**INTRODUCTION**

- Relays allow for an extended network coverage and increased network performance, especially within single-frequency networks (SFN).
- Among the different relay types, full-duplex relays transmit and receive simultaneously, which translates into:
  - Higher spectral efficiency than half-duplex relays.
  - Self-interference at the relay receive side.
- Self-interference at the relay can dramatically reduce the relay performance if its power is high enough. Consequently, mitigation of this distortion is required. We propose:
- Our method has the following characteristics:
  - It is adaptive, so it can keep track of environment changes.
  - It only requires statistical information of the source signal.
  - It introduces no extra delay in the relay processing.
  - It can equalize the source-relay channel.

**PROBLEM SETTING AND MITIGATION METHOD**

- The system model consists of a source (S), a relay (R) and a destination (D), with the following characteristics:
- S transmits $M_s$ streams using $M_s$ antennas.
- R has $M_r$ receive and $M_t$ transmit antennas.
- The proposed equalizer is $W(z) = (I - BA(z))^{-1}B$, with B and A(z) being $M_t \times M_r$ matrices.
- The relay response from $x(n)$ to $y(n)$ is $H_{y}(z) = (I - W_{r}(z)H_{r}(z)G(z))^{-1}W_{r}(z)$. Self-interference is eliminated $W_{r}(z) = (I + H_{r}(z)G(z))^{-1}$.
- $W_{r}(z)$ has enough degrees of freedom to additionally equalize $H_{r}(z)G(z)$, so we have $y(n) = s(n - 0)$.
- In order to achieve such desirable equalization, we adapt $B$ and $A(z)$ using the following rule:
  - $A[k](n+1) = A[k](n) + \mu_n R[k] - y(n)y^{H}(n-k)$
  - $B[n+1] = B[n] + \mu_n R[n][0] - y(n)y^{H}(n)$

for $k = 0, \ldots, L_{\alpha}$, with $L_{\alpha}$ being the order of $W_{r}(z)$ and step-sizes $\mu_n > 0$ and $\mu_0 > 0$. The algorithm only makes use of the side information $R[n][k] = E[\{s(n)\sigma^H(n-k)]$.

**CONCLUSIONS I**

- The proposed method solves the problem of self-interference mitigation in amplify-and-forward MIMO full-duplex relays by using only statistical information of the source signal as side information.
- Simulations show that our method improves the output SNR for a wide range of self-interference power levels.

**ALGORITHM ANALYSIS**

- Upon convergence, and assuming sufficient order $L_{\alpha}$, any stationary point will satisfy:
  - $H_{y}(z) = \Sigma(z)\Gamma^{-1}(z)$, with $\Sigma(z)$ and $\Gamma(z)$ being the minimum phase factors of $s(n)$ and $x(n)$, respectively. $V$ is a unitary matrix.
  - $y(n)$ can be thought of as $s(n)$ being filtered by a pre-whitening filter $\Gamma^{-1}(z)$, followed by a undetermined spatial rotation $V$, and a conformation filter $\Sigma(z)$.
  - Assuming that $H_{y}(z)G(z)$ is minimum-phase and $\Sigma(z) = \sigma I$, we can explicitly state that $H_{y}(z) = V$ and, consequently, the algorithm is able of self-interference mitigation and channel equalization.

**SIMULATION RESULTS**

- Simulation parameters:
  - We use $M = 2$ independent streams of an OFDM-modulated source signal with $N_{sub} = 8192$ subcarriers and $1/4N_{sub}$ cyclic prefix length. An oversampling factor of 2 is used at the input and output of $W_{r}(z)$.
  - Sufficient-order case with $L_{\alpha} = 4$, $\text{SNR}_{in} = 10$ dB and $\kappa = -5$ dB (ratio between information signal and self-interference signal powers).

**CONCLUSIONS II**

- In addition to self-interference mitigation, our method is able of equalizing the source-relay channel up to of a mere spatial rotation.
- Note that due to the structure of $W_{r}(z)$, no extra delay is introduced into the system, and therefore not increasing the network latency.