quasi-even vector. In addition, those columns of $\mathbf{P}_-$ and $\mathbf{Q}_-$ are odd and quasi-odd vectors, respectively. By applying Lemma 3, we have that $-\mathbf{W_I}\mathbf{P} = -\boldsymbol{\mathcal{H}}_{\rm I}\mathbf{P}_+ + \jmath\boldsymbol{\mathcal{H}}_{\rm I}\mathbf{P}_- = \boldsymbol{\mathcal{H}}_{\rm I}(-\mathbf{P}_+ + \jmath\mathbf{P}_-) = \bar{\mathbf{P}}$ and $\mathbf{W_{III}}\mathbf{Z_{-1}}\mathbf{Q} = -\jmath\boldsymbol{\mathcal{H}}_{\rm III}\mathbf{Q}_+ + \boldsymbol{\mathcal{H}}_{\rm III}\mathbf{Q}_- = \boldsymbol{\mathcal{H}}_{\rm III}(-\jmath\mathbf{Q}_+ + \mathbf{Q}_-) = \bar{\mathbf{Q}}$. □

Proof of Theorem 1. Considering that $\bar{\mathbf{P}} = [\,\bar{\mathbf{p}}_1 \;\cdots\; \bar{\mathbf{p}}_R\,]$ and $\bar{\mathbf{Q}} = [\,\bar{\mathbf{q}}_1 \;\cdots\; \bar{\mathbf{q}}_R\,]$, then, based on Propositions 6, 7, and 8, we have that:

$$\tilde{\mathbf{C}} = \left[\frac{[\bar{\mathbf{P}}\bar{\mathbf{Q}}^T]_{ij}}{2\sin\left(\frac{(2i+2j+1)\pi}{2M}\right)}\right]_{i,j=0}^{M-1} \quad (13)$$

$$\tilde{\mathbf{C}} = \frac{M}{2}\sum_{r=1}^{R}\mathbf{D}_{\bar{\mathbf{p}}_r}\boldsymbol{\mathcal{H}}_{\rm II}\boldsymbol{\mathcal{H}}_{\rm IV}\mathbf{D}_{\bar{\mathbf{q}}_r}, \quad (14)$$

leading to the required result using the fact that $\boldsymbol{\mathcal{H}}_{\rm II}^T = \boldsymbol{\mathcal{H}}_{\rm III}$. □

REFERENCES

[1] A. Scaglione, G. B. Giannakis, and S. Barbarossa, "Redundant filterbank precoders and equalizers part I: unification and optimal designs", *IEEE Trans. Signal Processing*, vol. 47, no. 7, pp. 1988–2006, July 1999.

[2] N. Al-Dhahir, H. Minn, and S. Satish, "Optimum DCT-based multicarrier transceivers for frequency-selective channels", *IEEE Trans. Commun.*, vol. 54, no. 5, pp. 911–921, May 2006.

[3] C. B. Ribeiro, M. L. R. Campos, and P. S. R. Diniz, "FIR equalizers with minimum redundancy", *Proc. 2002 IEEE Intern. Conf. on Acoust. Speech and Signal Processing*, Orlando, Florida, Vol. III, pp. 2673-2676, May 2002.

[4] Y.-P. Lin and S.-M. Phoong, "Minimum redundancy for ISI free FIR filterbank transceivers", *IEEE Trans. Signal Processing*, vol. 50, no. 4, pp. 842–853, April 2002.

[5] C. B. Ribeiro, M. L. R. Campos, and P. S. R. Diniz, "Time-varying FIR transmultiplexers with minimum redundancy", *IEEE Trans. Signal Processing*, vol. 57, no. 3, pp. 1113–1127, March 2009.

[6] W. A. Martins and P. S. R. Diniz, "Block-based transceivers with minimum redundancy", submitted for publication, March 2009.

[7] V. Y. Pan, *Structured Matrices and Polynomials: Unified Superfast Algorithms*. New York: Springer, 2001.

[8] G. Heinig and K. Rost, "Hartley transform representations of symmetric Toeplitz matrix inverses with application to fast matrix-vector multiplication", *SIAM J. Matrix Anal. Appl.*, vol. 22, no. 1, pp. 86–105, May 2000.

[9] C. Ribeiro, V. Silva, and P. S. R. Diniz, "Linear phase impulse response shortening for xDSL DMT modems", *IEEE Int. Telecom. Symp.*, Natal, RN, Brazil, pp. 368-371, September 2002.

[10] J. M. Cioffi, *A Multicarrier Primer*. Amati Commun. Corp., Stanford Univ., Tutorial.

A NOVEL LANE FEATURE EXTRACTION ALGORITHM BASED ON DIGITAL INTERPOLATION

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ABSTRACT

This paper presents a novel lane edge feature extraction algorithm based on digital interpolation. Zooming towards the vanishing point of the lanes creates a visual effect of driving. The positions of the lanes should not change significantly on the image plane while the vehicle is moving along the lanes. Considering the position information, more accurate lane features can be extracted. A gradient based vanishing point detection algorithm is incorporated to select the zooming area. The proposed algorithm shows outstanding performance on extracting features belonging solely to the lanes from severe noise environment. The algorithm is capable of removing non-relevant features produced by shadows, other vehicles, trees, buildings etc. The extracted feature map was tested with a classic lane detection algorithm, used in LOIS system. The detection results show that the improved feature map is an important factor to the performance of the whole system.

1. INTRODUCTION

Throughout the last two decades, a significant amount of research has been carried out in the area of lane detection. A complete typical model-based lane detection system consists of four parts: lane modelling, feature extraction, detection and tracking. Lane modelling is concerned with the mathematical descriptions that best represent the lanes. Feature extraction aims to find particular lane features such as colour, texture, edge etc. The detection stage then fits the lane model to the feature map and selects the best set of parameters. Lane tracking could then be applied to follow the change of lanes and reduce the system complexity by reducing the search region in the parameter space.

Many lane detection systems have been suggested. However, a robust system which is able to cope with very complex situations is yet to come. [1] presented the Likelihood Of Image Shape (LOIS) lane detection system. The left and right lanes are modelled as two parallel parabolas on the ground plane. The perspective projected model parameters are then estimated by applying the Maximum A Posteriori (MAP) estimator [2] based on the image gradient. It is robust in noise environment. The LANA system [3] is similar to the LOIS system at the detection stage but uses frequency features of the lanes instead of the edges. [4] introduced a system using the B-spline lane model as well as the Canny/Hough Estimation of Vanishing Points (CHEVP) algorithm to locate the vanishing points of the horizontally segmented lanes. The control points are then positioned by the snake algorithm. [5] uses texture anisotropy field as features to segment the lane from the background. The SPRINGROBOT System [6] uses colour and gradient as lane features and the adaptive randomised Hough transform to locate the lane curves on the feature map. [7] presented a lane model based on the lane curve function (LCF). Each lane boundary is represented by two curves, one for the far-field and the other for the near-field. The algorithm uses lane edges as features. For most of the existing systems, the global shape information is only included in the detection stage but not in feature extraction.

This paper focuses on the lane feature extraction stage. The most commonly used feature is the image gradient or the edges. It requires small computational power and results in a sharp transition in the image intensity. Well-painted lane markings produce strong edges at the lane boundaries which benefit the detection of the lanes. However, as the environment changes, the lane edges may not be as strong and could be heavily affected by the shadows, rain etc. The choice of the edge threshold has always been a difficult task and some existing systems chose a very small value or use the gradient directly without thresholding [1, 8]. This means that many unwanted features are included such as edges corresponding to trees, cars, buildings, shadows and so on. The detection of lanes is thus more difficult and time consuming since a large number of outliers are involved. Other lane features, such as textures, have proved to be useful as well [5]. The computation of texture is much more complex than the gradient and it still considers only the local information. As a result, distractive features could also be included.

The proposed feature extraction algorithm considers the characteristics of the lanes and the global shape information. The idea is to gradually zoom towards the vanishing point of the lanes on a single frame in order to simulate the view seen by the driver. The edges of the zoomed images are compared with the original image edges and the previously zoomed edge maps. Most of the irrelevant features can be removed from the edge map after the process. The system block diagram is shown in Figure 1.

Section 2 describes the theory behind the algorithm and concentrates on the effect of digital interpolating a lane image. Section 3 and 4 presents the proposed algorithm in details. Section 5 briefly introduces the detection algorithm used for testing the proposed feature extraction algorithm and Section 6 shows the experimental results.

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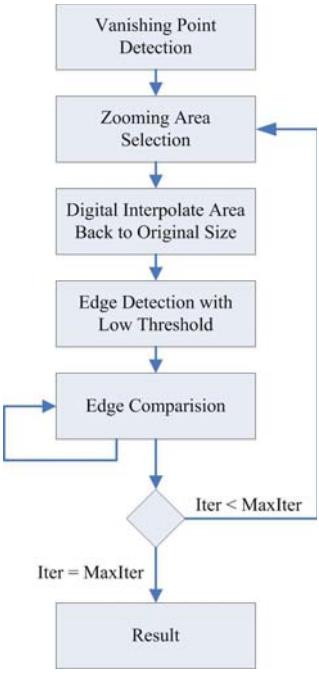


Figure 1: Block diagram of the proposed system.

2. DIGITAL INTERPOLATION ON LANE IMAGES

The purpose of the proposed algorithm is to find the features solely possessed by the lanes from the image. Suppose a vehicle is driven on a clear straight road with continuous lane marking and maintaining a constant lateral offset from the lanes. From the drivers point of view, it is easy to notice that the positions of lane markings does not change over short periods of time. Of course the lane markings are actually moving backwards as the vehicle moves forward. However, since the colour and the width of the markings are similar, the driver is tricked and think the lane markings are not moving. This algorithm takes advantage of the above phenomenon and tries to find the slightly changing features from the scene. However, instead of actually moving along the road, our algorithm is based on a single still image.

In order to simulate the view of driving, digital interpolation is applied. By carefully selecting a region of the image and interpolating this region back to the original image size, simulated view is obtained. All objects on the image will move backwards and their sizes and the positions will change. However, the lane markings or boundaries maintain similar appearances after changing their sizes and positions.

The first task is to select an appropriate area on the image. It is straight forward to see that the vanishing point of the left and right lanes is where the vehicle is heading towards.

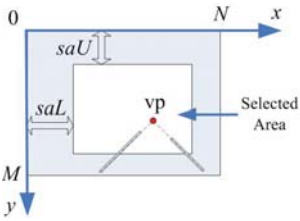


Figure 2: Selected zooming area of an image.

Also, after the interpolation, the vanishing point should stay at the same position. As illustrated in Figure 2, defining the position of vanishing point vp as (vpx, vpy), the total number of image rows as M, and the number of columns as N, the width and height of the selected area could be calculated as:

$$saN = z \times N \tag{1}$$

$$saM = z \times M \tag{2}$$

where z is the zooming ratio and z^2 is the ratio between the area of the selected region and the original image area. The selection of the zooming area must follow the rule that:

$$\frac{vpx}{N - vpx} = \frac{vpx - saL}{saL + saN - vpx} \tag{3}$$

$$\frac{vpy}{M - vpy} = \frac{vpy - saU}{saU + saM - vpy} \tag{4}$$

where saL and saU are the position of the left and upper border of the selected area.

Subsequently, the selected area is interpolated back to the original size. This operation moves all points except the vanishing point to new positions, which are calculated as:

$$x_I(t+1) = vpx + (x_I(t) - vpx) \times \frac{1}{1-z} \tag{5}$$

$$y_I(t+1) = vpy + (y_I(t) - vpy) \times \frac{1}{1-z} \tag{6}$$

where $x_I(t)$, $y_I(t)$ and $x_I(t+1)$, $y_I(t+1)$ represent the x and y coordinate of point I before and after the interpolation respectively. A point on a straight lane boundary before interpolation needs to stay on the same line after interpolation. To prove this, we assume a straight line:

$$y_I = ax_I + b \tag{7}$$

which passes through the vanishing point and a point I. Substitute Equation 7 into Equation 6:

$$y_I(t+1) = a \cdot vpx + b + (a \cdot x_I(t) + b - a \cdot vpx - b)\frac{1}{1-z} \tag{8}$$

which could be rearranged to give:

$$y_I(t+1) = a \cdot \left[vpx + (x_I(t) - vpx) \cdot \frac{1}{1-z}\right] + b \tag{9}$$

Substitute Equation 5 into Equation 9, we get:

$$y_I(t+1) = ax_I(t+1) + b \tag{10}$$

Equation 10 proves that the points on the lane will stay on the same line after interpolation.

So far we have assumed straight lanes and continuous lane markings. However, a multiple vanishing points detection algorithm, along with a iterative zooming process readily solves the problem for the cases of curved lanes and discontinuous lanes. This will be discussed in details in section 3 and 4.

3. VANISHING POINT DETECTION

Vanishing point detection is the first step of the algorithm. Its location is very important for the rest of the task. Although a few pixels variation of the vanishing point position does not significantly influence the system performance, the detected vanishing point has to be corresponding to the lanes. Most of the vanishing point detection algorithms are based on the Hough transform [4, 9, 10]. However, these methods require choosing hard thresholds for both edge detection and Hough space accumulator. It is very difficult to find a suitable set of thresholds for various tasks and environment. In this paper, we assume the road is flat. The vanishing line or the horizon could be calculated using the camera parameters. With this, the detection of the vanishing point is reduced to a one dimensional search.

First, the gradient map is generated by means of a Sobel edge mask. A very small threshold is applied to reduce the computation. The threshold in our case is between 10 and 40 from non-normalised gradient which is small enough to locate lane features under various conditions. Assuming an edge point is belonging to a lane, it is likely that the orientation of this edge is perpendicular to the gradient direction of the lanes. In this case, a line passing through this edge with the direction normal to its gradient orientation is generated to estimate the lane. The intersection of this line and the vanishing line can contribute to the estimation of the vanishing point.

A one dimensional accumulator with a length equals $2N$ ($-0.5N \sim 0.5N$) is created to account for the possibility of the vanishing point being outside the image. Each edge produces a line and each time the line intersects the vanishing line, the corresponding element in the accumulator increments by $(1+gm)$ where gm is the normalised gradient magnitude. The accumulator is then smoothed by a Gaussian low pass filter to compensate the inaccuracy of edge orientation. The element with the most votes corresponds to the vanishing point position. The problem is that if the lane is a curve, the vanishing point position of the lane changes gradually with distance. To solve this problem, the image is partitioned into a few horizontal sections as shown in Figure 3.

The vanishing points for different image sections are detected only using the edge points in the current section. In the far-field, the number of lane edges is comparably lower than that of the near-field. In this case, a tracking process is also included. The search region of the upper section is based on the vanishing point position in the lower sections and the previous vanishing point movement. An example of the multiple vanishing point detection result is given in Figure 3. The vanishing point corresponding to each image band is labelled respectively.

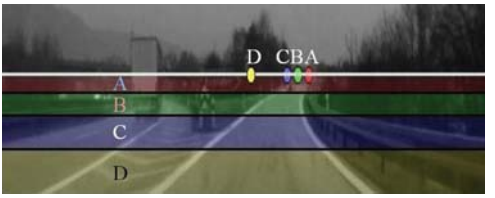


Figure 3: Vanishing point detection result. The image is horizontally partitioned and each partition is labelled. The white horizontal line is the horizon or the vanishing line. The vanishing point of each region is labelled respectively.

4. LANE FEATURE EXTRACTION

The task is now to find a way to extract the lane features. Since the points on the lane will stay on the same line after interpolation, the simplest idea is to apply the 'logical and' operator to the original image edge map and to the interpolated image edge pixel by pixel. This means that if the interpolated edges overlap with the original image edges, these edges are likely to be belonging to the lanes. Furthermore, the orientation of the overlapping edges should be similar. The allowed direction difference is set to be between $0 \sim \pi/2 rads$ in order to tolerate curves, edge detection errors and the orientation change caused by severe shadows. However, unwanted edges have the potential to overlay and have similar orientation as well. In this case, an iterative zooming process is suggested. Based on experiments, 10 iterations of a gradually zooming process are normally sufficient to remove most of the noise even under very severe conditions.

During the interpolation stage, bilinear interpolation is chosen for its low complexity and satisfactory performance. The one dimensional bilinear interpolation between two points (x_0, y_0) and (x_1, y_1) is given by:

$$y = y_0 + \frac{(x-x_0)(y_1-y_0)}{x_1-x_0} \tag{11}$$

In the 2D cases, interpolation is first applied in x-direction then in y-direction.

Edge detection is performed after each interpolation process. The edge map is then compared with the edge map generated by previous iterations. Only the positions occupied by similarly orientated edges throughout the whole process are preserved. Specifically, if the orientation of $I(x,y)_{original}, I(x,y)_1, \ldots, I(x,y)_{iter}$ are similar, then

$$\begin{aligned} I(x,y)_{final} = I(x,y)_{original} \& I(x,y)_1 \& \\ I(x,y)_2 \& \ldots \& I(x,y)_{iter} \end{aligned} \tag{12}$$

Another possibility is to accumulate the overlapping edges and set a threshold to ensure the final edge positions are occupied most of the time.

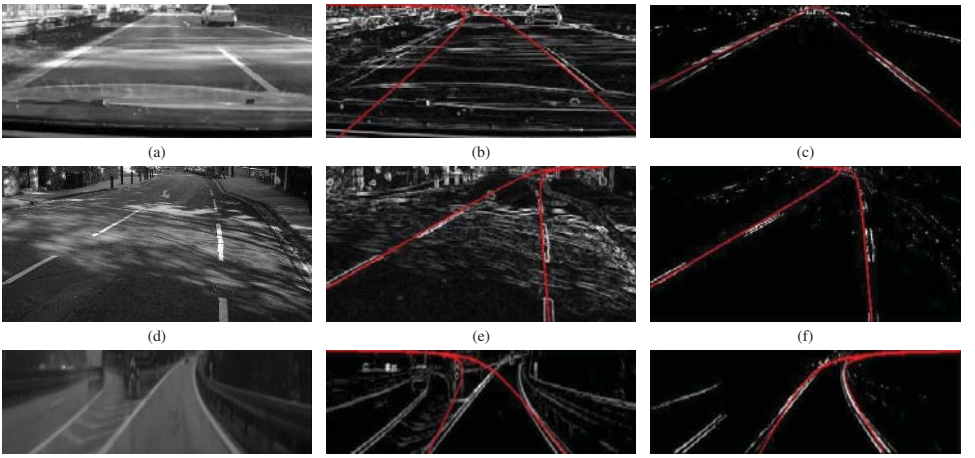


Figure 4: (a), (d) and (g): input images excluding the part above the vanishing line. (b), (e) and (h): detection results of (a), (d) and (g) respectively based on image gradient. (c), (f) and (i): detection results of (a), (d) and (g) respectively based on feature maps generated by the proposed algorithm.

The the zooming ratio, z, is also an important parameter. It is unreasonable to select a very small zooming area. This introduces large image distortion and also causes the system to remove a large number of lane features if the lanes are segmented lines. It has been found by experiment that the minimum degree of zooming should be round 85%. Consequently, a large zooming ratio is applied at each iteration (decremented from 100% to 85%) and only a very small portion of each segmented lane marking will be erased during the process. This allows the algorithm to deal with segmented or dashed lines.

For curved lanes, the vanishing point varies with distance. In this case, the zooming process is separated into different sections. Each section of the image zooms into the corresponding vanishing point. Also, the results of the edge detection on each section are compared separately.

Finally, most of the unwanted features are removed from the edge map and the remaining edges are marked to be '1's. In order to give each pixel a different weighting, the '1's are replaced by the corresponding gradient magnitudes. Furthermore, a weighted sum of the proposed feature map with the original gradient map produces a new feature map with magnified lane features. Some example feature extraction results are shown in Figure 4.

5. DETECTION

The detection of the lanes is implemented using the deformable template matching algorithm proposed in [1]. The lanes are modelled as two parallel parabolas as in the case of on the ground plane, and transformed to the image plane as:

$$x_L = \frac{s_1}{y - vpy} + s_2(y - vpy) + vpx \tag{13}$$

$$x_R = \frac{s_1}{y - vpy} + s_3(y - vpy) + vpx \tag{14}$$

where x_L and x_R are the x-coordinate of the left and right lane model. s_1, s_2 and s_3 are the three parameters need to be determined.

In contrast to LOISs method, by detecting the vanishing points, vpx becomes a known parameter. Specifically, it equals the vanishing point position of the lowest image band. The Metropolis algorithm [11] is applied to iteratively optimise the parameters and maximise the likelihood function.

6. EXPERIMENTAL RESULTS

In this section, we show the assessment of the proposed method. The algorithm (only feature extraction) is successfully implemented in real time on the TMS320DM6437 DSP platform from Texas Instruments. The system is able to achieve above 23 frames per second with a 352×240 video input. The frame rate could be further increased by optimising the code [12, 13]. It is worth noting that only the image gradient map is chosen here for comparison since the proposed algorithm only uses the gradient information during the entire process and could be easily extended to incorperate other features. Therefore, comparison between other types of feature maps is not relevant.

The test images included in this section are chosen from the most difficult scenes and from several video sequences. In Figure 4 (a) and (d), both scenes are affected heavily by shadows. A diverging lane scene is included in Figure 4 (g). The corresponding gradient maps are shown in Figure 4 (b), (e) and (h). All of these gradient maps contain a large number of unwanted feature points. Figure 4 (c), (f) and (i) show the feature map obtained using the proposed algorithm. Most of the unwanted features are removed. Comparing with the

gradient maps, the proposed feature maps are much cleaner while the lane features are well preserved.

The detection of the lanes is based on the metropolis algorithm, which does not guaranty to find the global maximum. The parameters update is based on a random selection process. In this case, the detection result varies even based the same feature map. The parameter settings during the detection stage are optimised for both feature maps.

The input images shown in Figure 4 are tested 200 times and the resultant parameters: s_1, s_2 and s_3 from Equation 13 and 14, are compared with the manually selected true parameters. The average absolute error for each of the parameters is calculated. As the required accuracies and dynamic ranges of s_1, s_2 and s_3 are different, the error ratio between the detection results based on different feature maps would be illustrative. Defining the parameter estimation error based on proposed feature map as $EP(s)$ and the parameter estimation error based on gradient map as $EG(s)$. The relationship between $EP(s)$ and $EG(s)$ could be represented as:

$$ER(s) = \frac{EP(s)}{EG(s)} \tag{15}$$

Table 1 shows the ER value corresponding to different parameters calculated from Figure 4 (a), (d) and (g) as well as the detection time ratio T_P/T_G.

	Figure 4(a)	Figure 4(d)	Figure 4(g)
$ER(s_1)$	0.11	0.36	1.06
$ER(s_2)$	0.27	0.99	0.41
$ER(s_3)$	0.38	0.27	0.19
T_P/T_G	0.19	0.18	0.56

Table 1: ER values corresponding to s_1, s_2 and s_3 and the Time ratio T_P/T_G calculated from Figure 4 (a), (d) and (g).

As Table 1 shows, the proposed feature map exhibits significant advantage over the traditional gradient map in extremely noisy environment. The detection processing time based on the proposed feature map is also massively reduced because much less feature points are included.

It is also important to note that sometimes the combination of the two feature maps gives better results since the proposed algorithm removes edges corresponding to very short segments of the lane markings. The weighted sum of the two feature maps (normally a larger weighting for the proposed feature map gives better performance) includes all the features and magnifies the ones that most likely to be belonging to the lanes.

7. CONCLUSION

In this paper, a novel lane feature extraction algorithm has been presented. This algorithm not only uses local information but also includes the global shape information of the lanes. This is achieved by simulating the vision of driving based on digital interpolation. Difficulties were encountered while extracting features from curved and segmented lane markings. However, the problems are solved by a multiple vanishing points detection algorithm and an iterative zooming process. The results of this algorithm show huge advantages over the traditional gradient maps but at the expense of an increased computational complexity (although it does significantly reduce the computational cost needed at the detection stage). Experiments showed that the feature map is very important for the detection stage. Removing unwanted features in noise environment helps the detection algorithm to locate the lane features quickly and the error rate has been reduced.

Our current work is focused on the inclusion of more features, such as texture and colour, in order to increase the performance and reduce the number of iterations needed for noise removal.

REFERENCES

[1] K. Kluge and S. Lakshmanan, "A deformable-template approach to lane detection," in *Proceedings of the Intelligent Vehicles '95 Symposium*, 1995, pp. 54–59.

[2] Steven M. Kay, *Fundamentals of Statistical Processing, Volume I: Estimation Theory*, Prentice Hall Signal Processing Series, 1993.

[3] C. Kreucher and S. Lakshmanan, "LANA: a lane extraction algorithm that uses frequency domain features," *Robotics and Automation, IEEE Transactions on*, vol. 15, pp. 343 – 350, 1995.

[4] Yue Wang, Eam Khwang Teoh, and Dinggang Shen, "Lane detection and tracking using B-snake," *Image and Vision Computing*, vol. 22, pp. 269–280, 2004.

[5] Jinyou Zhang and H.-H. Nagel, "Texture-based segmentation of road images," in *Proceedings of the Intelligent Vehicles '94 Symposium*, 1994, pp. 260–265.

[6] Qing Li, Nanning Zheng, and Hong Cheng, "SPRINGROBOT: A prototype autonomous vehicle and its algorithms for lane detection," *IEEE Transactions on Intelligent Transportation Systems*, vol. 5, pp. 300–308, 2004.

[7] Jong Woung Park, Joon Woong Lee, and Kyung Young Jhang, "A lane-curve detection based on an lcf," *Pattern Recognition Letters*, vol. 24, pp. 2301–2313, 2003.

[8] Dong-Joong Kang and Mun-Ho Jung, "Road lane segmentation using dynamic programming for active safety vehicles," *Pattern Recognition Letters*, vol. 24, pp. 3177–3185, July 2003.

[9] J.A. Shufelt, "Performance evaluation and analysis of vanishing point detection techniques," *Pattern Analysis and Machine Intelligence, IEEE*, vol. 21, pp. 282–288, Mar. 1999.

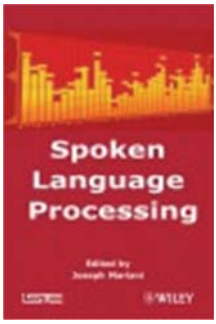
[10] Yue Wang, Dinggang Shen, and Eam Khwang Teoh, "Lane detection using spline model," *Pattern Recognition Letters*, vol. 21, pp. 677–689, 2000.

[11] I. Beichl and F. Sullivan, "The Metropolis algorithm," *Computing in Science and Engg*, vol. 2, pp. 65–69, 2000.

[12] Naim Dahnoun, *Digital Signal Processing Implementation: using the TMS320C6000 processors*, Prentice Hall PTR, 2000.

[13] Naim Dahnoun, *C6000 DSP teaching ROM*, Texas Instruments, 2nd edition.

Spoken Language Processing



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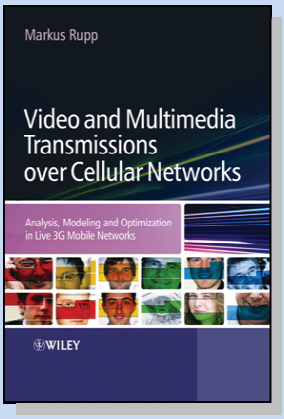

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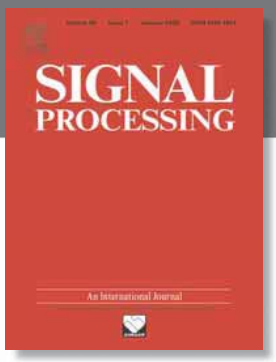

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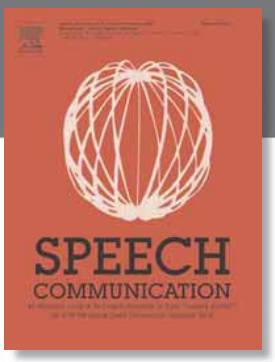

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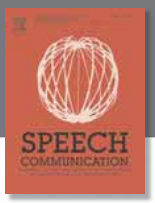

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Special Issue on
Robust Processing of Nonstationary Signals

CALL FOR PAPERS

Techniques for processing signals corrupted by non-Gaussian noise are referred to as the robust techniques. They are established and used in science in the past 40 years. The principles of robust statistics have found fruitful applications in numerous signal processing disciplines especially in digital image processing and signal processing for communications. Median, myriad, meridian, L filters (with their modifications), and signal-adaptive realizations form a powerful toolbox for diverse applications. All of these filters have lowpass characteristic. This characteristic limits their application in analysis of diverse nonstationary signals where impulse, heavy-tailed, or other forms of the non-Gaussian noise can appear: FM, radar and speech signal processing, and so forth. Recent research activities and studies have shown that combination of nonstationary signals and non-Gaussian noise can be observed in some novel emerging applications such as internet traffic monitoring and digital video coding.

Several techniques have been recently proposed for handling the signal filtering, parametric/nonparametric estimation, feature extraction of nonstationary and signals with high-frequency content corrupted by non-Gaussian noise. One approach is based on filtering in the time-domain. Here, the standard median/myriad forms are modified in such a manner to allow negative- and complex-valued weights. This group of techniques is able to produce all filtering characteristics: highpass, stopband, and bandpass. As an alternative, the robust filtering techniques are proposed in spectral (frequency- Fourier, DCT, wavelet, or in the time-frequency) domain. The idea is to determine robust transforms having the ability to eliminate or surpass influence of non-Gaussian noise. Then filtering, parameter estimation, and/or feature extraction is performed using the standard means. Other alternatives are based on the standard approaches (optimization, iterative, ML strategies) modified for nonstationary signals or signals with high-frequency content.

Since these techniques are increasingly popular, the goal of this special issue is to review and compare them, propose new techniques, study novel application fields, and consider their implementations.

Topics of interest include, but are not limited to:

- Robust statistical signal processing (estimation, detection, decisions)
- Robust tracking, classification and control
- Performance analysis, comparison, benchmark setting, and achievable bounds

- Robust parametric/non-parametric estimation, filtering, and feature extraction of nonstationary signals
- Robust learning and adaptive robust techniques
- Fast software and hardware realizations
- Applications

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Special Issue on

Signal Processing in Advanced Nondestructive Materials Inspection

CALL FOR PAPERS

Nondestructive testing (NDT) is a noninvasive technique widely used in industry to detect, size, and evaluate different types of defects in materials, and it plays an important role whenever integrity and safe operation of engineered components and structures are concerned. Efficient and reliable nondestructive evaluation techniques are necessary to ensure the safe operation of complex parts and construction in an industrial environment for assessing service life, acceptability, and risk, as well as for reducing or even eliminating human error, thus rendering the inspection process automated, more reliable, reproducible, and faster. Examples of widely used conventional nondestructive techniques are ultrasonics, radiography, computed tomography, infrared thermography, and electromagnetic-based techniques.

As nondestructive testing is not a direct measurement method, the nature and size of defects must be obtained through analysis of the signals obtained from inspection. Signal processing has provided powerful techniques to extract information on material characterization, size, defect detection, and so on. For instance, in the case of images, the major processing and analysis methods include image restoration and enhancement, morphological operators, wavelet transforms, image segmentation, as well as object and pattern recognition, facilitating extraction of special information from the original images, which would not, otherwise, be available. Additionally, 3D image processing can provide further information if an image sequence is available.

Nowadays, techniques of nondestructive testing have evolved greatly due to recent advances in microelectronics and signal processing and analysis. For example, many image processing and analysis techniques can now be readily applied at standard video rates using commercially available hardware, in particular, to methods that generate TV-type image sequences, such as real-time radiography, pulse-video thermography, ultrasonic-phased array, laser ultrasonics, and shearography.

The main objective of this special issue of "Signal processing in nondestructive materials inspection" is to promote a comprehensive forum for discussion on the recent advances in signal processing techniques applied to nondestructive material inspection.

Topics of interest include, but are not limited to:

- Signal processing and analysis in advanced NDT
- Image processing and analysis in advanced NDT
- Materials characterization using advanced NDT
- Defect detection and characterization using advanced NDT
- Pattern recognition and classification for advanced NDT
- 3D image reconstruction from advanced NDT data
- Applications of advanced NDT
- Algorithms development for signal processing and analysis in advanced NDT
- Software development for defect detection and characterization in NDT images

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Special Issue on

Applications of Time-Frequency Signal Processing in Wireless Communications and Bioengineering

CALL FOR PAPERS

Time-frequency signal processing is a well-established area with applications ranging from bioengineering and wireless communications to earthquake engineering and machine monitoring. Signals in these applications are typically nonstationary and as such require joint time-frequency analysis. The objective of this special issue is to bring together theoretical results and application of time-frequency methodologies from investigators in the wireless communications and bioengineering disciplines.

While novel theoretical results and applications of time-frequency signal processing in wireless communications and biomedical systems will be preferred, applications in other areas will also be considered. Likewise, this issue will emphasize methodologies related to Priestley's evolutionary spectrum and the fractional Fourier transform, but other methodologies will also be considered.

The intended focus of this issue will be on presenting time-frequency signal processing applications to wireless communications and biomedical systems using evolutionary spectral techniques and fractional Fourier transform.

Topics of interest include, but are not limited to:

- Biomedical systems: EEG, ECG waveforms and heart sound, vibroartrographic signals emitted by human knee joints, EEG signals, and various other biomedical waveforms analyzed by time-frequency techniques
- Wireless communications: time-frequency receivers, channel characterization, channel diversity, time-varying modulation schemes, and suppressing nonstationary interference as chirp jammers

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Special Issue on Genomic Signal Processing

CALL FOR PAPERS

Genomic signal processing is the engineering discipline that studies modeling and statistical issues related to biological signals obtained from high-throughput measurement technology. Applications of genomic signal processing typically involve the discovery of molecular biomarkers for disease diagnosis and prognosis, the inference of gene and protein regulatory networks, the study of new algorithms for managing and processing large volumes of sequence information, and more. This special issue intends to be an international forum for the diffusion of the latest results and ideas in the field. We invite authors to contribute research articles on methods of statistical signal processing, pattern recognition, machine learning, statistical and probabilistic modeling, and related fields, in the context of applications that include, but are not limited to:

- Discovery of molecular signatures and biomarkers
- Gene and protein sequence analysis
- Deep-sequencing data analysis
- Functional genomics
- Phylogenetic analysis
- Modeling and analysis of microarray and mass spectrometry data
- Integrated analysis of diverse high-throughput data
- Denoising and compression of genomic data
- Regulatory network modeling, simulation, and inference
- Pathway identification and analysis

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Special Issue on

Time-Frequency Analysis and Its Applications to Multimedia Signals

CALL FOR PAPERS

Time-frequency analysis has been intensively investigated and developed in the last two decades. The time-frequency distributions have found fruitful applications in numerous fields dealing with nonstationary signals, such as biomedical, radar as well as seismic and mechanical signals. Also, numerous applications are related with multimedia signals in speech, audio/music, as well as image and video signal processing. Having the different dimensionality of these signals in mind, time-frequency analysis for one-, two-, and three-dimensional signal should be used.

The fact that there is no time-frequency distribution that can be used for efficient representations of all kinds of nonstationary signals makes the theoretical considerations still challenging. For signals of high instantaneous frequency variation, complicated time-frequency distributions should be used. Moreover, improved forms of time-frequency distributions will further expand and diversify their applicability.

This special issue should benefit readers to understand how the time-frequency distributions could be used for the analysis of multimedia signals, with the consideration of the specific nature, complexity, and multidimensionality of these signals. Also, it aims to examine and highlight the appropriateness of some specific distributions for different applications, as well as to propose new methods and approaches together with their applications. In addition to original research articles, we are open to review articles as well. Topics of interest include, but are not limited to:

- Time frequency analysis of digital audio signals
- Time-varying filtering of digital audio signals
- Time-frequency-based compression of digital audio signals
- Two-dimensional time-frequency analysis of Images
- Space-varying filtering and compression based on two dimensional time-frequency analysis
- Time-frequency analysis of video signals
- Time-frequency-based digital watermarking
- Time-frequency-based motion parameters estimation in video sequences

- Time-frequency approaches in human-computer interaction
- New trends and theoretical developments in time-frequency analysis

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Special Issue on Digital Audio Effects

CALL FOR PAPERS

Digital audio effects usually refer to processing solutions that are aimed at generating, enhancing, processing, and rendering sounds in a wide range of multimedia applications.

In the past few years, the range of research topics that fall within digital audio effects has broadened to accommodate new topics and applications, from space-time processing, to human-machine interaction. All the technologies and the research topics that are behind such topics are today addressed by the International Digital Audio Effects Conference (DAFx), which has become a reference gathering for researchers working in the audio field.

This special issue is devoted to new research developments and trends aimed at going beyond the well-established low-level sound processing and promoting novel emerging solutions based on high-level processing, content-based processing, environment-aware processing, and user-aware processing.

The aim of this special issue is to present the latest research efforts in the above areas, promote emerging applications, stimulate new fields of investigation, and capture emerging research trends.

Topics of interest include, but are not limited to:

- Audio Effects
- Virtual musical instruments and virtual analog models
- Sound representation, generation, and modeling
- Time-frequency and spectral processing
- Space-time audio processing
- Synthesis, reproduction, and perception of spatial sound
- Perception, cognition, and psychoacoustics
- Audio-based music classification and retrieval
- Automatic transcription and high-level features
- Compositional issues, sound design, and sonic interaction design
- Software and hardware implementations
- Networked audio and audio in mobile applications

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Special Issue on

Recent Advances in Theory and Methods for Nonstationary Signal Analysis

CALL FOR PAPERS

All physical processes are nonstationary. When analyzing time series, it is well to remember that nature can be amazingly complexed and that many of the theoretical constructs used in stochastic process theory, for example, linearity, ergodicity, normality, and particularly stationarity, are mathematical fairy tales. For example, there are, by virtue of the "big bang" if nothing else, no stationary time series in the strict mathematical sense. Thus, while it is necessary to know the theory of stationary processes, one should not adhere to it dogmatically when analyzing data from physical sources, particularly when the observations span an extended period. Nonstationary signals are appropriate models for signals arising in several fields of applications including communications, speech and audio, mechanics, geophysics, climatology, solar and space physics, optics, and biomedical engineering. Nonstationary models account for possible time variations of statistical functions and/or spectral characteristics of signals. Thus, they provide analysis tools more general than the classical Fourier transform for finite-energy signals or the power spectrum for finite-power stationary signals.

Nonstationarity, being a "nonproperty", has been analyzed from several different points of view. Several approaches that generalize the classical Fourier transform analysis have been considered, including time-frequency, time-scale, as well as wavelets analysis, fractional Fourier transform, and linear canonical transform analysis. Approaches that generalize the power-spectrum analysis include cyclostationary signal analysis, self-similar signal analysis, multitaper spectral estimation, and evolutionary spectral analysis. In addition, techniques such as adaptive system and signal analysis, empirical mode decomposition, and other data-driven methods have been used with the purpose of modeling nonstationary phenomena. The aim of this special issue is to address recent advances in the theory and methodology for nonstationary signal analysis, compare different approaches, propose emerging or new techniques, and explore new application fields. Overviews, theoretical results, and applications contributions are welcome. Topics of interest include, but are not limited to, the following:

- Time-frequency and time-scale analysis
- Wavelets analysis

- Multitaper spectral estimation
- Fractional Fourier transform and linear canonical transform analysis
- Cyclostationary signal analysis
- Self-similar signal analysis
- Evolutionary spectral analysis
- Adaptive system and signal analysis
- Empirical mode decomposition and other data-driven methods

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Special Issue on

Computational Approaches to Assist Disease Mechanism Discovery

CALL FOR PAPERS

Rapidly advanced biotechnology has created a number of "omics" such as genomics, transcriptomics, proteomics, and epigenomics. This massive biological data provides new perspectives on disease study. Many computational algorithms have been proposed and implemented to extract information from diverse data resources in order to characterize human diseases and develop treatment strategies. However, most of the proposed methodologies have still not achieved the sensitivity and specificity to be effectively used.

The main focus of this Special Issue will be on the study of diseases through computational approaches. How to integrate large-scale biological data and clinical data to understand disease physiology and pathology, and to advance disease diagnosis and treatment? We invite authors to present original research articles as well as review articles that will stimulate the continuing efforts in computational study of disease mechanisms. Potential topics include, but are not limited to:

- Machine learning application in disease data analysis
- Pattern recognition in disease data
- Methods to identify disease genes and pathways
- System approaches to discover drug target or diagnostic biomarker
- SNP, protein structure, and diseases
- Phenome-Genome integrative approach for disease study

Besides, only papers with strong validation methodology will be selected. In addition, papers where the methods have been demonstrated in the clinic to deliver a diagnostic, prognostic, or therapeutic choice of value will be preferred. Before submission authors should carefully read over the journal's Author Guidelines, which are located at http://www.hindawi.com/journals/bsb/guidelines.html. Prospective authors should submit an electronic copy of their complete manuscript through the journal Manuscript Tracking System at http:// mts.hindawi.com/ according to the following timetable:

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Special Issue on
Real-World Challenges for Biometrics

CALL FOR PAPERS

Identification of persons through biometric data has emerged as a convenient solution for secured access to restricted data as well as physical or virtual areas. Despite its clear advantages over password or token-based security, the strong inherent link of biometric data to its owner raises new social concerns on privacy and personal data vulnerability. Moreover, and contrarily to passwords and tokens, the intraclass variability of the biometric sample challenges researchers to find robust methods for extracting, processing, coding, transmitting, or storing this piece of personal information. There exist a plethora of biometric systems deployed around the world, most of them requiring collaborative procedures by the user for biometric data acquisition. Recently, the proliferation of surveillance devices has directed the research interest for unobtrusive or unperceived identification systems, denoted as remote biometrics or biometrics at a distance. Also, the advances on audiovisual biometric recognition allow automatic indexing and retrieval in multimedia streams, without any collaboration of the person being targeted. All these scenarios increase both the concerns on security and handling of these personal data. In this way, there remain several avenues of research to be pursued whose outcome will enable biometric methods, collaborative or not, more widespread and rapid acceptance of this technology.

The goal of this special issue is to bring together research work on techniques that aim for a more effective deployment of biometric systems, ranging from security access (high user cooperation) to seamless tracking of identities (null collaboration). We seek submissions presenting novel research and field experiments on topics which include:

- Challenges on privacy, authenticity, and integrity of biometric data:
  - Biometric template encryption, error correcting and coding approaches, cancelable biometrics, biometric cryptosystems
  - Biometric attacks, aliveness detection
  - Biometric data hiding: watermarking and steganography
  - Identity theft, identity management
  - Smart cards, Biometric ID-cards
  - Match-on-chip, match-on-device
  - Biometric tracing, RFID
  - Ethical and legal issues
- Challenges on biometric data handling:

- Quality measures, multimodality
- Aging effects, updating of templates
- Remote biometrics, behavioral analysis
- Interoperability, standardization, and usability
- Biometrics through internet

Before submission authors should carefully read over the journal's Author Guidelines, which are located at http://www.hindawi.com/journals/is/guidelines.html. Prospective authors should submit an electronic copy of their complete manuscript through the journal Manuscript Tracking System at http://mts.hindawi.com/ according to the following timetable:

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Special Issue on

Remote and Proximal Sensing of the Environment for the Detection and Monitoring of Natural Risks

CALL FOR PAPERS

Natural phenomena such as storms, tsunamis, floods, fires, and volcanic eruptions occur frequently. They often result in significant human and economic costs. Land degradation and desertification, although less violent and evident over a longer timescale, represent a natural risk in many countries of the world.

Extensive research is carried out to understand, monitor, manage, and prevent naturally occurring dangers. The contributing areas of research are diverse, requiring both strong individual and multidisciplinary skills in collaboration. It is clear, however, that, in addressing this challenge, the image and video processing discipline makes a very significant contribution.

Natural risks are unpredictable, dangerous, and may be widespread. It is often not straightforward, cost-effective, or accurate to use metrological sensors in the ground, for example, to study and track their global evolution. The use of image data is a powerful way to do this: imaging technology enables the phenomena to be observed continuously, safely, and economically without the use of expensive equipment for a single purpose. High-resolution, multispectral, and remote/proximal sensing can be achieved with standard imaging technologies. Once the image/video data is acquired, research into image/video processing is subsequently necessary to obtain useful and timely information about the nature of the risk arising from the natural phenomena drawing on a range of techniques in a well-established and productive field of research.

This special issue invites original, high-quality research articles which address the problem of natural risks and develop or apply advanced image and video processing techniques to detect, monitor, or predict their occurrence.

Topics of interest include, but are not limited to the use of satellite, multispectral, radar, and stereo images combined with image/video processing for the study of natural risks which may include:

- Tsunami
- Flooding
- Fire
- Storm

- Volcanic eruption
- Ocean and sea pollution
- Desertification
- Deforestation
- Glacier elevation changes
- Avalanche
- Monitoring of the Ozone layer

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Special Issue on

Emerging Methods for Color Image and Video Quality Enhancement

CALL FOR PAPERS

Digital color imaging devices, ranging from the low-end camera phones to the high-end digital cinema cameras, are ubiquitous in the current e-world. The image/video quality, including the color fidelity, resolution, signal-to-noise ratio, and sharpness, is among the most common concerns of the consumers. Therefore, how to improve the quality of digital images/videos is an important topic in both academia and industry. In the recent years, many new image processing techniques, such as nonlocal means, collaborative filtering, sparse coding, and dictionary learning, have been proposed. These techniques can provide new solutions to the resolution and quality enhancement of color images and videos.

The main focus of this special issue will be on the recent advances in theory and algorithm for color image and video quality enhancement. We welcome authors to submit their original research articles or comprehensive reviews in the related areas. This special issue is expected to be an effective channel for researches to report their latest results and findings in color image and video processing and propose new ideas and directions for the future development. The topics include, but are not limited to:

- Nonlocal techniques in color image/video processing
- Sparse coding and dictionary learning for color image/video processing
- Inpainting, interpolation, and superresolution
- Multiframe acquisition and merging
- Image sequence processing and video stabilization
- Color demosaicking and temporal color demosaicking
- Color cross-talk reduction
- Color enhancement by semantic analysis of scene content
- Color processing and enhancement for embedded systems
- Bioinspired color image/video processing methods
- Full-reference, reduced-reference, and no-reference color image/video quality assessment

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Special Issue on

Physical Layer Network Coding for Wireless Cooperative Networks

CALL FOR PAPERS

Cooperative communication is an overwhelming research topic in wireless networks. The notion of cooperative communication is to enable transmit and receive cooperation at user level by exploiting the broadcast nature of wireless radio waves so that the overall system performance including power efficiency and communication reliability can be improved. However, due to the half-duplex constraint in practical systems, cooperative communication suffers from loss in spectral efficiency. Network coding has recently demonstrated significant potential for improving network throughput. Its principle is to allow an intermediate network node to mix the data received from multiple links for subsequent transmission. Applying the principle of network coding to wireless cooperative networks for spectral efficiency improvement has recently received tremendous attention from the research community. *Physical-layer network coding* (PLNC) is now known as a set of signal processing techniques combining channel coding, signal detection, and network coding in various relay-based communication scenarios, such as two-way communication, multiple access, multicasting, and broadcasting. To better exploit this new technique and promote its applications, many technical issues remain to be studied, varying from fundamental performance limits to practical implementation aspects. The aim of this special issue is to consolidate the latest research advances in physical-layer network coding in wireless cooperative networks. We are seeking new and original contributions addressing various aspects of PLNC. Topics of interest include, but not limited to:

- Fundamental limits of relay channels with PLNC
- Protocol design and analysis for PLNC
- Cross-layer design for systems with PLNC
- Joint channel coding, modulation, and PLNC
- PLNC with Turbo/LDPC codes
- PLNC with fountain codes
- Channel estimation and synchronization of PLNC
- Scheduling and resource allocation with PLNC
- PLNC with MIMO and OFDM

- PLNC in cooperative and cognitive networks
- Implementation aspects of PLNC
- Random network coding
- Other issues related to PLNC

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Manuscript Due	January 1, 2010
First Round of Reviews	April 1, 2010
Publication Date	July 1, 2010

Lead Guest Editor:

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Special Issue on

Adaptive Cross-Layer Strategies for Fourth Generation Wireless Communications

CALL FOR PAPERS

Adaptive transmission and resource allocation techniques are widely studied and employed for optimization of wireless networks. Among such strategies, adaptive coding and modulation (AMC) in Physical layer, dynamic scheduling in MAC layer, and variable source rate setting in application layer can be named. More recently, cross-layer methodologies are being considered for the fourth generation wireless systems, as joint optimizing the system parameters and adaptation strategies across the open system interconnection (OSI) layers can provide efficient tradeoffs in service quality and outage, implementation complexity, and spectral efficiency within wireless communication networks.

Authors are invited to present their original research or review articles on various aspects of multilayer adaptive techniques which can potentially enhance quality of service and capacity of future wireless communication networks. Particular interest will be on, but not restricted to, theoretical models for cross-layer design, and QoS-based adaptation techniques, with focus on IP applications.

Topics of interest include, but are not limited to:

- Mathematical modeling for cross-layer design
- Analytical and Simulation results for cross-layer approaches in LTE and WiMAX
- Adaptive cross-layer methods for IP applications
- Application-aware and TCP-aware link-layer adaptation
- Complexity analysis of multilayer adaptive transmission techniques
- Optimization techniques for cross-layer resource allocation in wireless communication systems

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Manuscript Due	January 15, 2010
First Round of Reviews	April 15, 2010
Publication Date	July 15, 2010

Lead Guest Editor:

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Special Issue on

Signal Processing-Assisted Protocols and Algorithms for Cooperating Objects and Wireless Sensor Networks

CALL FOR PAPERS

With the advent of the so-called Internet of Things (IoTs), we will witness an unprecedented growth in the number of networked terminals and devices. In attaining this IoT vision, a class of energy- and, in general, resource-constrained systems like Wireless Sensor Networks (WSNs), networks of cooperating objects and embedded devices such as RFIDs, or networks for Device-to-Device (D2D) and Machine-to-Machine (M2M) communications are to play a fundamental role. The paradigm shift from general-purpose data networks to application-oriented networks (e.g., for parameter or random field estimation, event detection, localization, and tracking) clearly calls for further optimization at the physical, link, and network layers of the protocol stack. Interestingly, the above-mentioned estimation/detection/localization/tracking problems have been addressed for years by the signal processing community, this resulting into a number of well-known algorithms. Besides, some inspiration could be also borrowed from other communication schemes, such as MIMO and beamforming techniques or cooperative communications that were traditionally developed for wireless data networks, or even from other fields such as mathematical biology (e.g., networks of coupled oscillators). However, the challenge now is to enhance such algorithms and schemes and make them suitable for decentralized and resource-constrained operation in networks with a potentially high number of nodes. Complementarily, the vast literature produced by the information theory community, on the one hand, reveals the theoretical performance limits of decentralized processing (e.g., distributed source coding) and, on the other, offers insight on the scalability properties of such large networks and their behavior in the asymptotic regime. Realizing the information-theoretic performance with practical decentralized networking, radio resource management schemes, routing protocols, and other network management paradigms is a key challenge.

The objective of this Special Issue (whose preparation is carried out under the auspices of the EC Network of Excellence in Wireless Communications NEWCOM++) is to gather recent advances in the areas of cooperating objects, embedded devices, and wireless sensor networks. The focus is on how the design of future physical, link, and network layers could

benefit from a signal processing-oriented approach. Specific topics for this Special Issue include but are not limited to:

- Decentralized parameter estimation
- Estimation of random fields
- Distributed MIMO and beamforming
- Decentralized and cooperative time and frequency synchronization
- Cooperative event detection
- Data gathering and data fusion
- Data-centric multihop techniques and routing
- Scalability and asymptotic laws for in-network distributed estimation/detection
- Energy-saving algorithms and protocols
- Feedback-limited scheduling and MAC protocols
- Decentralized joint source-channel coding
- Cooperative localization and tracking
- Topology control in resource-constrained networks
- Low-complexity opportunistic networking protocols

Before submission, authors should carefully read over the journal's Author Guidelines, which are located at http://www.hindawi.com/journals/wcn/guidelines.html. Prospective authors should submit an electronic copy of their complete manuscript through the journal Manuscript Tracking System at http://mts.hindawi.com/ according to the following timetable:

Manuscript Due	February 1, 2010
First Round of Reviews	May 1, 2010
Publication Date	August 1, 2010

Lead Guest Editor:

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Special Issue on

Design, Implementation, and Evaluation of Wireless Sensor Network Systems

CALL FOR PAPERS

The recent advances in embedded software/hardware design have enabled large-scale and cost-effective deployment of Wireless Sensor Networks (WSNs). Such a network consists of many small sensor nodes with sensing, control, data processing, communications, and networking capabilities. The wireless sensor networks have a broad spectrum applications ranging from wild life monitoring and battlefield surveillance to border control and disaster relief, and have attracted significant interests from both academy and industry.

A wireless sensor node generally has limited storage and computation capabilities, as well as severely constrained power supplies, and the networks often operate in harsh unattended environments. Successful design and deployment of wireless sensor networks thus call for technology advances and integrations in diverse fields including embedded hardware manufacturing and signal processing as well as wireless communications and networking across all layers. We have seen the initial and incremental deployment of real sensor networks in the past decade, for example, the ZebraNet for wildlife tracking, the CitySense for weather and air pollutants reporting, and the Sensormap portal for generic monitoring services, to name but a few; yet the full potentials of such networks in the real world remain to be explored and demonstrated, which involves numerous practical challenges in diverse aspects.

This special issue aims to summarize the latest development in the design, implementation, and evaluation of wireless sensor systems. Topics of interest include but are not limited to:

- Practical architecture and protocol design for sensor communications and networking
- Management, monitoring, and diagnosis of sensor networks
- Implementation and measurement of experimental systems and testbeds
- Experience with real-world deployments of wireless sensor networks
- Interactions with ubiquitous communication and networking infrastructures
- Novel killer applications of wireless sensor networks

We solicit original unpublished research papers only. Papers previously published in conference/workshop proceedings can be considered, but should be substantially extended.

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Manuscript Due	February 15, 2010
First Round of Reviews	May 15, 2010
Publication Date	August 15, 2010

Lead Guest Editor:

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Special Issue on

Multimedia Communications over Next Generation Wireless Networks

CALL FOR PAPERS

Here the special issue "Multimedia Communications over Next Generation Wireless Networks (NGWNs)" is an area of tremendous industrial as well as academic activities at present. Simply stated, an NGWN is a packet-based wireless network that offers access over diverse connected technologies by users from diverse service providers. Recent advances in communication technologies have witnessed a growing and evolving multimedia-content-delivery market based on information gathering, manipulation, and dissemination. Unlike traditional Internet based on communication systems, a fundamental challenge for NGWN is the ability to transport multimedia content over a variety of networks at different channel conditions and bandwidth capacities with various requirements of quality-of-service. There are many issues such as signal processing, collaborations, power management, flexible delivery, specialization of new content, dynamic access, telecommunications, networking, and so forth, resulting from the multidisciplinary nature of the applications in advanced multimedia communications.

The goal of this special issue is to bring together the state-of-the-art research contributions, which describe original and unpublished work to address the new emerging techniques on multimedia communications over NGWN. Topics of primary interest include, but are not limited to:

- Communications issues for multimedia over NGWN
  - Multimedia communications in new emerging networks (e.g., heterogeneous networks, relay networks, cognitive networks, LTE-Advanced)
  - System architectures and framework
  - Collaborative in-network processing
  - Cross-layer design for multimedia communications
  - Resource allocation and system scheduling
  - Multimedia security
- Signal processing issues for multimedia over NGWN
  - Distributed coding and joint source-channel coding
  - Network coding for multimedia over NGWN
  - Error resilience and concealment
  - Information restoration and resolution-improvement

- Sync and timing recovery
- New emerging multimedia applications over NGWN
  - IPTV, 3DTV, and mobile TV-related efforts
  - Enabling multimedia capability in E-healthcare, E-education, smart house, and so forth
  - Video surveillance system in wireless senor networks

We solicit original unpublished research papers only. Papers previously published in conference/workshop proceedings can be considered, but should be substantially extended.

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Manuscript Due	March 1, 2010
First Round of Reviews	June 1, 2010
Publication Date	September 1, 2010

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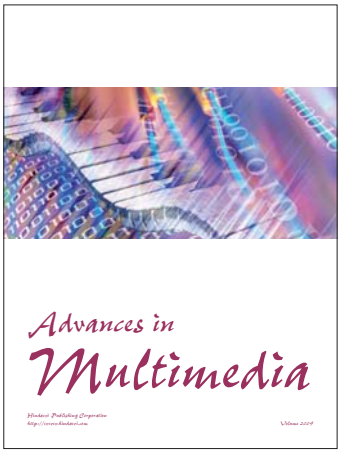
Advances in Multimedia

http://www.hindawi.com/journals/am/

Aims and Scope

Advances in Multimedia is aimed at presenting comprehensive coverage of the field of multimedia. The journal covers research and developments in multimedia technology and applications, including compression, storage, networking, communication, retrieval, algorithms, architectures, software design, circuits, multimedia signal processing, and multimodality devices and systems. Types of multimedia signals involved include audio, speech, video, image, graphics, geophysical, musical, sonar, radar, and medical signals.



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International Editorial Board

The journal has a distinguished Editorial Board with extensive academic qualifications, which ensures that the journal maintains high scientific standards and has broad international coverage.

Hindawi

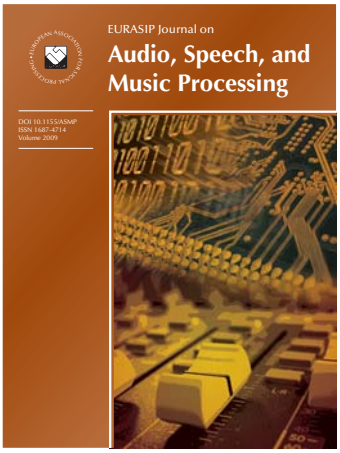
EURASIP Journal on

Audio, Speech, and Music Processing

http://www.hindawi.com/journals/asmp/

Aims and Scope

EURASIP Journal on Audio, Speech, and Music Processing is a peer-reviewed, open access journal, which aims at bringing together researchers, scientists, and engineers working on the theory and applications of the processing of various audio signals, with a specific focus on speech and music.



The journal is dedicated to original research work, but also allows tutorial and review articles. Articles deal with both theoretical and practical aspects of audio, speech, and music processing.

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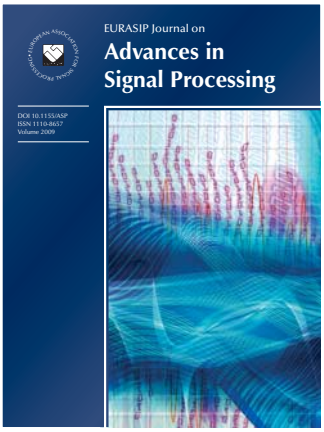
EURASIP Journal on Advances in Signal Processing

http://www.hindawi.com/journals/asp/

Aims and Scope

The aim of the EURASIP Journal on Advances in Signal Processing is to highlight the theoretical and practical aspects of signal processing in new and emerging technologies. Application areas include (but are not limited to) communications, networking, sensors and actuators, radar and sonar, medical imaging, biomedical applications, remote sensing, consumer electronics, computer vision, pattern recognition, robotics, fiber optic sensing/transducers, industrial automation, transportation, stock market and financial analysis, seismography, and avionics.



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In order to provide the maximum exposure for all published articles, the EURASIP Journal on Advances in Signal Processing is covered by many leading abstracting and indexing databases.

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EURASIP Journal on Bioinformatics and Systems Biology

http://www.hindawi.com/journals/bsb/

Aims and Scope

The overall aim of EURASIP Journal on Bioinformatics and Systems Biology is to publish research results related to signal processing and bioinformatics theories and techniques relevant to a wide area of applications into the core new disciplines of genomics, proteomics, and systems biology.

The journal is intended to offer a common platform for scientists from several areas including signal processing, bioinformatics, statistics, biology, and medicine, who are interested in the development of algorithmic, mathematical, statistical, modeling, simulation, data mining, and computational techniques, as demanded by various applications in genomics, proteomics, system biology, and more general in health and medicine.

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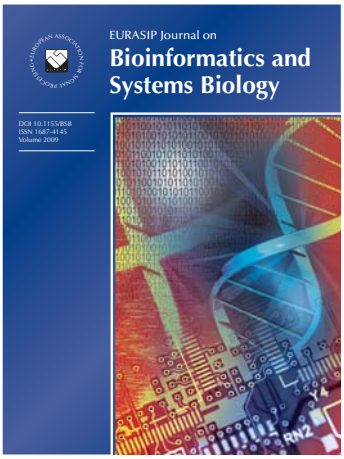

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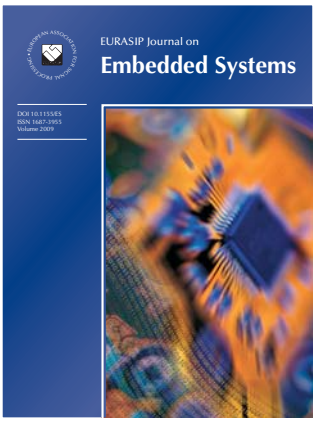
EURASIP Journal on Embedded Systems

http://www.hindawi.com/journals/es/

Aims and Scope

EURASIP Journal on Embedded Systems is a peer-reviewed open access journal that serves the large community of researchers and professional engineers who deal with the theory and practice of embedded systems, including complex homogeneous and heterogeneous embedded systems, specification languages and tools for embedded systems, modeling and verification techniques, hardware/software tradeoffs and codesign, new design flows, design methodologies and synthesis methods, platform-based design, component-based design, adaptation of signal processing algorithms to limited implementation resources, rapid prototyping, computing structures and architectures for complex embedded systems, real-time operating systems, methods and techniques for the design of low-power systems, interfacing with the real world, and novel application case studies and experiences.



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EURASIP Journal on Image and Video Processing

http://www.hindawi.com/journals/ivp/

Aims and Scope

EURASIP Journal on Image and Video Processing is a peer-reviewed, open access journal, intended for researchers from both academia and industry, who are active in the multidisciplinary field of image and video processing. The scope of the journal covers all theoretical and practical aspects of the domain, from basic research to the development of applications.

Contributed articles on image and video processing may be focused on specific techniques, on diverse functionalities and services, within the context of various activity sectors (e.g., multimedia, medical, aerial, robotics, security, communications, arts), or on employing diverse data formats.

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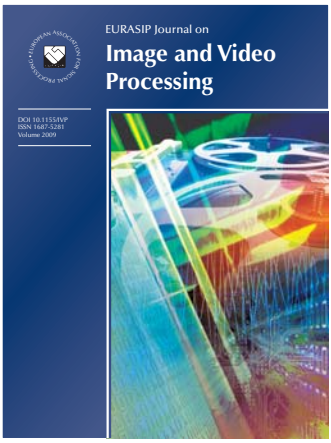

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EURASIP Journal on

Wireless Communications and Networking

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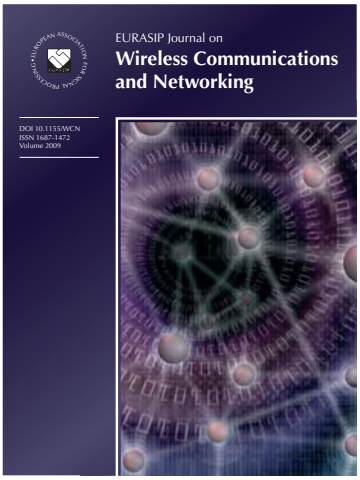
Aims and Scope

The overall aim of the EURASIP Journal on Wireless Communications and Networking is to bring together science and applications of wireless communications and networking technologies, with emphasis on signal processing techniques and tools. Subject areas include antenna systems and design, channel modeling and propagation, coding for wireless systems, multiuser and multiple access schemes, optical wireless communications, resource allocation over wireless networks, security, authentication, and cryptography for wireless networks, signal processing techniques and tools, software and cognitive radio, wireless traffic and routing, ultra-wideband systems, vehicular networks, wireless multimedia communication, wireless sensor networks, and wireless system architectures and applications.



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Computational Intelligence & Neuroscience

http://www.hindawi.com/journals/cin/

Aims and Scope

Computational Intelligence and Neuroscience is a forum for the publication of research in the interdisciplinary field of neural computing, neural engineering, and artificial intelligence, where neuroscientists, cognitive scientists, engineers, psychologists, physicists, computer scientists, and artificial intelligence investigators among others can publish their work in one periodical that bridges the gap between neuroscience, artificial intelligence, and engineering. The journal provides research and review papers at an interdisciplinary level, with the field of intelligent systems for computational neuroscience as its focus.

Manuscript Submission

Manuscripts are invited and should be submitted by one of the authors of the manuscript through the online Manuscript Tracking System located at http://mts.hindawi.com.

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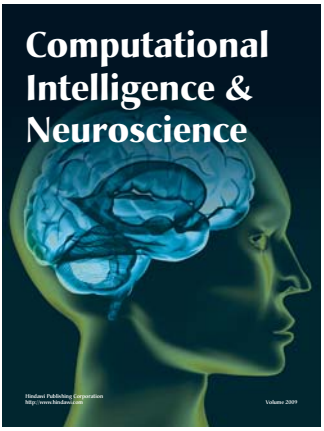

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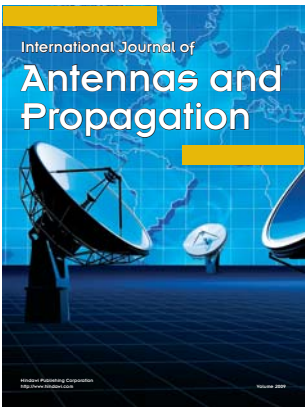
International Editorial Board

The journal has a distinguished Editorial Board with extensive academic qualifications, which ensures that the journal maintains high scientific standards and has broad international coverage.

Hindawi

International Journal of Antennas and Propagation

http://www.hindawi.com/journals/ijap/



Aims and Scope

The overall aim of the International Journal of Antennas and Propagation is to explore emerging concepts and applications in antennas and propagation. The journal focuses on the physical link from antenna to antenna including antenna hardware and associated electronics, the nature and impact of propagation channels and measurement, prediction, and simulation methods for evaluating or designing antennas or the channel. The journal is directed at both practicing engineers and academic researchers and will highlight new ideas and challenges in antennas and propagation for both application development and basic research.

Manuscript Submission

Manuscripts are invited and should be submitted by one of the authors of the manuscript through the online Manuscript Tracking System located at http://mts.hindawi.com.

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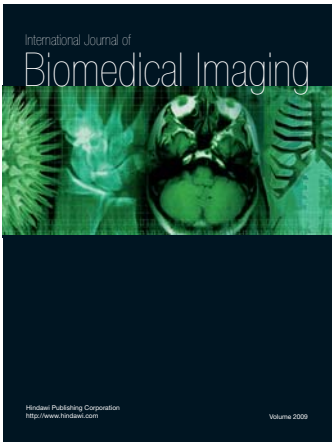
International Journal of Biomedical Imaging

http://www.hindawi.com/journals/ijbi/

Aims and Scope

The overall goal of the International Journal of Biomedical Imaging is to promote the research and development of biomedical imaging by publishing high-quality research articles and reviews in this rapidly growing, interdisciplinary field. Generally speaking, the scope of the journal covers data acquisition, image reconstruction, and image analysis, involving theories, methods, systems, and applications.



Indexing/Abstracting

In order to provide the maximum exposure for all published articles, International Journal of Biomedical Imaging is covered by many leading abstracting and indexing databases.

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International Journal of

Digital Multimedia Broadcasting

http://www.hindawi.com/journals/ijdmb/

Aims and Scope

International Journal of Digital Multimedia Broadcasting aims to provide a high-quality and timely forum for engineers, researchers, and educators whose interests are in digital multimedia broadcasting to learn recent developments, to share related challenges, to compare multistandards, and further to design new and improved systems.

Subject areas include, but are not limited to:

- Multimedia broadcasting overall system and standardization, multimedia signal compression, and coding for broadcasting
- Multimedia streaming and control, IPTV with broadcasting, multimedia content services, and digital rights management over broadcasting
- Modulation and demodulation
- Channel estimation and equalization
- VLSI design and system-on-chip implementation for multimedia broadcasting reception
- Cross-layer analysis and integration, single-chip solution, and power and spectral efficiency
- Antenna and propagation for multimedia transmission and reception
- Multistandards compatibility and multisystems interoperability
- Multibands frequency interface issues, spectrum management, and usage
- Filed-trials and testing analyses
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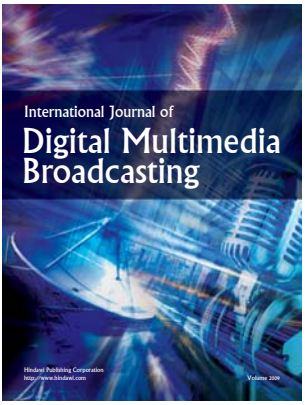

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Hindawi

International Journal of
Navigation and Observation

http://www.hindawi.com/journals/ijno/

Aims and Scope

The overall aim of the International Journal of Navigation and Observation is to explore emerging concepts and applications in navigation, positioning, earth observation, and related fields. The journal is directed at both practicing engineers as well as academic researchers. It will highlight new ideas and challenges in both application development and basic research, thus seeking to bridge the gap between innovation and practical implementation. Authors of manuscripts with novel contributions to the theory and/or the practice of navigation, positioning, and earth observation are encouraged to submit their contributions for consideration.

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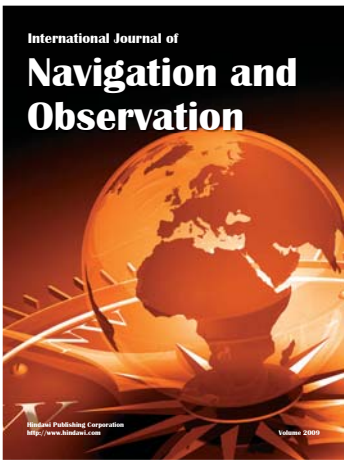

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International Journal of

Reconfigurable Computing

http://www.hindawi.com/journals/ijrc/

Aims and Scope

The aim of the International Journal of Reconfigurable Computing is to serve the large community of researchers and professional engineers working on theoretical and practical aspects of reconfigurable computing. The journal seeks to promote the use of reconfigurable computing for research, education, and applications. Original full and short papers on all aspects of reconfigurable computing, from hardware architectures and devices to custom computers and high performance systems, are encouraged for submission.

All aspects of reconfigurable computing are considered. Since the entire field is very dynamic, areas of the interest include but are not limited to:

- Models, methods, tools, and architectures for reconfigurable computing
- Compilation, simulation, debugging, synthesis, verification, and test of reconfigurable systems
- Field programmable gate arrays and other reconfigurable technologies
- Self adaptation and dynamic reconfiguration
- Evolvable hardware and adaptive computing
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- Hardware/software codesign and cosimulation with reconfigurable hardware
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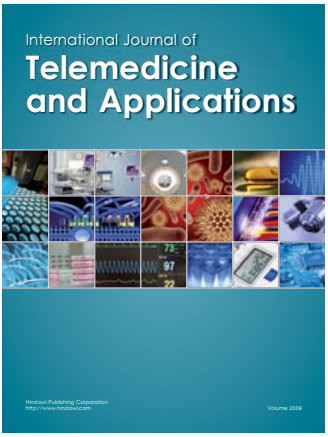
International Journal of

Telemedicine and Applications

http://www.hindawi.com/journals/ijta/

Aims and Scope

The overall aim of the International Journal of Telemedicine and Applications is to bring together science and applications of medical practice and medical care at a distance as well as their supporting technologies such as computing, communications, and networking technologies with emphasis on telemedicine techniques and telemedicine applications. Telemedicine is an information technology that enables doctors to perform medical consultations, diagnoses, and treatments, as well as medical education, away from patients. International Journal of Telemedicine and Applications will highlight the continued growth and new challenges in telemedicine, applications, and their supporting technologies, for both application development and basic research.



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Journal of

Computer Systems, Networks, and Communications

http://www.hindawi.com/journals/jcsnc/

Aims and Scope

Journal of Computer Systems, Networks, and Communications is dedicated to report the state-of-the-art research in the most important areas of information technology that are computer systems, networks, and communications.

Subject areas covered by the journal include (but are not limited to):

- Cognitive, smart and software radios, computer and network software/storage
- Computer architecture and telecommunications, digital signal processing, multimedia and DSL based applications, information theory, information systems, integrated circuitry and voice applications.
- Intelligent computer, network systems, Internet and web technologies, mobile and ubiquitous computing, network coding/cooperation, optical systems, communications and networking
- PAN/LAN/MAN/WAN and high speed packet data access
- Peer-to-peer, QoS and routing & switching, satellite and mobile cellular communications, security, privacy and encryption
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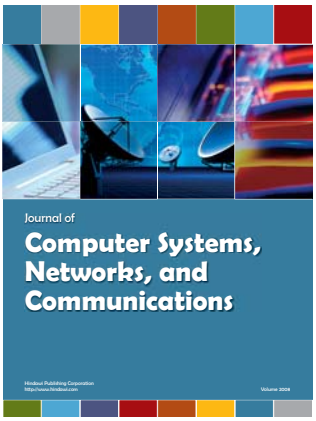

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VLSI Design

http://www.hindawi.com/journals/vlsi/

Aims and Scope

VLSI Design is a peer-reviewed, open access journal, which presents state-of-the-art papers in VLSI design, computer-aided design, design analysis, design implementation, simulation, and testing. Topics relating to both theory and applications are discussed. The journal's scope also includes papers that address technical trends, pressing issues, and educational aspects in VLSI Design.

The journal provides a dynamic, high-quality, international forum for original papers and tutorials by academic, industrial, and other scholarly contributors in VLSI Design.

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