# The Asymptotic Capacity of Noncoherent Single-Input Multiple-Output Fading Channels with Memory and Feedback

Yuan-Zhu Guo and Hsuan-Yin Lin

Department of Electrical and Computer Engineering
National Chiao Tung University (NCTU)
Hsinchu 30010, Taiwan
{guo.yuan-zhu,lin.hsuanyin}@ieee.org

Stefan M. Moser*

ETH Zürich, Switzerland, and Dep. of Electrical and
Computer Engineering, National Chiao Tung
University (NCTU), Hsinchu 30010, Taiwan
stefan.moser@ieee.org
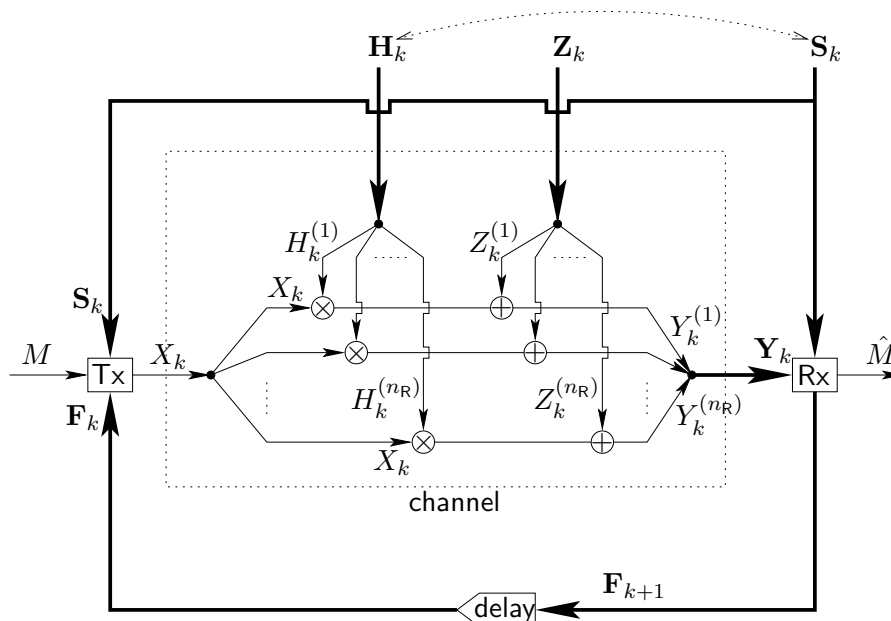
1 Channel Model

We consider a noncoherent SIMO fading channel

$$\mathbf{Y}_k = \mathbf{H}_k x_k + \mathbf{Z}_k$$

under the following assumptions:

- SIMO: 1 antenna at Tx, n_R antennas at Rx
- fading process $\{\mathbf{H}_k\}$ is **general** (not necessarily Gaussian!), of finite energy, stationary, ergodic, **with memory**, and of **finite differential entropy rate** $h(\{\mathbf{H}_k\}) > -\infty$
- **noncoherent**: Tx and Rx do not know realization of fading
- additive white Gaussian noise $\{\mathbf{Z}_k\}$
- partial side-information process $\{\mathbf{S}_k\}$ about fading, **revealed acausally to Rx and Tx**
- peak- or average-power constraint $\mathsf{E_s}$ on input
- **noiseless causal feedback link** (i.e., feedback link has infinite capacity!)

2 Main Result

Theorem: Asymptotic capacity remains unchanged by feedback:

$$\mathsf{C}(\mathsf{E_s}) = h_\lambda\Big(\hat{\mathbf{H}}_0\, e^{\mathrm{i}\Theta_0}\,\Big|\,\big\{\hat{\mathbf{H}}_\ell\, e^{\mathrm{i}\Theta_\ell}\big\}_{\ell=-\infty}^{-1}, \mathbf{S}_{-\infty}^0\Big)$$
$$+ n_\mathsf{R}\,\mathsf{E}\big[\log\|\mathbf{H}_0\|^2\big] - \log 2$$
$$- h\big(\mathbf{H}_0\big|\mathbf{H}_{-\infty}^{-1}, \mathbf{S}_{-\infty}^0\big) + \log\log\mathsf{E_s} + o(1)$$

References

[1] Y.-Z. Guo, H.-Y. Lin, and S. M. Moser, "The asymptotic capacity of noncoherent single-input multiple-output fading channels with memory and feedback," in *Proc. IEEE Int. Symp. Inf. Theory*, Istanbul, Turkey, Jul. 7–13, 2013, pp. 2269–2273.

[2] S. M. Moser, "Impact of feedback and side-information on the asymptotic capacity of single-input multiple-output fading channels with memory," Dec. 2013, subm. [Online]. Available: http://moser-isi.ethz.ch/publications.html