Energy Efficient Transmission for DF MIMO Relay Systems with Antenna Selection

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Motivations

- Green Communications is **IMPERATIVE!**
- MIMO is **NOT** always GREEN. [S. Cui '04]
- **Relay** is often ENERGY constrained.

- Our Goal: Green DF MIMO Relay with Antenna Selection (**AS**).

AS & EE Overview

- Low complexity AS schemes for MIMO relay [M. Ding '10]

Power of RF chains is **ignored**

- Energy Efficiency (EE) maximization in MIMO relay [A. Zappone '14]

Relay AS scheme is **ignored**

Energy Efficient Relay AS?

System Model & Problem Formulation

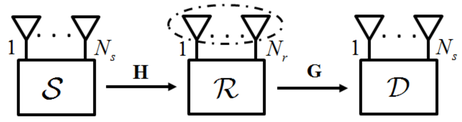


Fig.1: System Model

Achievable Rate

$$C\left(P_s,P_r,\mathbf{H}_{\omega_r},\mathbf{G}_{\omega_t}\right)=\frac{1}{2}\min\left(\log\left(\mathbf{I}+\frac{P_s}{N_s\sigma_r^2}\mathbf{H}_{\omega_r}^H\mathbf{H}_{\omega_r}\right),\log\left(\mathbf{I}+\frac{P_r}{L\sigma_d^2}\mathbf{G}_{\omega_t}\mathbf{G}_{\omega_t}^H\right)\right)$$

Power Model

Circuits Power

$$P=\frac{1}{\eta_s}P_s+\frac{1}{\eta_r}P_r+P_c$$

$$P_c=N_sP_{ct}+N_dP_{cr}+\left|\omega_r\right|(P_{cr,R}+P_{ct,R})+P_{c0}$$

Energy Efficiency

$$EE=\frac{C\left(P_s,P_r,\mathbf{H}_{\omega_r},\mathbf{G}_{\omega_t}\right)}{\frac{1}{\eta_s}P_s+\frac{1}{\eta_r}P_r+N_sP_{ct}+N_dP_{cr}+\left|\omega_r\right|P_{c,R}+P_{c0}}$$

Optimization Problem

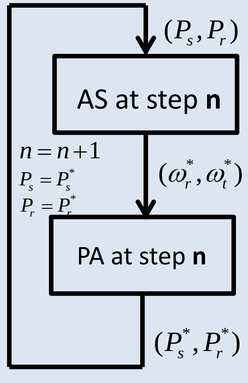
$$\max_{(P_s,P_r,\omega_r,\omega_t)} EE$$

$$s.t.\begin{cases}1\le\left|\omega_r\right|=\left|\omega_t\right|\le N_r\\ C\left(P_s,P_r,\mathbf{H}_{\omega_r},\mathbf{G}_{\omega_t}\right)\ge C_{\min}\\ 0<P_s\le P_s^{\max},0<P_r\le P_r^{\max}.\end{cases}$$

Low Complexity Method?

Energy Efficient Relay AS Method

Proposed Algorithm



Theorem 1 *Closed-form iterative EE equation*

$$EE_{(n+1)}=\frac{1}{2}\min\left(\Psi(n)EE_{(1,n)}+\Delta_{1,s,n},\ \Psi(n)EE_{(2,n)}+D_n+\Delta_{2,s,n}\right)$$

Selection

$$s_r^*=\arg\max_s\left(\log\left(1+\delta_{1,s,n}\right)\right)$$

$$s_t^*=\arg\max_s\left(\log\left(1+\delta_{2,s,n}\right)\right)$$

Fractional Programming

$$\max\{R(x)-qP(x)\mid x\in S\},q\in R$$

Solution:

Dinkelbach method

Simulation Results

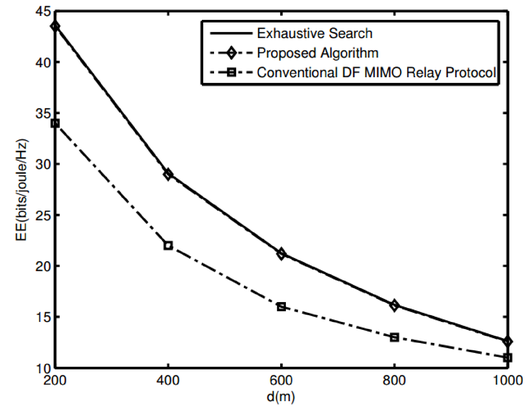


Fig. 2: EE with respect to d.

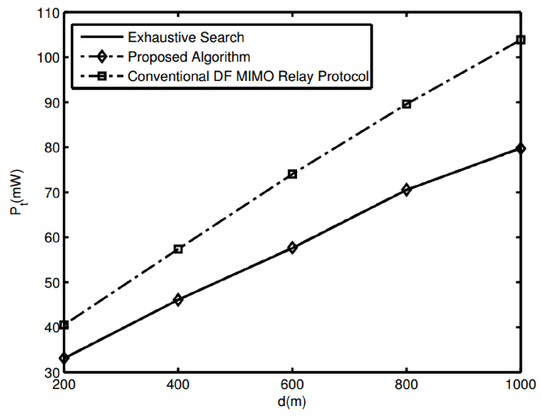


Fig. 3: Transmission Power VS. d

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