



A deterministic model for Gaussian networks

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Objective

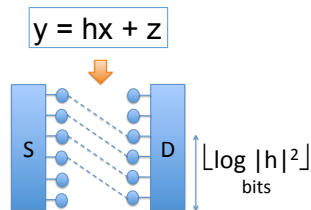
Capacity and optimal coding schemes for most Gaussian networks are not known. So we try to find answers within a bound. We wish to construct a deterministic network whose capacity differs from that of Gaussian networks by a constant, with the constant independent of channel gains.

System model

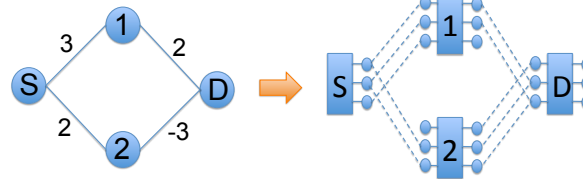
- One source-destination pair, many relay nodes.
- Fixed channel gains, Gaussian noise added at receiver.
- Channels are directed wireless links.
- Broadcast and interference assumptions hold.

Linear deterministic model

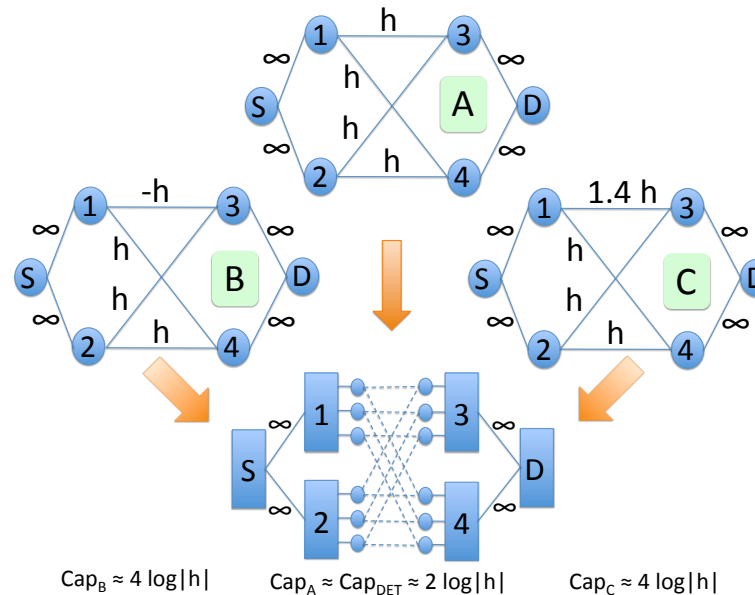
- Channel allows $\lfloor \log |h|^2 \rfloor$ MSBs of input to pass through.
- Length of each input vector is maximum of all channel capacities.
- Broadcast and interference assumptions still hold.



Example



Three Gaussian networks with same linear deterministic counterpart



Linear deterministic model is unable to capture phase information in Network B and received signal power in Network C. The model cannot approximate all Gaussian networks.

Deterministic superposition model

- Inputs are positive fractions.
- Channel gains are quantized to nearest integers.
- Channel scales inputs with gains and add them at a receiver.
- Retain integer portion of channel output, discard rest.
- This model has capacity within a bound of the original Gaussian network.

Method of proof

- Cut-set bound is approximately tight for Gaussian and deterministic networks.
- Restrict attention to MIMO channels formed at all cuts.
- Capacity of MIMO channel at every cut is approximately equal for both networks.

Future extensions

- Can we derive optimal coding schemes for Gaussian networks from strategies for deterministic superposition model?
- Can we extend these ideas to multi-terminal Gaussian networks?

