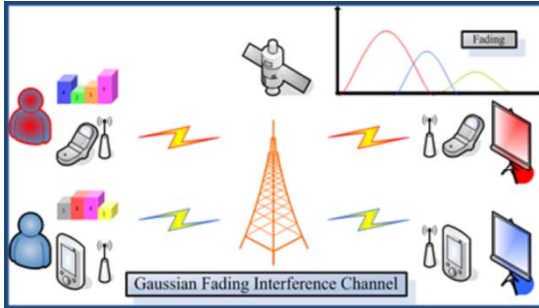


# Outage analysis of Block-Fading Gaussian Interference Channel

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## BACKGROUND

1. In today's cellular network multiple sources transmit simultaneously.
2. Avoiding interference leads to simple network architectures that are suboptimal in terms of rates.
3. Fading and interference are two major factors in wireless channel that influence the performance.
4. How to deal with both of them simultaneously?

### References:

- [1] T. S. Han and K. Kobayashi, "A new achievable region for the interference channel", IEEE Trans. Info. Theory, vol.IT-27, pp. 49 - 60, January 1981.
- [2] R. Etkin, D. Tse, and H. Wang, Gaussian Interference Channel Capacity to Within One Bit, IEEE Trans. Inf. Theory, Dec. 2008
- [3] E. Akuiyibo, O. Leveque, "Diversity-Multiplexing Trade-off for the Slow Fading Interference Channel", Proc. of 2008 Intern. Zurich Seminar, March 2008.
- [4] Y. Weng, D. Tuninetti, Outage analysis of Block-Fading Gaussian Interference Channels, Submitted to the IEEE Trans. Info. Theory

## ASSUMPTION

1. The channel is block-fading .
2. The receivers know perfectly the channel realization, but the transmitters do not.
3. We use a genie-aided outer bound [2] and the Han-Kobayashi inner bound [1] to bound the diversity:

$$1 - \mathbb{P}[\mathcal{R}_{ETW}] \leq \mathbb{P}_{out}(r_1, r_2) \leq 1 - \mathbb{P}[\mathcal{R}_{HK}]$$

## ANALYSIS DETAILS

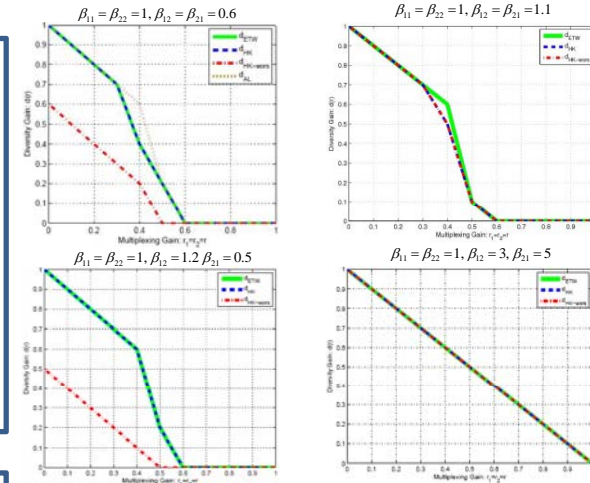
1. In [2] a novel outer bound for the capacity region of unfaded GIFC was shown to be within 1 bit of a simplified version of the Han-Kobayashi region [1].
2. By using the Laplace's integration method with the parameterization

$$H_{ij} = \sqrt{\mathbb{E}[|H_{ij}|^2]} x^{-\gamma_{ij}} e^{j\theta_{ij}}$$

$$\mathbb{E}[|H_{cu}X_u|^2] = \mathbb{E}[|H_{cu}|^2]P_u \triangleq x^{\beta_{cu}}$$

we obtain bounds for the diversity.

1. Our bounds are closed form analytical solution of optimization problems for any channel parameters.
2. Our model not only includes the case of symmetric channel of [3], but also covers asymmetric channels relevant in practical applications such as the case of mixed interference.



## RESULTS

Fig.1, Weak: Rate-splitting fully achieves the diversity outer bound for a very wide range of channel parameters.

Fig.2, Moderate weak and Moderate strong: the inner and outer bound meet for low and high rates.

Fig.3., Mixed: The two bounds coincide. Considerations similar to those for strong interference hold in more general cases such as the one depicted in Fig.4

Fig.4, Strong: In very strong interference, i.e.,  $\min\{\beta_{12}, \beta_{21}\} \geq \beta_{11} + \beta_{22}$ , the interference is so strong that each user can completely remove the unintended signal before decoding its own signal.