MU5EES08 – Project ideas

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Projects

Wireless Communications: Matlab project

- The project is an extension of the livescript 5, so:
  - All live scripts should work properly
  - Your project should go further than livescript 1-5
  - It can consist in implementing:
    - An additional signal processing at TX and/or RX to improve the performance of the communication (it can be a processing seen during the course or something else)
    - An additional channel model
    - More realism to the simulation to investigate: phase noise effects, IQ imbalance effects, investigate power non-linearities effects, carrier frequency offset due to Doppler effect…
    - Other features: localization…
- This project is 35% of the overall course evaluation

Projects

4 ideas of project, but you are free to propose your own one!

Communication performance improvement thanks to multiple-antenna systems:

1. MRC: Maximum Ratio Combining
2. Transmit Beamforming
3. Alamouti coding

Localization using communication signals

4. Angle-of-Arrival estimation using MUSIC in SIMO systems

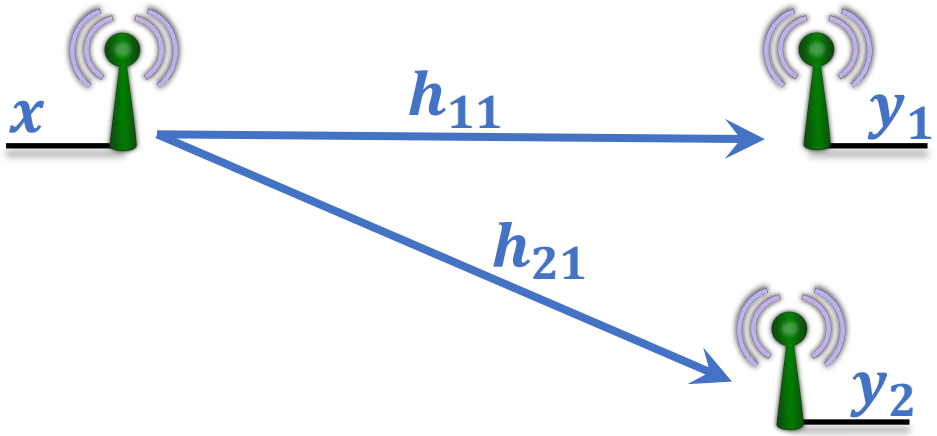
Everything should be implemented with Matlab

Projects

Project 1: Maximum Ratio Combining (SIMO)

- Step 1: Build the system model (based on livescript 5)

h_{11} and h_{21} are both Rayleigh or Rice channel models

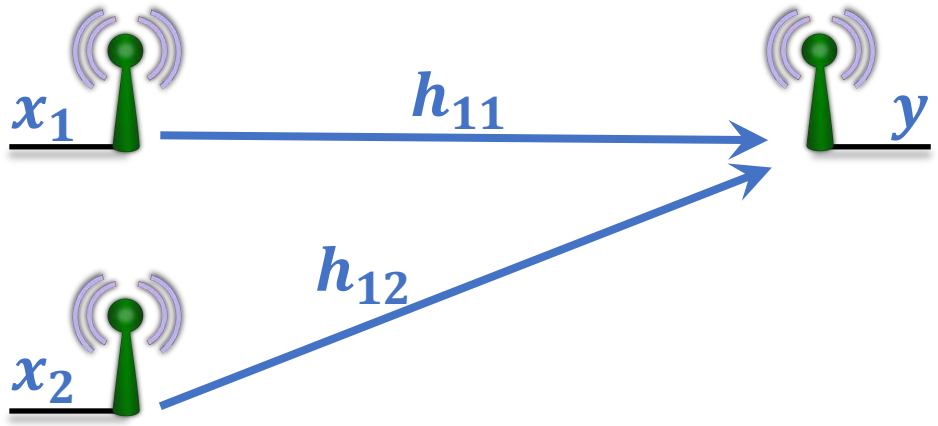


- Step 2: Implement the MRC processing at RX (see slides 4-10 of the course: *"MU5EEF08 - Unit 4 - 3 - MIMO Processing"*)

Project 2: TX Beamforming (MISO)

- Step 1: Build the system model (based on livescript 5)

h_{11} and h_{12} are both Rayleigh or Rice channel models

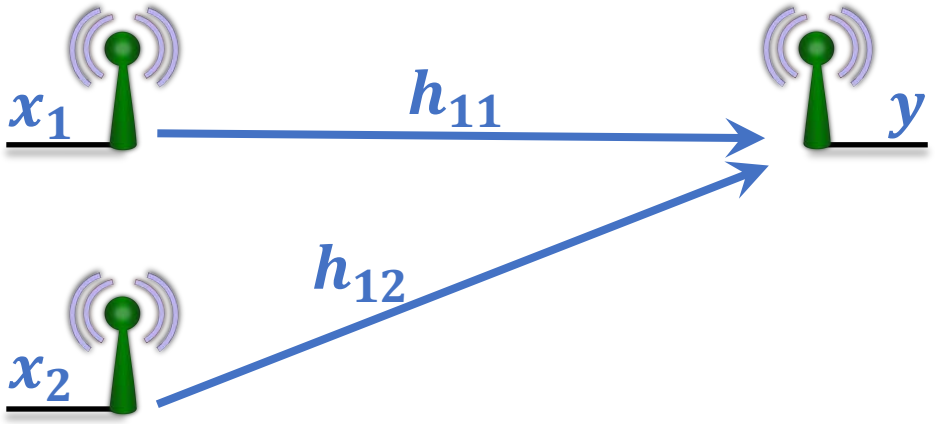


- Step 2: Implement the beamforming processing at TX (see slides 11-23 of the course: *"MU5EEF08 - Unit 4 - 3 - MIMO Processing"*)

Project 3: Alamouti coding (MISO)

- Step 1: Build the system model (based on livescript 5)

h_{11} and h_{12} are both Rayleigh or Rice channel models

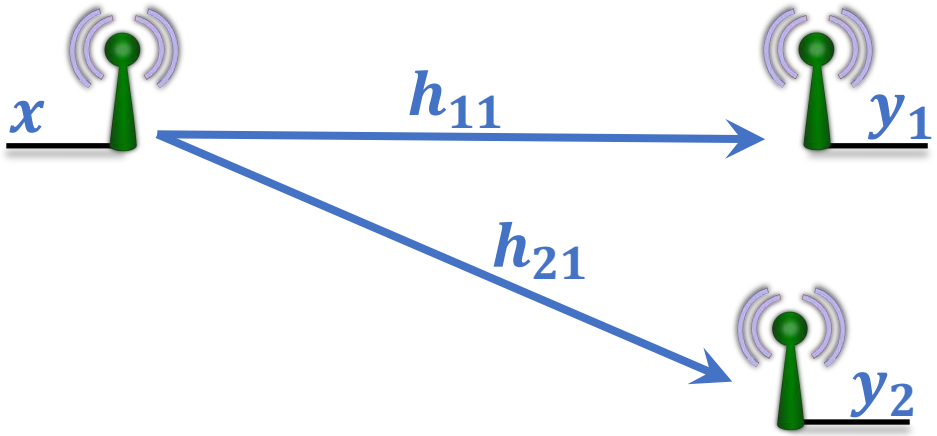


- Step 2: Implement the Alamouti at TX and RX (see slides 24-25 of the course: *"MU5EEF08 - Unit 4 - 3 - MIMO Processing"*)

Project 4: Angle-of-Arrival estimation using MUSIC

- Step 1: Build the system model (based on livescript 5)

h_{11} and h_{21} are both Rice channel models



The phase of the strong component in the Rice channel should be the phase of the LOS path between TX and RX using paraxial approximation (see slide 5-6 of the course "MU5EEF08 - Unit 4 - prerequisites - Antenna Array Theory"

- Step 2: Implement the MUSIC algorithm: plot the pseudo spectrum and check whether its maximum corresponds to the direction of the TX

Project evaluation

- Oral presentation (12 minutes) + questions (5 minutes)
- Your presentation should contain between 10 and 15 slides including at least:
  - 1 slide to present the project
  - 4 slides to present your code (no Matlab code in the slides, only schematics, figures, or any representations to understand what your code does and how it operates)
  - 4 slides of results you should present and comment (e.g., constellations, spectrum, BER curves…). You should highlight the effect of the processing you have implemented.