Error Plots for Elementary MUD Analysis

(accompanies Section 2.5 of the notes)

Definitions and parameter entry:

power ratio: user 1/user 2 $\lambda := 2$

pulse crosscorrelation coefficient $\rho := 0.6$

noise std dev $\sigma := 1$

user 1 SNR and amplitude γ_1 $A_1 = \sqrt{\gamma_1}$

user 2 SNR and amplitude $\gamma_2 = \frac{\gamma_1}{\lambda}$ $A_2 = \sqrt{\gamma_2}$

Single user bound

$$P_{1sing}(\gamma_1) := Q\left(\sqrt{\gamma_1}\right) \qquad P_{2sing}(\gamma_1) := Q\left(\sqrt{\gamma_1 \cdot \lambda^{-1}}\right)$$

Ignore MAI, conventional detector

$$P_{1conv}(\gamma_1, \rho) := \frac{1}{2} \cdot Q\left(\sqrt{\gamma_1} - \sqrt{\gamma_1 \cdot \lambda^{-1}} \cdot \rho\right) + \frac{1}{2} \cdot Q\left(\sqrt{\gamma_1} + \sqrt{\gamma_1 \cdot \lambda^{-1}} \cdot \rho\right)$$

$$P_{2conv}(\gamma_1, \rho) := \frac{1}{2} \cdot Q\left(\sqrt{\gamma_1 \cdot \lambda^{-1}} - \sqrt{\gamma_1} \cdot \rho\right) + \frac{1}{2} \cdot Q\left(\sqrt{\gamma_1 \cdot \lambda^{-1}} + \sqrt{\gamma_1} \cdot \rho\right)$$

Zero forcing

$$P_{1zf}(\gamma_1, \rho) := Q\left[\sqrt{\gamma_1 \cdot \left(1 - \rho^2\right)}\right] \qquad P_{2zf}(\gamma_1, \rho) := Q\left[\sqrt{\gamma_1 \cdot \lambda^{-1} \cdot \left(1 - \rho^2\right)}\right]$$

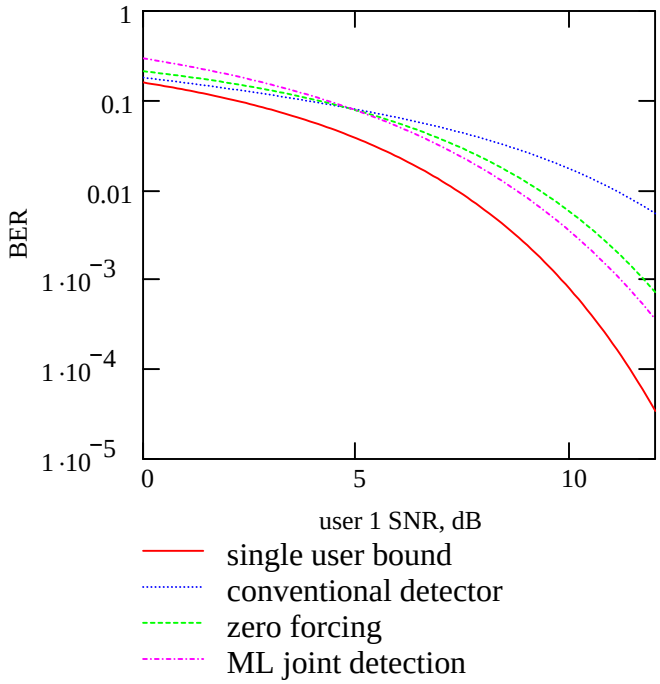
ML joint detection

$$P_{MLcross}(\gamma_1, \rho) := \frac{1}{2} \cdot Q\left[\sqrt{\gamma_1 \cdot \left(1 + \lambda^{-1} + 2 \cdot \rho \cdot \lambda^{-0.5}\right)}\right] + \frac{1}{2} \cdot Q\left[\sqrt{\gamma_1 \cdot \left(1 + \lambda^{-1} - 2 \cdot \rho \cdot \lambda^{-0}\right.}\right.$$

$$P_{1ML}\left(\gamma_1, \rho\right) := P_{1sing}\left(\gamma_1\right) + P_{MLcross}\left(\gamma_1, \rho\right)$$

$$P_{2ML}\left(\gamma_1, \rho\right) := P_{2sing}\left(\gamma_1\right) + P_{MLcross}\left(\gamma_1, \rho\right)$$

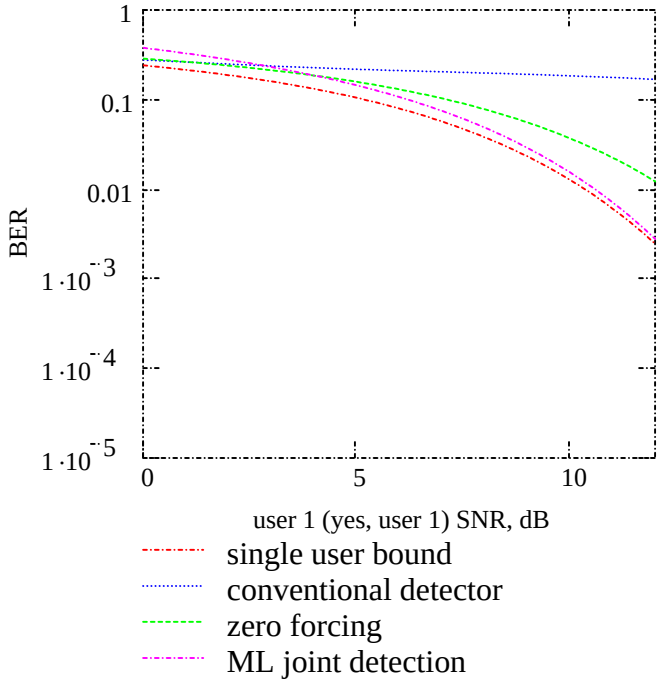
Plots are on the next page...



ρ = 0.6 λ = 2

Notes:
* A large value of ρ.
* ZF worse than conv. at low SNR, because noise enhancement.
* ML union bound diverges at low SNR.
* ML bound is too loose for the strong user - a problem with standard union bound.

User 1 performance, various detectors



Notes:
* Conv. detector crippled by MAI.
* ML benefits this weaker user, effectively eliminating MAI.

User 2 performance, various detectors