OFDM system

Thomas Lenges,
Renuka Singh Virk

December 2024

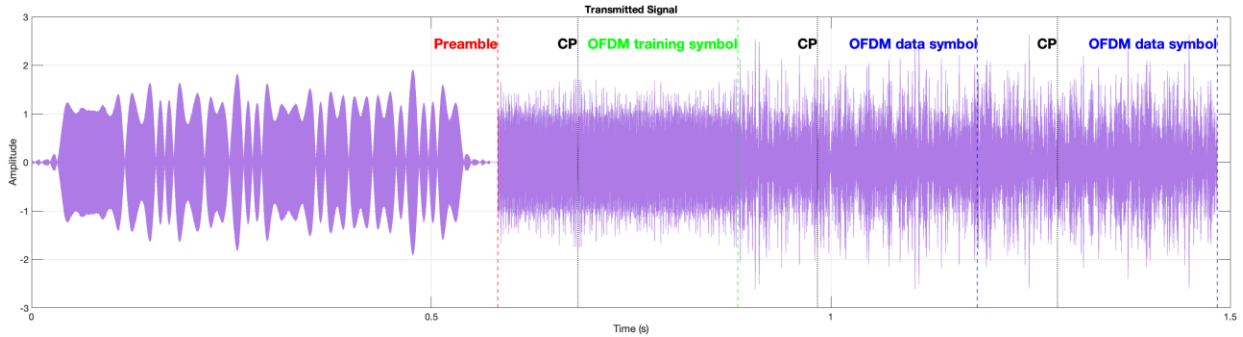
École
polytechnique
fédérale
de Lausanne

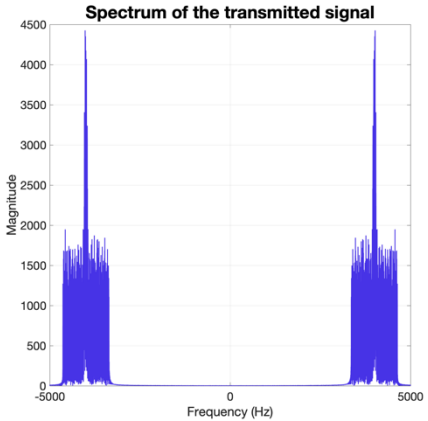
1 Transmitter

RRC | OSIFFT | OSIFFT | OSIFFT

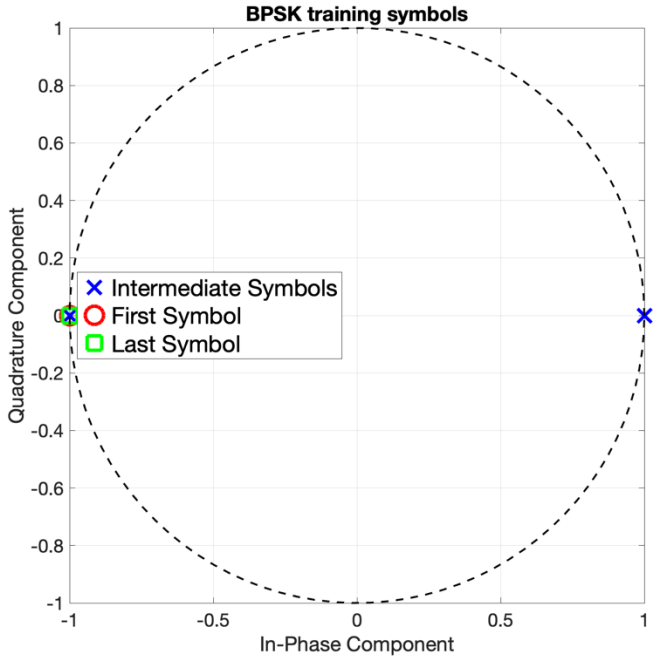
Preamble BPSK	CP	Training BPSK	CP	Data QPSK	CP	Data QPSK

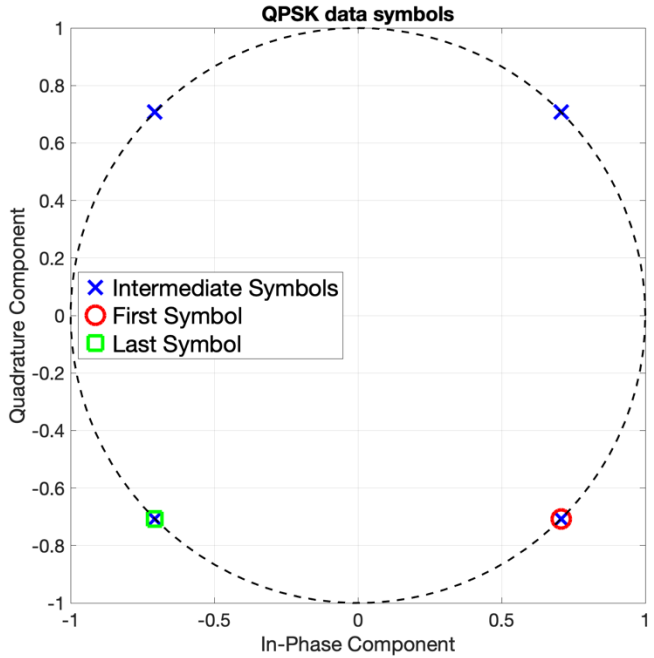
$x \quad e^{(2\pi j f_c t)} \longrightarrow \mathrm{Re}(\cdot)$



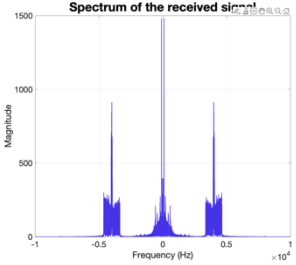


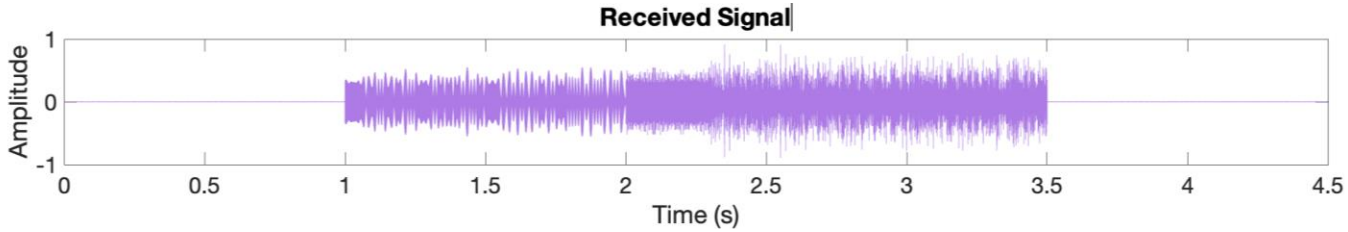
1 Transmitter: transmitted symbols



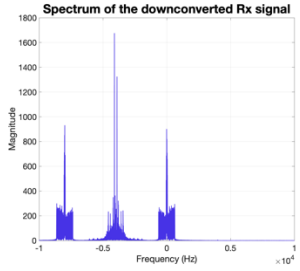


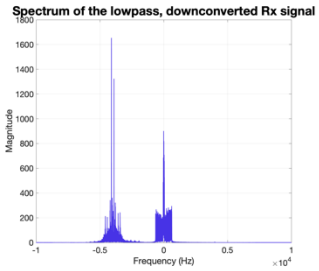
2 Receiver





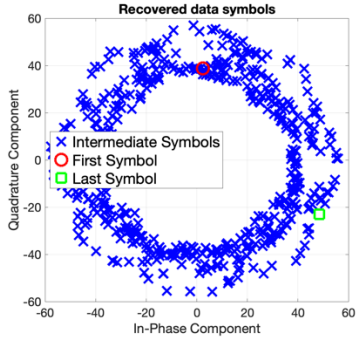
Rx signal downconversion → Lowpass filter → Start identification → Channels estimation & correction → Demapping & final results

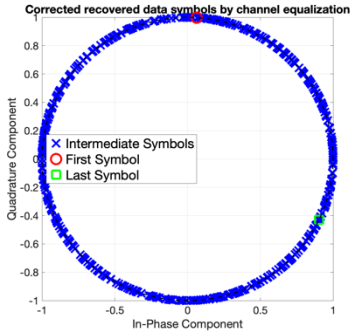


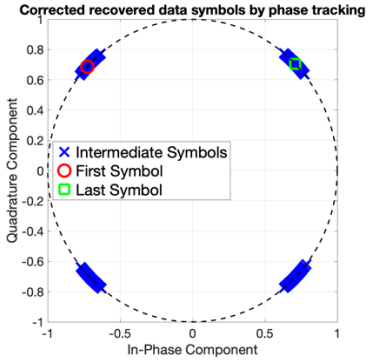


2 Receiver: channel equalization & phase tracking

Transmission of 1024 data bits:





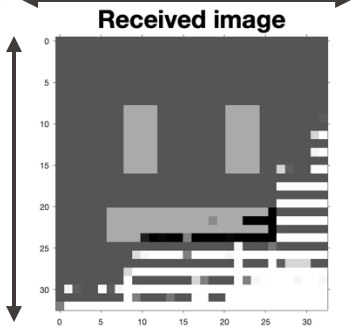


Channel equalization, no phase correction:

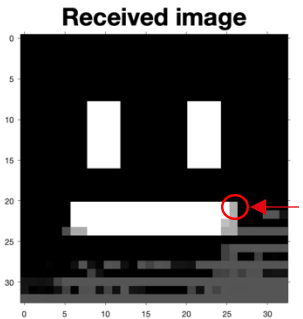
8-bit pixel depth
Total: 8192 bits

32 px

32 px

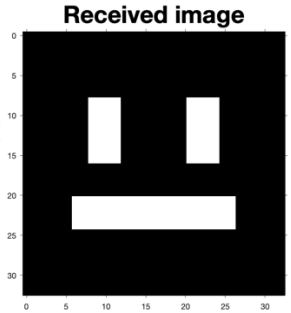


Naive phase correction:



~5320th bit

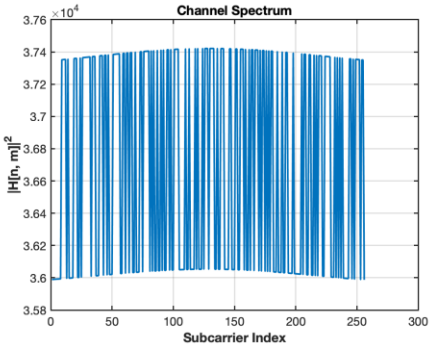
Channel equalization & continuous phase tracking:

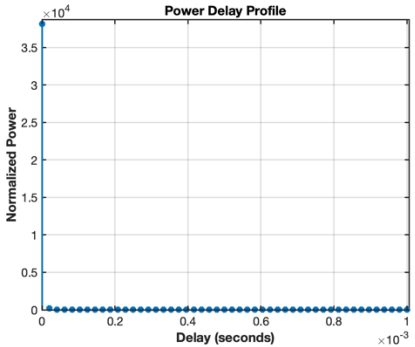


3 Channel analysis

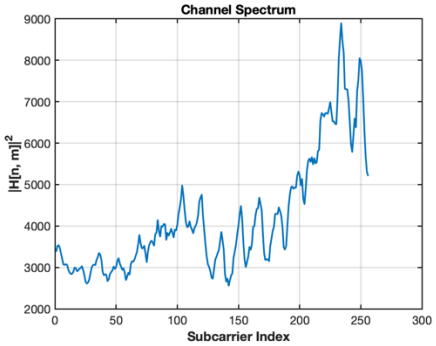
256 subcarriers

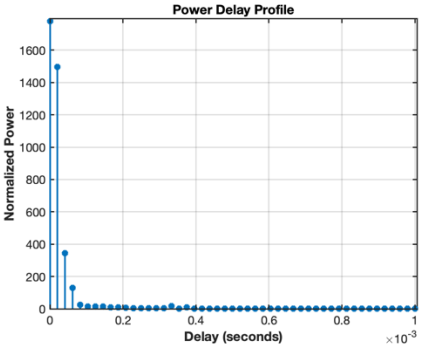
Bypass:



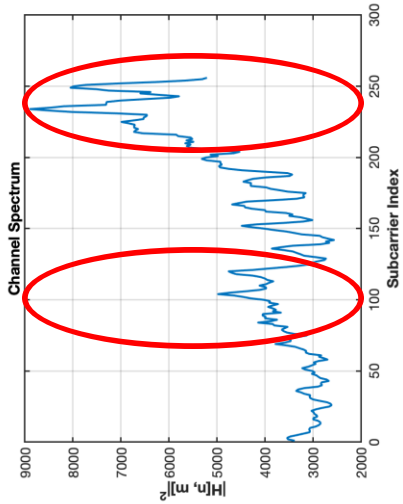


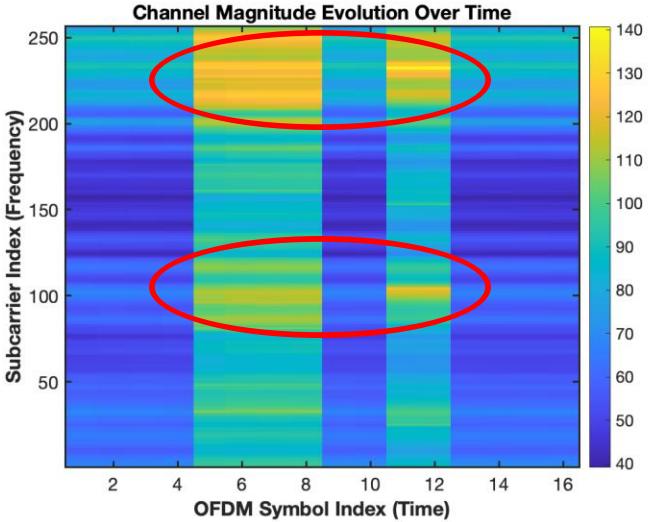
Matlab:

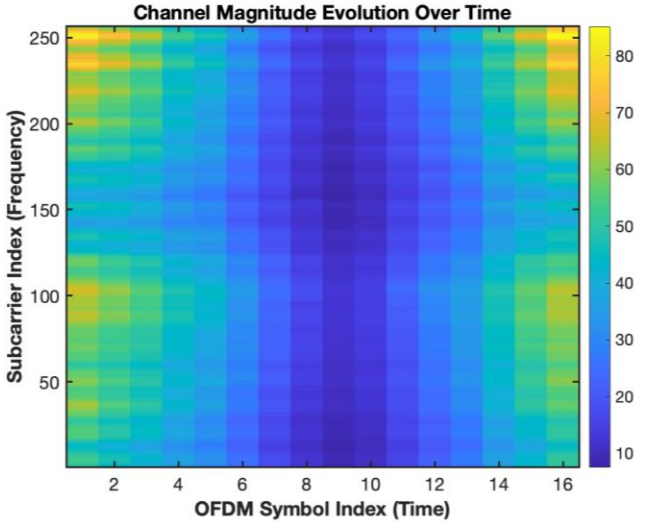




3 Channel analysis

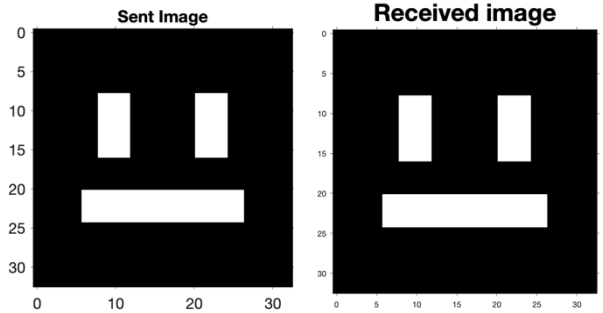




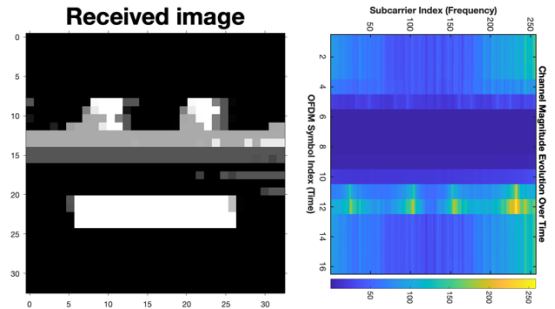


4 Image transmission

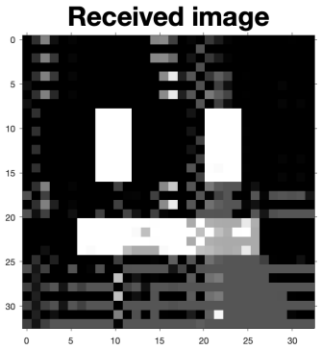
Under ‘ideal’ conditions:

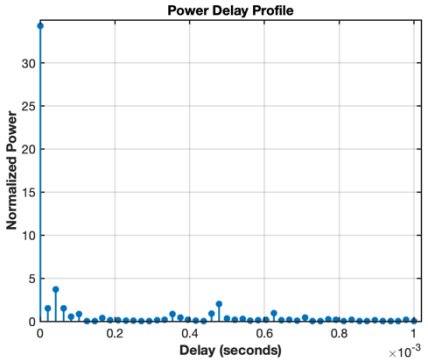


Varying volume:



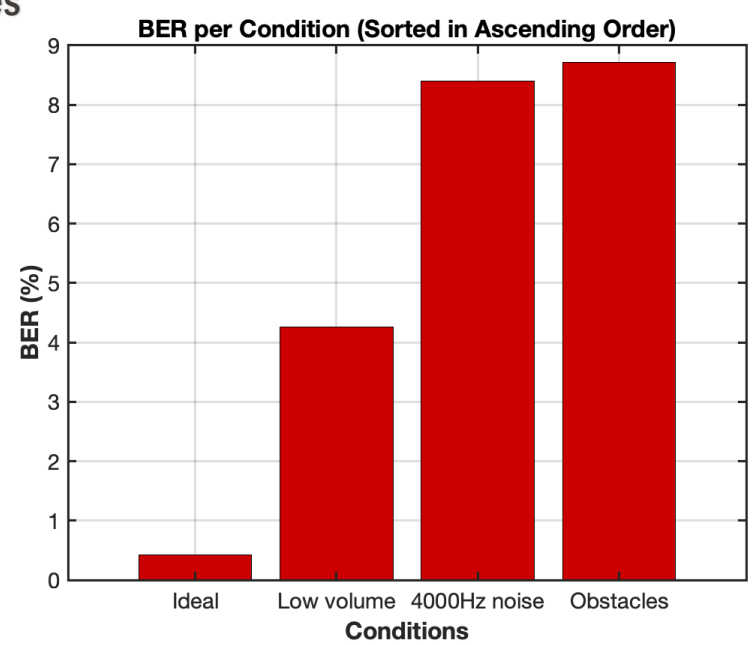
Obstacles in the path:

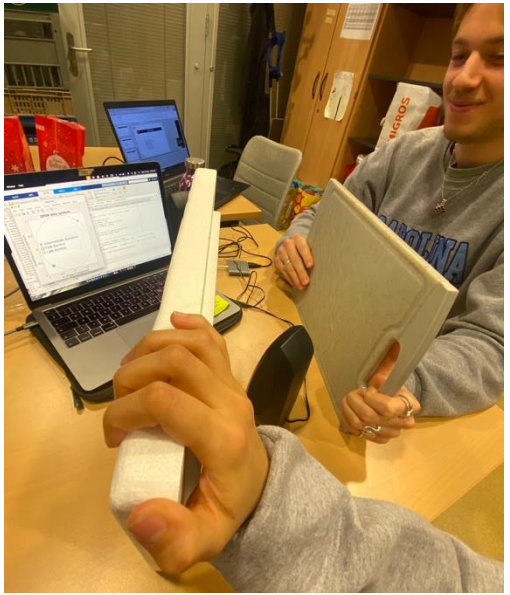




5 BER analysis under varying conditions

5 frames





6 Future improvements

- Robustness to multipath propagation: use multiple input multiple output (MIMO) to exploit spatial diversity
- Continuous channel amplitude tracking (could be useful if we implement QAM for higher data rates)
- Experiment with more subcarriers