



MANET Capacity to 1st Order (Degrees of Freedom Region)

STATUS QVO

Lack of non-trivial outer bounds.

Too many inner-bounds
What are **good** achievable schemes?

Scaling laws for **large** networks do **not** describe smaller networks.

Capacity of Ad-Hoc Networks?

Runs into open problems of classical information theory.

NEW INSIGHTS

Find network capacity to first order in log (SNR)

How do the data rates in the network scale with log(SNR) ?

Degrees of Freedom Region

First order capacity can be found for many networks where precise capacity is unknown.

Interference Alignment

Signals can be aligned so that they cast overlapping shadows at the interfering nodes while they continue to be distinct at the desired nodes.

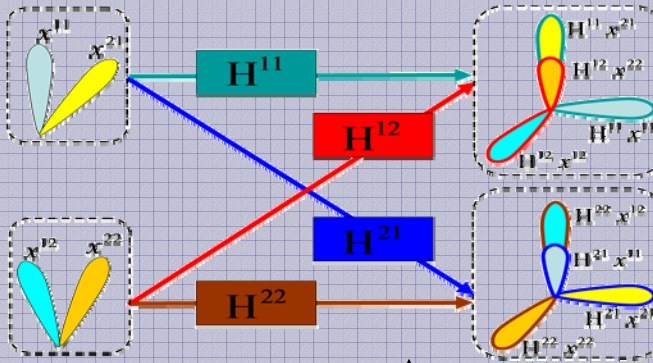
NEQUIT ACHIEVEMENT(S)

Found TIGHT achievability and converse for the "X channel"

Achievability: Interference Alignment

[Jafar, Shamai 2007]

Converse: First Order Capacity Region (shown for d_{22} fixed)



Key Features:

- d_{ij} = DoF for message from Tx i to Rx j .
- Includes interference channel (open problem)
- Includes Z channel (open problem)
- Includes multiple access and broadcast channels
- Applicable to space/time/frequency dimensions

Limitation: 2 Tx, 2 Rx, perfect channel knowledge

END-OF-PHASE GOAL

Optimal interference alignment and first order capacity characterization for increasingly complex networks

- More nodes
- More hops

First order MANET capacity region with cooperation.

- Benefits of transmitter cooperation
- Benefits of receiver cooperation

COMMUNITY CHALLENGE

Degrees of freedom region characterization for general networks.

Impact of channel uncertainty and feedback on degrees of freedom.

Incorporating interference alignment into wireless network design.

Higher order capacity approximation

Higher order coefficients for Taylor series in log(SNR)

A new upper bounding approach + an optimal design that beats MIMO by 4/3 in a 2x2 system