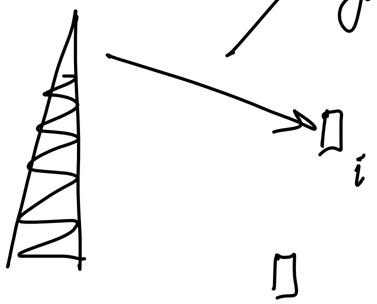
Power Control using GPs



gain g_{ii}

tx power p_i

rx power = $p_i g_{ii}$

interference = $\sum_{j \neq i} p_j \underbrace{g_{ij}}_{\text{leakage}}$

noise power = n_i

Signal-to-noise-plus-interference (SINR)

$$= \frac{p_i g_{ii}}{\sum_{j \neq i} p_j g_{ij} + n_i} = \gamma_i$$

so $p_i \uparrow \Rightarrow$ rx power increases
but SINR may decrease

sum-rate max.

$$\max_{\{p_i\}} \sum w_i \log(1+\gamma_i)$$

Quality-of-Service (QoS) :

$$\min_i \left[\log(1+\gamma_i) \right] \geq R_{th}$$

$$0 \leq p_i \leq P$$

QoS constraint: $\log(1+\gamma_i) \geq R_{th} \quad \forall i$

or $\gamma_i \geq \exp(R_{th}) - 1 = \gamma_{th}$

$$\max_{\{p_i\}} \sum w_i \log(1+\gamma_i)$$

$\gamma_i \geq \gamma_{th}$ convex? no

$0 \leq p_i \leq P$

High SINR case: γ_{th} high

$\gamma_i >> 1$ $\quad \log(1+\gamma_i) \simeq \log(\gamma_i)$

$$\max \sum w_i \log(\gamma_i)$$

$\gamma_i \geq \gamma_{th}$

$0 \leq p_i \leq P$

$$\gamma_i = \frac{p_i g_{ii}}{\sum_{j \neq i} p_j g_{ij} + n_i}$$

$$\frac{1}{\gamma_i} = \sum p_j p_i^{-1} g_{ij} g_{ii}^{-1} + n_i p_i^{-1} g_{ii}^{-1}$$

(posynomial)

$$\gamma_i \geq \gamma_{th} \iff \gamma_{th}\left(\frac{1}{\gamma_i}\right) \leq 1$$

$p_i \le P \iff \frac{p_i}{P} \le 1$

monomial

$\max \sum w_i \log(\gamma_i)$ $\qquad w_i > 0$

or $\max \prod \gamma_i^{w_i}$ or $\min \prod \left(\frac{1}{\gamma_i}\right)^{w_i}$

epigraph: $\min \prod t_i^{w_i}$

s.t. $\frac{1}{\gamma_i} \le t_i$ or $\frac{1}{t_i \gamma_i} \le 1$

(posynomial)

<u>Summary</u>

$$\min \prod t_i^{w_i}$$

$$\sum p_j p_i^{-1} t_i g_{ij} g_{ii}^{-1} + n_i p_i^{-1} g_{ii}^{-1} t_i \le 1$$

$$\sum p_j p_i^{-1} g_{ij} g_{ii}^{-1} \gamma_{th} + n_i p_i^{-1} g_{ii}^{-1} \gamma_{th} \le 1$$

$$\frac{p_i}{P} \le 1$$

High SINR case $\rightarrow$ GP