MAXIMUM SINR-BASED BEAMFORMING FOR THE MISO INTERFERENCE CHANNEL

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ABSTRACT

Multi-antenna wireless mesh networks are a promising means to achieve high data rate in next generation of wireless networks. However, because co-channel interference (CCI) is a major source of performance degradation in such networks, cooperative techniques have been proposed to cope with CCI. Nevertheless, these techniques require the exchange of information between the transmit nodes (e.g. channel knowledge acquisition, synchronization, etc...) and are thus very complex to implement. Conversely, non-cooperative techniques have limited complexity and are therefore an interesting alternative. Two non-cooperative methods have been proposed in the literature: the zero-forcing and the maximal signal-to-noise ratio beamformers. However, those two schemes do not maximize the aggregate capacity of the network nor minimize the bit error rate (BER) of each communication channel. In this paper, we consider a different optimization metric based on maximizing the SINR at the transmitters. We show that the proposed scheme achieves maximal capacity and outperforms the two existing non-cooperative schemes in terms of BER.

1. INTRODUCTION

A wireless mesh network (WMN), as shown in Fig. 1, can exploit the presence of multiple multi-antenna nodes within a network to increase the spectral and power efficiency and relay the information farther away. Thanks to these benefits, WMNs are considered as a promising research area in wireless communications, and have recently become popular in emerging wireless standards (e.g. the 802.11s [1] and the 802.16e [2]). However, co-channel interference (CCI) or interference channel (IFC) [3], [4] is a major source of performance degradation in WMNs because different nodes may want to communicate concurrently, using the same radio channel and the same time slot. This is a setup that frequently occurs in wireless communication systems (both in mesh and in cellular networks).

The performance of the IFC and thus of WMNs can be improved when channel knowledge is available at the transmitters. In such a case, multiple antenna techniques exploit this channel state information (CSI) to perform signal shaping before transmission, reducing the receiver complexity for given performance. In the non-interfering scenario, multiple antenna techniques for maximizing the capacity of general multiple antenna systems is a well studied topic (see [5], [10] and references therein). In the interfering (or IFC) scenario, when cooperation between the transmitters and full channel knowledge at the transmitters are available, cooperative multiple antenna techniques can be used to maximize the performance. Cooperation enables joint transmission schemes (for example, the Max-SINR beamforming with coordination [5] and the cooperative maximal ratio combining (MRC) [6]). The cooperative approaches have also been studied in the literature from a game-theory perspective [7], [8], [9] to compute operating points (e.g. the Nash-bargaining and the maximal sum-rate solutions). However, cooperative transmission schemes rely on the exchange of information between the transmitters (e.g. data and channel knowledge) and a high level of synchronization between them.

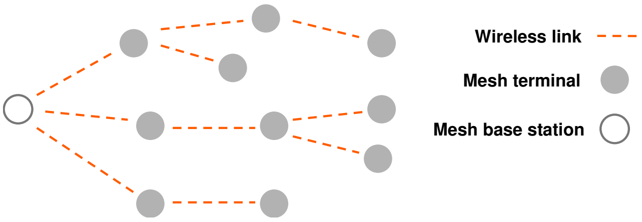

Figure 1: Example of a mesh network. The intermediate mesh terminals forward the information from/to the mesh base station.

On the other hand, non-cooperative (or competitive) multiple antenna techniques are an interesting solution because they do not require synchronization or exchange of information between the transmitters. Two non-cooperative beamforming techniques, namely, the zero-forcing (ZF) and the maximal signal to noise ratio (Max-SNR) schemes [5] have been proposed to improve the performance in the case of the multiple-input single-output (MISO) IFC scenario. However, those two schemes do not maximize the aggregate capacity of the network nor minimize the bit error rate (BER) of each communication channel as they focus on either cancelling the interference (ZF) or on maximizing the power to the desired user (Max-SNR), respectively.

In this paper, we propose a non-cooperative beamforming scheme based on the SINR criterion for the MISO IFC. We show that the proposed scheme achieves maximal capacity and outperforms the two existing non-cooperative schemes in terms of BER.

The outline of this paper is as follows. In section 2, we introduce the system model. In section 3, we introduce the ZF and Max-SNR beamforming schemes and provide the derivations of the proposed beamformer in section 4. Simulations in section 5 present the performance of the SINR beamformer and section 6 concludes our work.

The following notations are used in this paper. The vec-

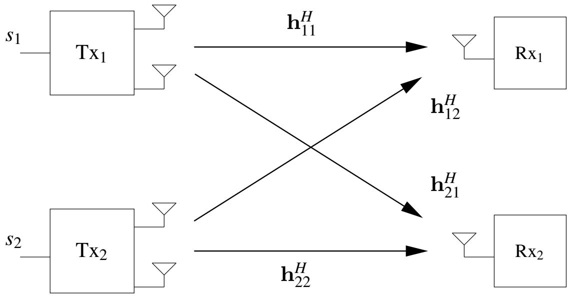

Figure 2: System model

tors and matrices are in boldface letters, vectors are denoted by lower-case and matrices by capital letters. The superscript $(\cdot)^H$ denotes the Hermitian transpose operator. $\mathbf{I}_N$ is an identity matrix of size $(N \times N)$ and $\mathbb{C}^{N\times 1}$ denotes the set of complex vectors of size $(N \times 1)$. $\mathbf{x} \sim \mathbb{C}N(\mathbf{0}, \sigma_n^2 \mathbf{I}_N)$ means that the vector $\mathbf{x}$ of size $N \times 1$ has zero-mean Gaussian distributed independent complex elements with variance σ_n^2. $tr(\mathbf{A})$ denotes the trace of matrix $\mathbf{A}$.

2. SYSTEM MODEL

We consider an IFC scenario where two independent BSs transmit concurrently to two distinct receivers (Rxs). The system model is shown in Fig. 2. Each transmitter (Tx) is equipped with multiple antennas ($N_t \geq 2$) while the receivers have just a single antenna. We consider flat fading channels and define $\mathbf{h}_{ji} \in \mathbb{C}^{N_t \times 1}$ as the channel vector between the receiver j and the transmitter i where $1 \leq i, j \leq 2$. In the sequel,

- we denote as a direct-link the channel vector between a transmitter and its dedicated user. That is $\mathbf{h}_{11}^H$ for Tx_1 and $\mathbf{h}_{22}^H$ for Tx_2. The direct-link channel vectors have independent and identically distributed (i.i.d.) elements of zero-mean and variance σ_{ii}^2, $\mathbf{h}_{ii}^H \sim \mathbb{C}\mathcal{N}(\mathbf{0}, \sigma_{ii}^2 \mathbf{I}_{N_t})$
- similarly, we define as a cross-link, the channel vector between a transmitter and its non-dedicated user. That is $\mathbf{h}_{12}^H$ for Tx_2 and $\mathbf{h}_{21}^H$ for Tx_1. The cross-link channel vectors have i.i.d. elements of zero-mean and variance σ_{ji}^2, $\mathbf{h}_{ji}^H \sim \mathbb{C}\mathcal{N}(\mathbf{0}, \sigma_{ji}^2 \mathbf{I}_{N_t})$, $i \neq j$

We consider a slow varying environment and thus assume that each transmitter has the knowledge of the local channels, i.e. the channels from its antennas to the two receivers (both desired and non-targeted receivers). That is Tx_1 has the channel knowledge of $\mathbf{h}_{11}^H$ and $\mathbf{h}_{21}^H$ while Tx_2 has the channel knowledge of $\mathbf{h}_{22}^H$ and $\mathbf{h}_{12}^H$. At the channel output, the received sample at receiver i is denoted by $y_i \in \mathbb{C}^{1\times 1}$ and can be expressed at a given time as

$$y_1 = \mathbf{h}_{11}^H \mathbf{w}_1 s_1 + \mathbf{h}_{12}^H \mathbf{w}_2 s_2 + n_1 \tag{1}$$

$$y_2 = \mathbf{h}_{22}^H \mathbf{w}_2 s_2 + \mathbf{h}_{21}^H \mathbf{w}_1 s_1 + n_2 \tag{2}$$

where $s_i \in \mathbb{C}^{1\times 1}$ denotes the symbol transmitted by Tx_i, $\mathbf{w}_i \in \mathbb{C}^{N_t \times 1}$ is the beamforming vector at Tx_i and $n_i \in \mathbb{C}^{1\times 1}$ is the zero-mean circularly symmetric complex additive white Gaussian noise with variance σ_i^2. In the equations above, the first term denotes the desired signal, the second term represents the non-desired signal (or interference) from the other transmitter and the third term is the noise. At the receiver, the samples are processed by a zero-forcing equalizer.

3. EXISTING NON-COOPERATIVE SCHEMES IN IFCS

In order to estimate the interest of the proposed SINR-based beamformer, we compare its performance with two existing beamforming schemes: the Zero-Forcing beamformer and the maximal SNR beamformer. These are briefly reviewed in this section.

3.1 Zero-Forcing (ZF) Beamformer

The ZF beamformer exploits the knowledge of the cross-link channel only to choose the beamforming vector such that the nulls are placed in the direction of the non-targeted user (i.e. null-beamforming). The ZF beamformer satisfies then the following conditions:

$$\mathbf{h}_{21}^H \mathbf{w}_1 = 0 \quad \text{and} \quad \mathbf{h}_{12}^H \mathbf{w}_2 = 0 \tag{3}$$

at Tx_1 and Tx_2, respectively. As a result, the signal at the receiver is interference free. Therefore, we can rewrite the received signals given in (1) and (2) as

$$y_1 = \mathbf{h}_{11}^H \mathbf{w}_1 s_1 + n_1 \quad \text{and} \quad y_2 = \mathbf{h}_{22}^H \mathbf{w}_2 s_2 + n_2 \tag{4}$$

However, the ZF beamformer does not maximize the power of the desired term.

3.2 Maximal SNR (Max-SNR) Beamformer

In this case, the beamformer exploits the knowledge of the direct-link channel to compute the beamforming vectors that maximize the signal received at the target-user. The Max-SNR beamforming beamformer is given as

$$\mathbf{w}_i = \frac{\mathbf{h}_{ii}}{|\mathbf{h}_{ii}|_F}, \quad i = 1, 2 \tag{5}$$

where $|\mathbf{a}|_F$ is equivalent to $\sqrt{tr(\mathbf{a^H a})}$ for any vector $\mathbf{a}$. The power of the desired term is then maximized, but no effort is made to mitigate the interference towards the non-desired user.

4. PROPOSED BEAMFORMING SCHEME

In this section, we derive a beamformer that maximizes the SINR criterion at both transmitters in a MISO IFC scenario. The beamforming exploits the knowledge of the local channel vectors at each transmitter. We first state the optimization problem (section 4.1). Then we give the expression of the beamforming vector in section 4.2. Finally, we evaluate the behavior of the proposed beamformer with respect to the ZF and the Max-SNR beamforming schemes in section 4.3.

4.1 Definition of the Optimization Problem

In wireless communications, the capacity of a system as well as its performance (e.g. in terms of BER) are dependent of the value of the SINR at the receiver(s). Considering an IFC scenario, we aim then at maximizing the SINR at the receivers. Based on equations (1) and (2), the SINR at Rx_1 and Rx_2 can be expressed as

$$\mathrm{SINR}_1 = \frac{|\mathbf{h}_{11}^H \mathbf{w}_1|^2}{|\mathbf{h}_{12}^H \mathbf{w}_2|^2 + \sigma_1^2} \tag{6}$$

and

$$\mathrm{SINR}_2 = \frac{|\mathbf{h}_{22}^H \mathbf{w}_2|^2}{|\mathbf{h}_{21}^H \mathbf{w}_1|^2 + \sigma_2^2}. \tag{7}$$

We can observe that finding beamforming vectors $\mathbf{w}_1$ and $\mathbf{w}_2$ which maximize the individual SINR's or their sum is a difficult task. Indeed, firstly, the SINR at a receiver, as observed in (6), requires the knowledge of the cross-link channel from the other transmitter (i.e. $\mathbf{h}_{12}$ for SINR_1 and $\mathbf{h}_{21}$ for SINR_2) which would require cooperation between the two transmitters. As our scenario is non-cooperative we assume that the transmitters have knowledge of the local channels only. Moreover, the SINR at a given receiver depends on the beamforming vectors from both transmitters, i.e. $\mathbf{w}_1$ and $\mathbf{w}_2$. In such a case, joint beamforming is necessary and a centralized processor must compute the beamforming weights of the transmitters. This is not an option for our non-cooperative scheme. To circumvent this, we define the following objective function which is proportional to the total system capacity (in bit per second per Hz) for sufficiently high SINR's:

$$\begin{aligned} \mathrm{C} &= \mathrm{W} \max_{\mathbf{w}_1,\mathbf{w}_2} \left(\log_2(\mathrm{SINR}_1) + \log_2(\mathrm{SINR}_2)\right) && (8)\\ &= \mathrm{W} \max_{\mathbf{w}_1,\mathbf{w}_2} \left(\log_2(\mathrm{SINR}_1 \times \mathrm{SINR}_2)\right) && (9) \end{aligned}$$

where W denotes the system's bandwith (in Hz). Equation (9) can be written as

$$\begin{aligned} \mathrm{S} &= \max_{\mathbf{w}_1,\mathbf{w}_2} \frac{|\mathbf{h}_{11}^H \mathbf{w}_1|^2 |\mathbf{h}_{22}^H \mathbf{w}_2|^2}{(|\mathbf{h}_{12}^H \mathbf{w}_2|^2 + \sigma_1^2)(|\mathbf{h}_{21}^H \mathbf{w}_1|^2 + \sigma_2^2)} && (10)\\ &= \max_{\mathbf{w}_1} \frac{|\mathbf{h}_{11}^H \mathbf{w}_1|^2}{|\mathbf{h}_{21}^H \mathbf{w}_1|^2 + \sigma_2^2} \times \max_{\mathbf{w}_2} \frac{|\mathbf{h}_{22}^H \mathbf{w}_2|^2}{|\mathbf{h}_{12}^H \mathbf{w}_2|^2 + \sigma_1^2}. && (11) \end{aligned}$$

Since the beamforming vectors $\mathbf{w}_1$ and $\mathbf{w}_2$ are independent, the optimization problem on $\mathbf{w}_1$ and $\mathbf{w}_2$ can be decoupled as follows

$$\mathbf{w}_1^{opt} = \arg\max_{\mathbf{w}_1} \frac{|\mathbf{h}_{11}^H \mathbf{w}_1|^2}{|\mathbf{h}_{21}^H \mathbf{w}_1|^2 + \sigma_2^2} \tag{12}$$

$$\text{and} \quad \mathbf{w}_2^{opt} = \arg\max_{\mathbf{w}_2} \frac{|\mathbf{h}_{22}^H \mathbf{w}_2|^2}{|\mathbf{h}_{12}^H \mathbf{w}_2|^2 + \sigma_1^2} \tag{13}$$

and subject to the power constraint $\mathbf{w}_i^{opt^H} \mathbf{w}_i^{opt} \leq 1. \quad i = 1,2.$

In such a case, maximizing the capacity does not require any collaboration between the transmitters. The beamformer at one transmitter exploits the knowledge of the local channels only and does not depend on the beamforming vector at the other transmitter.

4.2 Expression of the Beamforming Vector

Equations in (12) can be recognized as the generalized Rayleigh quotient problem whose solution is given in [11]. The beamforming vectors based on the objective functions above can be expressed as

$$\mathbf{w}_1^{opt} = e_v\left(\left(\mathbf{h}_{21}\mathbf{h}_{21}^H + \sigma_2^2\right)^{-1} \mathbf{h}_{11}\mathbf{h}_{11}^H\right) \tag{14}$$

$$\text{and} \quad \mathbf{w}_2^{opt} = e_v\left(\left(\mathbf{h}_{12}\mathbf{h}_{12}^H + \sigma_1^2\right)^{-1} \mathbf{h}_{22}\mathbf{h}_{22}^H\right) \tag{15}$$

where $e_v(\mathbf{A})$ denotes the eigenvector corresponding to the largest eigenvalue of matrix $\mathbf{A}$.

4.3 Behavior of the SINR Beamformer

We study the behavior of the SINR beamformer at the first transmitter (Tx_1) in two situations: first when the interference term is much higher than the noise term and secondly when the interference term is much lower than the noise term. A similar reasonning could be done with the second transmitter (Tx_2).

4.3.1 Case 1: the interference term is much higher than the noise term

$|\mathbf{h}_{21}^H \mathbf{w}_1|^2 >> \sigma_1^2$. In such a case, the denominator in (12) can by approximated by the interference term, i.e. $|\mathbf{h}_{21}^H \mathbf{w}_1|^2 + \sigma_1^2 \approx |\mathbf{h}_{21}^H \mathbf{w}_1|^2$. The SINR beamformer will then aim at making a good trade off between maximizing the desired signal and minimizing the interference, that is

$$\mathbf{w}_1^{opt} = \arg\max_{\mathbf{w}_1} \frac{|\mathbf{h}_{11}^H \mathbf{w}_1|^2}{|\mathbf{h}_{21}^H \mathbf{w}_1|^2}. \tag{16}$$

In this scenario, the SINR beamformer is still expected to perform better than the ZF beamformer since the latter only suppresses the interference. However, as the ratio of the interference power to the desired signal power increases, both beamformers should converge to the same beamforming vectors (i.e. suppressing the interference) and thus to the same performance. In case 1, the Max-SNR beamformer achieves poor performance because it does not minimize the interference term.

4.3.2 Case 2: the interference term is much lower than the noise term

$\sigma_1^2 >> |\mathbf{h}_{21}^H \mathbf{w}_1|^2$. In this case, the denominator in (12) can by approximated by the noise term, i.e. $|\mathbf{h}_{21}^H \mathbf{w}_1|^2 + \sigma_1^2 \approx \sigma_1^2$. The SINR beamformer aims then at maximizing the desired signal, that is

$$\mathbf{w}_1^{opt} = \arg\max_{\mathbf{w}_1} \frac{|\mathbf{h}_{11}^H \mathbf{w}_1|^2}{\sigma_1^2} = \arg\max_{\mathbf{w}_1} |\mathbf{h}_{11}^H \mathbf{w}_1|^2. \tag{17}$$

This is equivalent to the Max-SNR beamformer. Both SINR and Max-SNR beamformers achieve then the same performance when the noise is the source of errors (i.e. when the interference term is not significant). Meanwhile, the ZF beamformer achieves poor performance because cancelling the interference is ineffective.

Simulations in section 5 confirm the statements made above in those two cases.

5. RESULTS

In this section, we present the performance obtained for the non-beamformed, the ZF, the Max-SNR and the SINR-based beamforming schemes for various scenarios. In section 5.1, two scenarios are considered: one in which the interference power is as strong as the desired signal and the second one in which the interference is lower than the desired signal. In section 5.2 we show the impact of interference power on the beamforming schemes. Finally, we study the impact of imperfect channel knowledge on the performance of these beamformers in section 5.3.

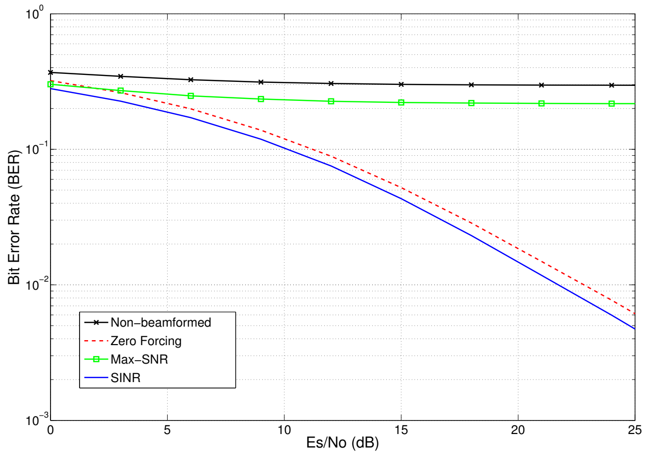

Figure 3: BER curves for the MISO IFC with the non-beamformed, the ZF, the Max-SNR and the SINR beamforming schemes when the desired signal and the interference term are equally strong (i.e. $\sigma_{ii}^2 = \sigma_{ji}^2 = 1$).

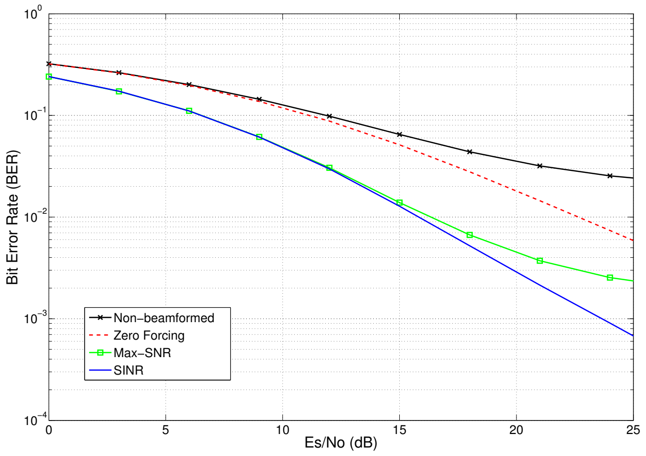

Figure 4: BER curves for the MISO IFC with the non-beamformed, the ZF, the Max-SNR and the SINR beamforming schemes when the desired signal has a higher power than of the interference term (here $\sigma_{ii}^2/\sigma_{ji}^2 = 20$ dB).

5.1 Performance of the Various Beamforming Schemes

As already mentioned in the text, we consider a MISO IFC scenario with two transmitters and two receivers. Each of the transmitters is equipped with two antennas and each receiver has just a single antenna. All simulations are for a 16 QAM modulation scheme and without channel coding. The variance of the direct-link channels is set to one ($\sigma_{11}^2 = \sigma_{22}^2 = 1$). The goal is to compare the performance of the SINR-based beamformer with the non-beamformed, the ZF beamforming, and the Max-SNR beamforming schemes.

In Fig. 3, we present the BER curves versus the average SNR (defined as the average Es/No) when the direct-link channels and the cross-link channels have same variance, i.e. $\sigma_{ii}^2 = \sigma_{ji}^2 = 1, \forall i, j$. In this case, the interference is a major source of performance degradation because the desired signal and the interference term are equally strong. The SINR-based beamformer behaves then as the ZF beamformer and tends to transmit in the nulls of the cross-link channel (as expressed by (3)) so as to minimize the interference caused at the non-desired user. We can observe that our precoder performs slightly better than the ZF scheme. This is because the latter only suppresses the interference and does not try to improve the term at the numerator (i.e. the desired signal), degrading the BER. As expected, the Max-SNR achieves poor performance since it does not try to cancel the interference term.

Fig. 4 shows the BER curves when the power of the cross-link channels is much lower than that of the direct-link channels ($\sigma_{ii}^2/\sigma_{ji}^2$ = 20 dB with $i \neq j$). At low Es/No, the interference component is negligible compared to the noise term. In such a case, the SINR beamformer tends to maximize the signal to the desired receiver, which is equivalent to the Max-SNR beamforming scheme, as shown by the figure. We can also observe that in the medium-to-high range of Es/No the SINR criterion outperforms the Max-SNR beamforming. In this region, the interference becomes significant compared to the noise. This also leads to the fact that the curve of the ZF beamforming separates from the non-beamformed one. In such a case, the SINR beamforming scheme amplifies the received desired signal while mitigating the interference whereas the Max-SNR beamformer only aims at maximizing the desired signal (i.e. it does not try to mitigate the interference term). As a result, the SINR beamformer outperforms the Max-SNR beamformer whose BER curve achieves a flooring in the range of high Es/No because of the interference term.

5.2 Impact of Interference on the Beamforming Schemes

As seen in the figures above, the ratio of the noise power to the interference power dictates the performance of the various beamforming schemes. In Fig. 5, we display the behavior of these beamforming schemes in terms of BER for a varying interference power and a fixed Es/No of 20 dB. We define ξ as the ratio of the variance of the direct-link channels to the variance of the cross-link channels, i.e. $\xi = \sigma_{ii}^2/\sigma_{ji}^2$. We display the BER curves for $-20 \leq \xi \leq 45$ dB. We can observe that the SINR beamformer tends to behave as the ZF beamformer or the Max-SNR beamformer depending on which term is the dominant source of errors (the noise or the interference). When the interference is the dominant term (i.e. $\xi \leq$ -10 dB), the SINR beamformer behaves as the ZF beamformer and tries to minimize the effects of the interference. When the noise is the dominant term (i.e. $\xi \geq$ 30 dB), the SINR beamformer behaves as the Max-SNR beamformer and maximizes the power to the desired user. Fig. 5 shows that the SINR beamformer behaves as a trade-off between the ZF and the Max-SNR beamformers and outperforms these beamforming schemes for any value of ξ. This is because the SINR criterion takes into consideration both the noise and the interference terms and aims at enhancing the desired signal while mitigating the interference to the other user.

All these observations confirm the statements made in section IV-C.

5.3 Impact of Imperfect Channel Knowledge

The results above are based on a perfect channel knowledge at the transmitters. In case of a noisy channel feedback, the

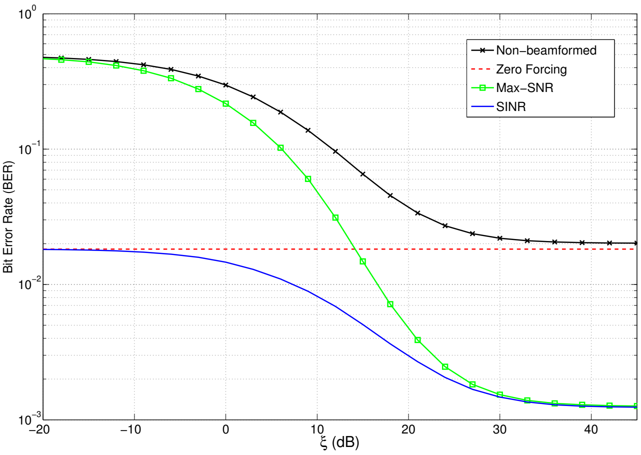

Figure 5: BER curves for the MISO IFC with the non-beamformed, the ZF, the Max-SNR and the SINR beamforming schemes. The Es/No is fixed to 20 dB and the power of the desired signal over the power of the interference term varies from $-20 \leq \xi \leq 45$ dB.

CSI is corrupted, degrading the effectiveness of the beamforming schemes and therefore the performance of the system. To estimate the impact of a corrupt channel knowledge, we introduce a noise component into the CSI:

$$\tilde{\mathbf{h}}_{ji} = \mathbf{h}_{ji} + \varepsilon_{ji}, \text{ for } i,j \in \{1,2\} \tag{18}$$

where ε_{ji} denotes a $N_t \times 1$ complex Gaussian vector with i.i.d. elements of zero mean and variance σ_ε^2, i.e. $\varepsilon_{ii} \sim \mathbb{C}\mathcal{N}(0, \sigma_{\varepsilon_{ii}}^2)$ and $\varepsilon_{ji} \sim \mathbb{C}\mathcal{N}(0, \sigma_{\varepsilon_{ji}}^2)$. Simulations for the different beamforming schemes under a noisy CSI are given in Fig. 6. We display the BER curves for a power of the direct-link channels over the cross-link channels of 12 dB ($\sigma_{ii}^2/\sigma_{ji}^2$ = 12 dB). The variance of the noise components (i.e. $\sigma_{\varepsilon_{ii}}^2$ and $\sigma_{\varepsilon_{ji}}^2$) is normalized to the squared norm of the instantaneous channel, that is $|\mathbf{h}_{ii}|_F^2$ for $\sigma_{\varepsilon_{ii}}^2$ and $|\mathbf{h}_{ji}|_F^2$ for $\sigma_{\varepsilon_{ji}}^2$. This can be jutified since the error on the CSI feedback is proportional to the value of the instantaneous channel. The Es/No is fixed to 20 dB and -50$\leq \sigma_{\varepsilon_{ii}}^2/|\mathbf{h}_{ii}|_F^2 = \sigma_{\varepsilon_{ji}}^2/|\mathbf{h}_{ji}|_F^2 \leq$40 dB. The flooring at low $\sigma_{\varepsilon_{ii}}^2/|\mathbf{h}_{ii}|_F^2 = \sigma_{\varepsilon_{ji}}^2/|\mathbf{h}_{ji}|_F^2$ indicates that the error on the CSI is low enough to not impact the performance of the beamforming schemes. As shown in the figure, an $\sigma_{\varepsilon_{ii}}^2/|\mathbf{h}_{ii}|_F^2 = \sigma_{\varepsilon_{ji}}^2/|\mathbf{h}_{ji}|_F^2$ of approximately -20 dB on the CSI estimate is enough for the SINR beamformer to be effective.

6. CONCLUSION

In this paper, we have proposed a beamforming scheme that exploits the knowledge of the local channels to maximize the SINR at both receivers for the MISO IFC. Interestingly, this scheme does not require synchronization or exchange of information (e.g. data and channel knowledge) between the transmitters. Simulation results show that the proposed beamformer outperforms the non-beamformed, the Zero-Forcing and the maximal SNR beamforming schemes in all cases.

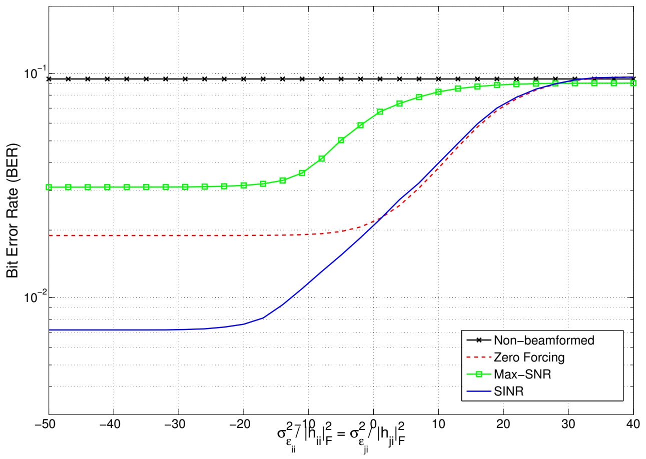

Figure 6: BER for the MISO IFC with the non-beamformed, the ZF, the Max-SNR and the SINR beamforming schemes given a noisy CSI feedback. The Es/No is fixed to 20 dB and -50 $\leq \sigma_{\varepsilon_{ii}}^2/|\mathbf{h}_{ii}|_F^2 = \sigma_{\varepsilon_{ji}}^2/|\mathbf{h}_{ji}|_F^2 \leq$40 dB.

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