

Multipath Fading Demonstration Platform using Software Defined Radio

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1 Multipath Fading

- Discrete-time model
- Statistical model

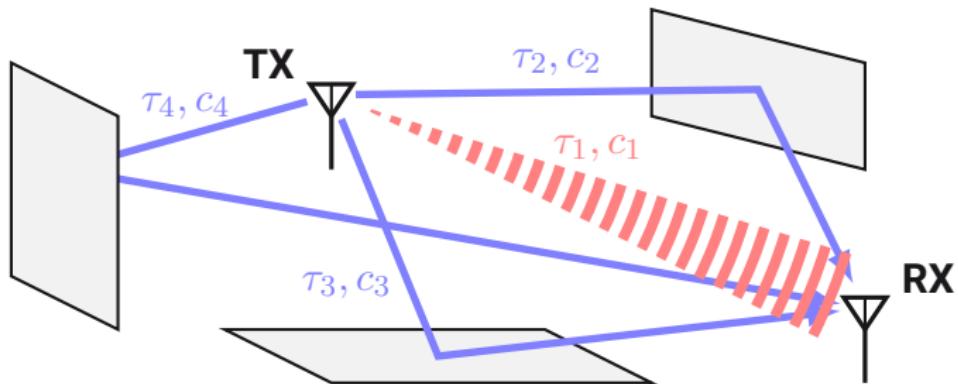
2 Implementation

- Transmitter and Receiver Chains
- Channel model

3 Conclusion

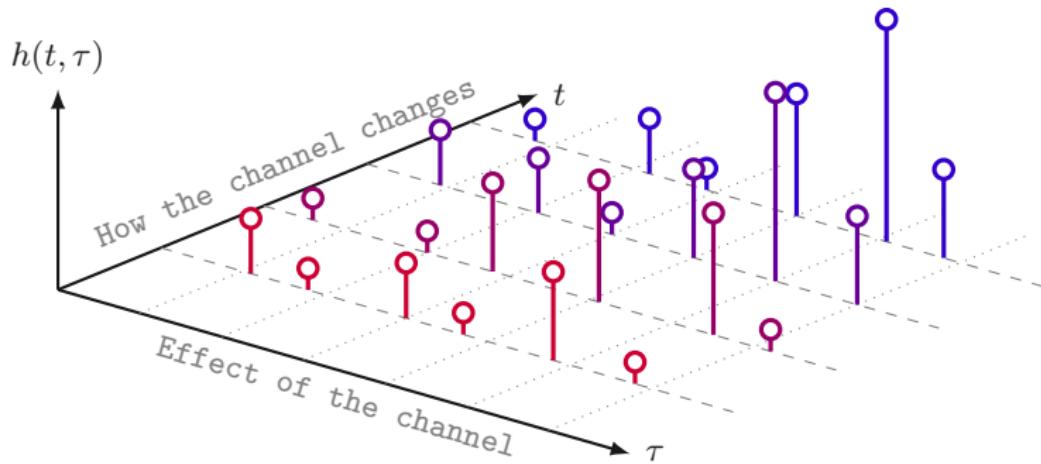
4 Demonstration

Multipath fading



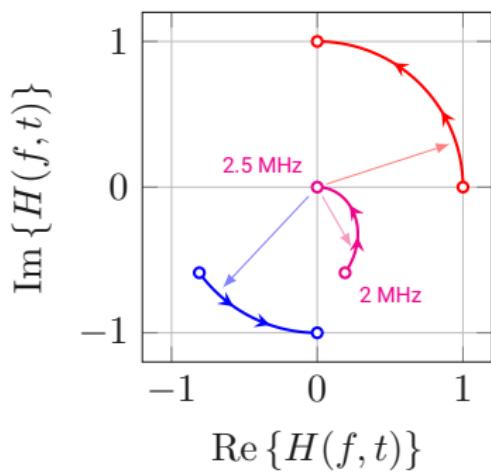
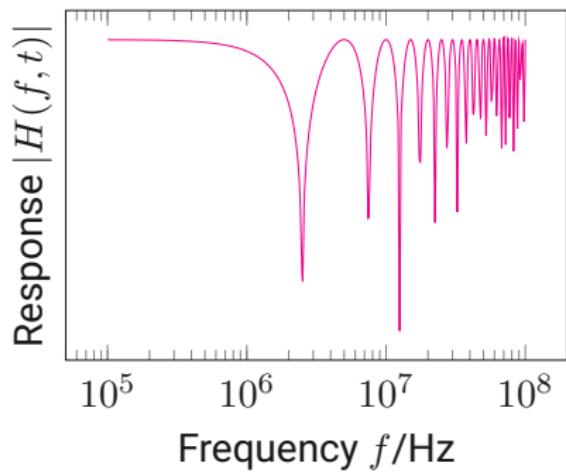
$$r(t) = \sum_k c_k s(t - \tau_k).$$

Impulse response of a multipath fading channel

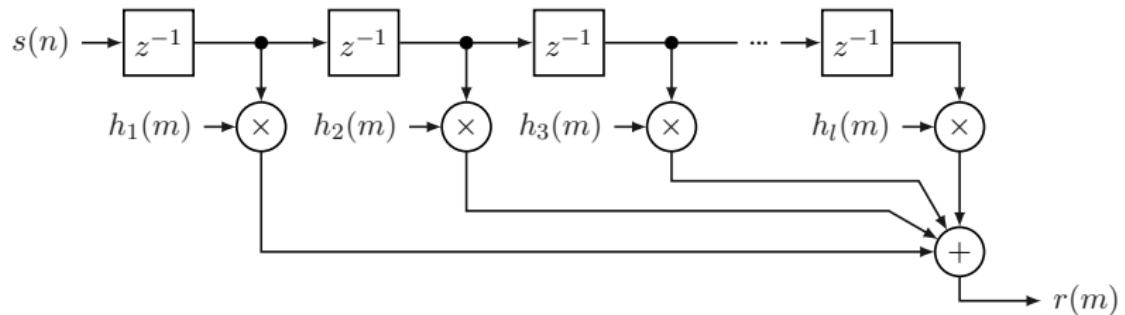


$$h(\tau, t) = \sum_k c_k(t) \delta(\tau - \tau_k(t))$$

Spectrum of a multipath fading channel



Discrete-time and FIR



$$h_l(m) = \sum_k c_k(mT) \operatorname{sinc} \left(l - \frac{\tau_k(mT)}{T} \right)$$

Statistical model

Assuming WSSUS

$$\theta_k \sim \mathcal{U}(0, 2\pi)$$

The NLOS Fading

$$f = \lim_{N \rightarrow \infty} \frac{1}{\sqrt{N}} \sum_{k=1}^N e^{j\theta_k}$$

$f \sim \text{Rayleigh}$

if there is a LOS

$$f \sim \text{Rice}(K)$$

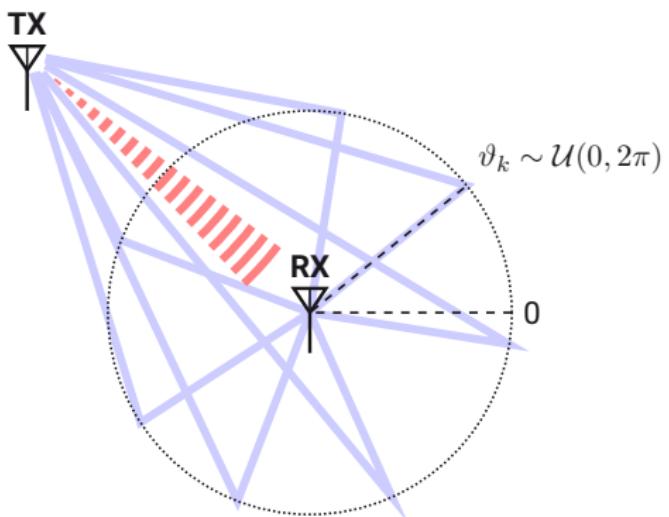


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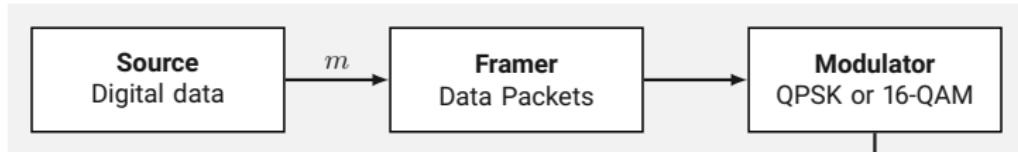
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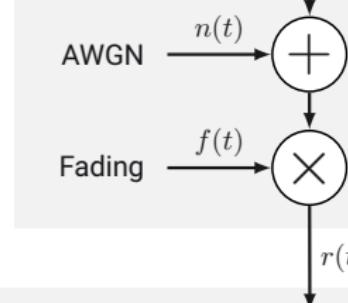
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Block Diagram

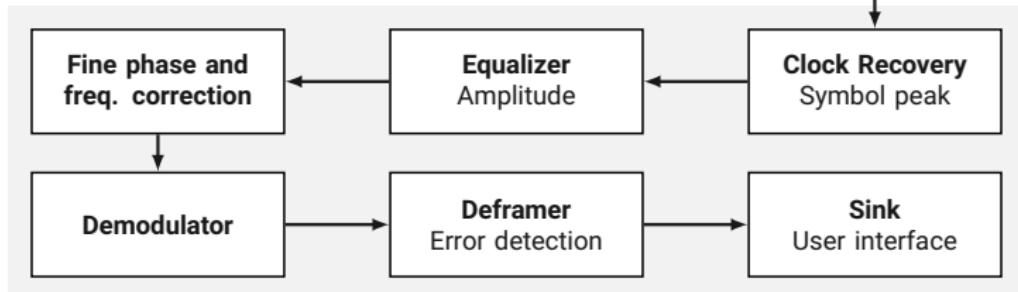
Transmitter



Channel Model



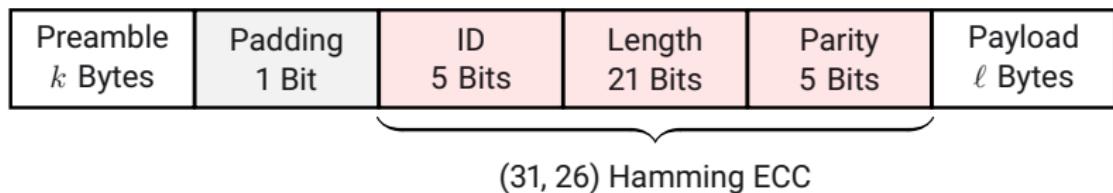
Receiver



Transmitter

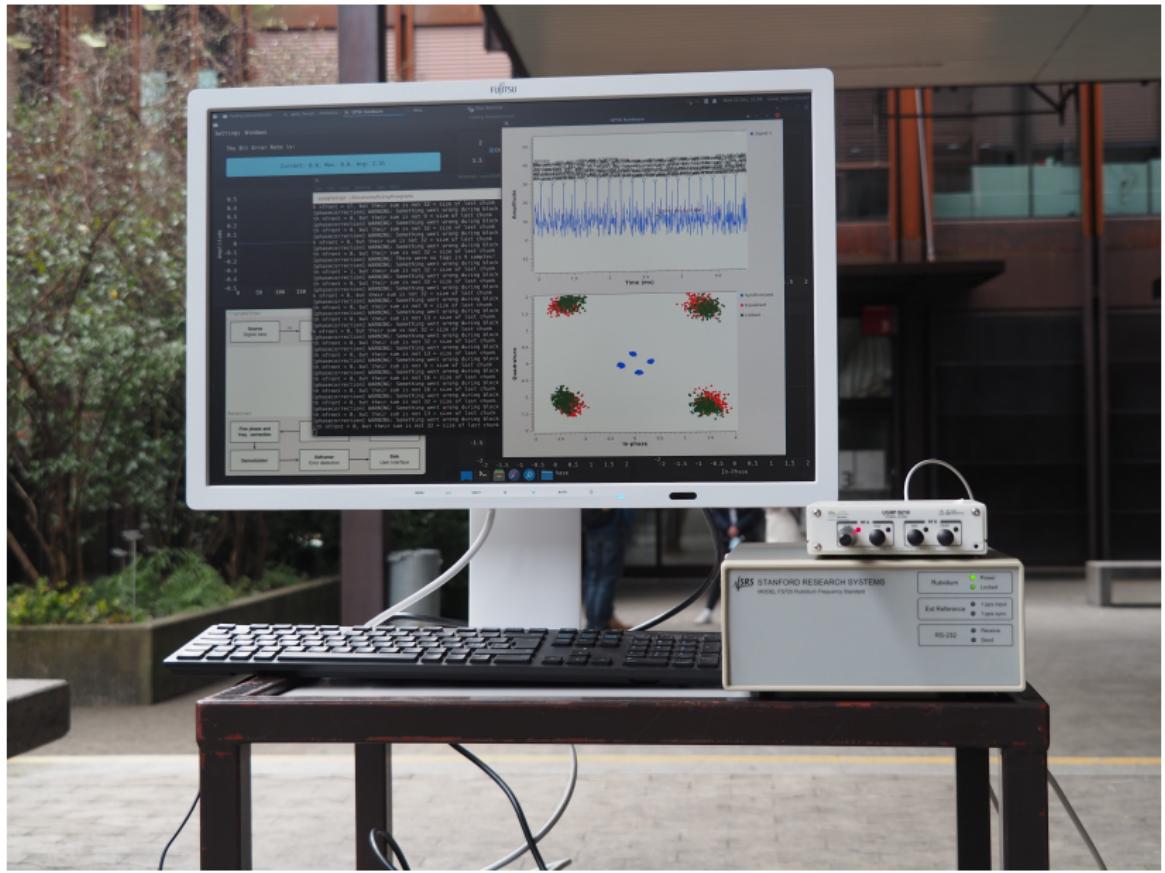


Framed data packets

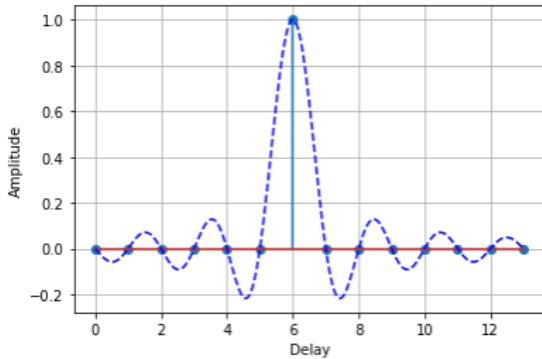
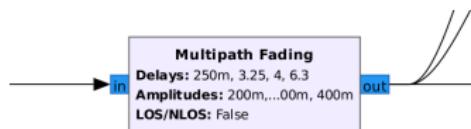


- Very short payload
- k -Byte preamble is a Barker code 0x1f35 for Sync
- Should be replaced with CAZAC

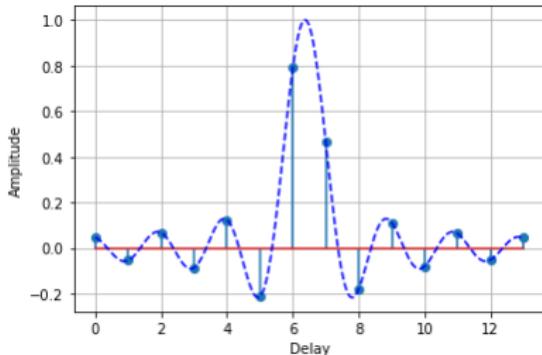
Receiver



Discrete-time model



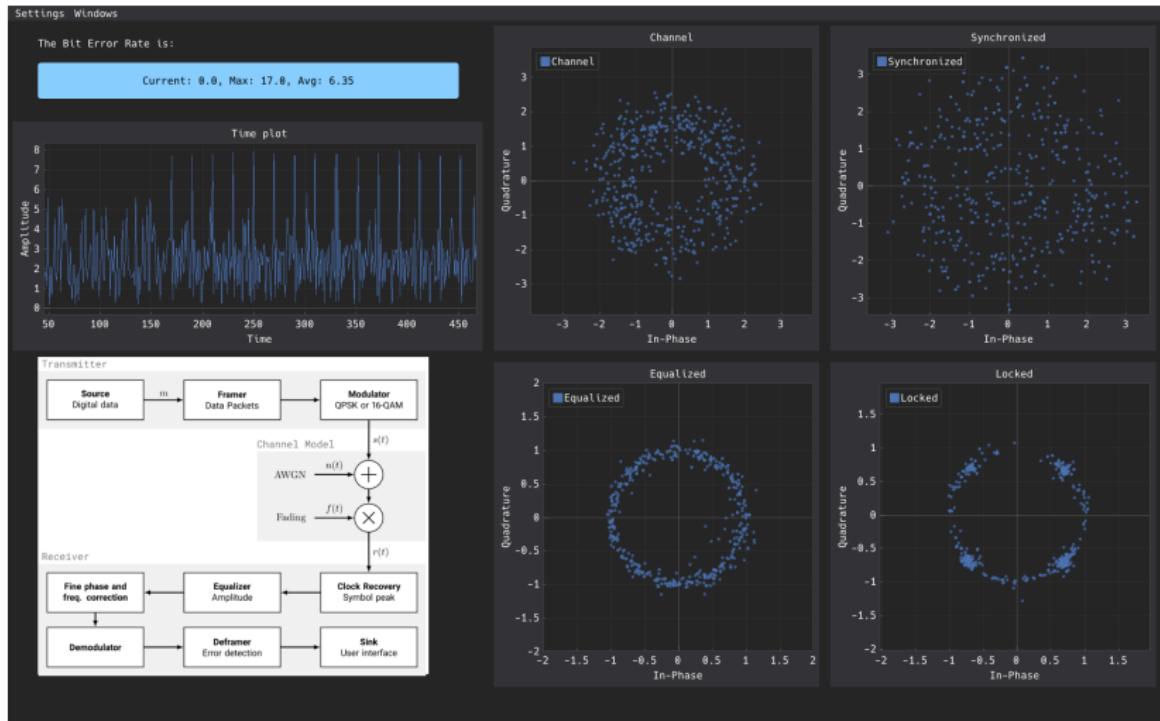
- FIR filter
- Allows for non integer delays



Statistical model



Graphical user interface



Built with DearPyGUI, talks to GR via UDP/IP.

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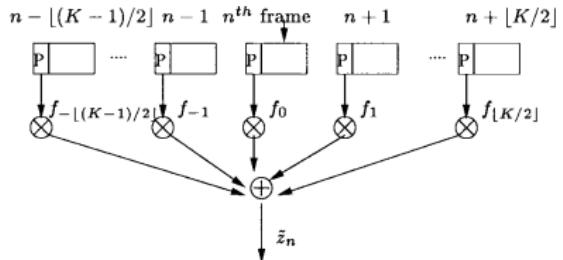
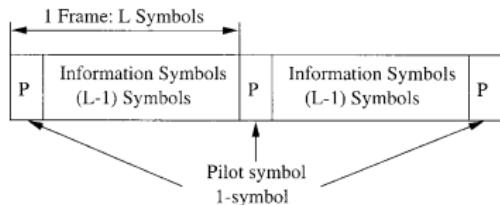
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Further steps



- Improve BER measurements and simulations
- Improvements in the GUI front-end
- Portable transmitter on a Raspberry PI
- Channel parameters estimation with PSAM

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Demonstration

- Simulation
 - Discrete-time model
 - Statistical model
- Hardware