Sharif University of Technology

Communication Systems Project

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3 Simulation of Telecommunication Channels in MATLAB

3.1 Objective

The aim of this project is to simulate and analyze various telecommunication channels, specifically Rayleigh and Rician channels, under different conditions including time-variation and cumulative noise. The project will involve creating a MATLAB function to simulate these channels and analyze their behavior.

3.2 Project Tasks

1. Understanding Rayleigh and Rician Channels
   - **Rayleigh Channel**: Characterized by the absence of a line-of-sight (LOS) component, with channel coefficients following a Rayleigh distribution.
   - **Rician Channel**: Contains a LOS component, with channel coefficients following a Rician distribution.
2. Channel Types to Simulate
   - **Ray_TI_FF**: Time-invariant Rayleigh channel with flat fading.
   - **Ray_TI_FS**: Time-invariant Rayleigh channel with frequency selective fading.
   - **Ray_TV_FS**: Time-varying Rayleigh channel with frequency selective fading.
   - **Ric_TV_FS**: Time-varying Rician channel with frequency selective fading.
   - **Awgn**: Channel with additive white Gaussian noise.
   - **Ray_TV_FF**: Time-varying Rayleigh channel with flat fading.
3. MATLAB Function Implementation Create a MATLAB function with the following signature:

```
function ch_output=simulate_channel(ch_input, ch_type, snr, Tm, fd)
```

3.3 Deliverables

- A detailed report explaining the theoretical background of Rayleigh and Rician channels.
- A MATLAB function `simulate_channel` that simulates the specified telecommunication channels.
- Plots of the impulse response for each channel type.
- Analysis of the impact of time-variation and cumulative noise on signal transmission.