Validating wireless system Design via MATLAB Simulations

EWCN Laboratory
Session 2

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September 2, 2020

Decode-and-Forward (DF) Relaying protocol

1. This sort of relaying protocol, detects the signal, decodes it, and re-encode it prior to transmission.
2. Here the information bits is modified which needs a powerful hardware.
3. Termed as Regenerative relaying protocol.

Decode-and-Forward (DF) Relaying protocol

Operation:

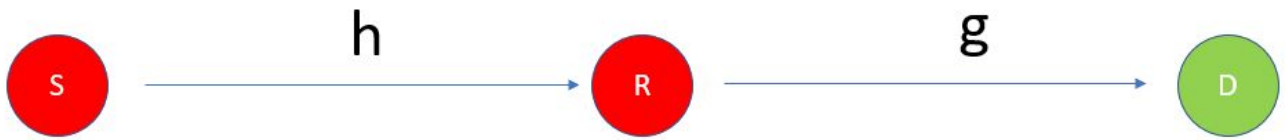

Figure: DF relay assisted wireless communication network

1. First hop received SNR at R is $\frac{P_S}{N_0}|h|^2$.
2. Second hop SNR is $\frac{P_S}{N_0}|g|^2$.
3. With DF relaying end-to-end received SNR (Λ) at D is given by

$$\Lambda = \min\left(\frac{P_S}{N_0}|h|^2, \frac{P_S}{N_0}|g|^2\right). \quad (1)$$

Experiment 2.1: Implementation of Decode and forward (DF) relaying in MATLAB

- Consider a two hop communication network where a source node S wishes to send its information to a destination terminal D via a DF relay terminal R.
- The channel coefficients are assumed to be Rayleigh distributed and hence the channel gains will be exponential distributed.
- In the first phase, the received SNR at R is given by $\frac{P_s}{N_o}|h_{sr}|^2$.
- During the second phase relay decodes and transmits the information and the corresponding end-to-end SNR at D is given by $\min(\frac{P_s}{N_o}|h_{sr}|^2, \frac{P_R}{N_o}|h_{rd}|^2)$.
- Outage probability is defined as the probability that the end-to-end SNR is below a given predefined threshold.

- For the above system model, plot the outage behaviour vs transmit SNR curve.
- Compare the outage behaviour of the simulated system with the outage behaviour of the system simulated in the last lab (without direct link).
- Variance Ω_{ij} is defined as

$$\Omega_{ij} = d_{ij}^{-\alpha} \tag{2}$$

  where, d_{ij} is the distance between nodes i and j, and α is the path loss exponent.
- Plot and analyze the impact of relay location on the system outage behaviour. Assume S to be at origin (0,0), R at (x,0) and D at (1,0).

Experiment 2.2 : To analyze the capacity of a system with Decode and forward (DF) relaying in MATLAB

- Consider a two hop communication network where a source node S wishes to send its information to a destination terminal D via a DF relay terminal R.
- The channel coefficients are assumed to be Rayleigh distributed and hence the channel gains will be exponential distributed.
- In the first phase, the received SNR at R is given by $\frac{P_s}{N_o}|h_{sr}|^2$.
- During the second phase relay decodes and transmits the information and the corresponding end-to-end SNR at D is given by $\min(\frac{P_s}{N_o}|h_{sr}|^2, \frac{P_R}{N_o}|h_{rd}|^2)$.

- For the above system model, plot the capacity vs transmit SNR curve.
- Compare the capacity of the simulated system with the capacity of the same system without direct link.
- Variance Ω_{ij} is defined as

$$\Omega_{ij} = d_{ij}^{-\alpha} \tag{3}$$

  where, d_{ij} is the distance between nodes i and j, and α is the path loss exponent.
- Plot and analyze the impact of relay location on the system capacity. Assume S to be at origin (0,0), R at (x,0) and D at (1,0).