



C++ Implementation of Channel Estimation for a novel Physical Layer

(Research Project / Bachelor thesis / Master thesis)

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Unique-word (UW) transmission is a promising candidate that facilitates per-block synchronization and channel estimation [1]. The main concept is to replace the cyclic prefix (CP) of random nature by a deterministic sequence that is known to both transmitter and receiver. Hence, maintaining the advantages of CP in terms of robustness against multipath channels, UW allows fast channel tracking in highly mobile scenarios where the underlying wireless channel is extremely doubly-dispersive. This makes the UW-based PHY layer, a promising candidate for vehicle-to-everything (V2X) applications.

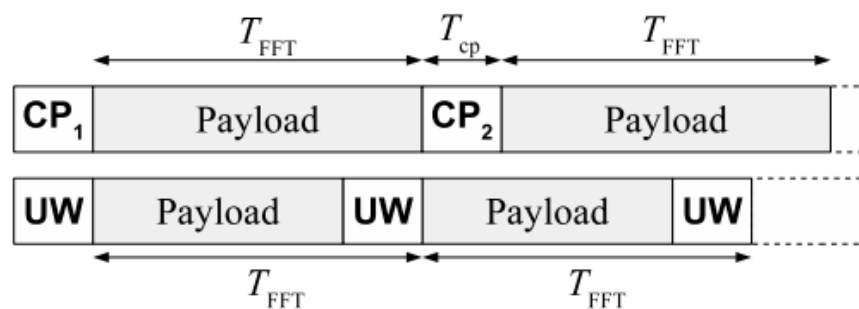
The task of this work is mainly implementation of an already available MATLAB code into C++ and integration of the code in Open-Air-Interface (OAI) simulator. The work shall be also extended to MIMO. The results can be summarized as a report for a research project or a bachelor thesis.

Once the UW-based PHY layer over the OAI simulator has been developed, the work should be implemented on a software defined radio (SDR) platform and tested over the air. Multiple channel sounding and measurements summarizes the work for a Master thesis.

Subtasks:

- Literature research on channel estimation in V2X scenarios.
- Derivation of the channel estimation for unique-word based frame structures.
- Adaptation of the MATLAB code with the developed channel estimator.
- Development of a testbench for C++ implementation.
- Implementation of the MATLAB simulation code in the C++ testbench.
- Integration of the C++ implementation code into OAI simulator.
- Integration of the C++ implementation on SDR hardware.
- Executing a measurement campaign on channel estimation.

[1] Ehsanfar, Shahab, Marwa Chafii, and Gerhard Fettweis. "On UW-based Transmission for MIMO Multi-Carriers with Spatial Multiplexing." *IEEE Transactions on Wireless Communications* (2020).



Example of a UW vs. CP design

What you will learn:

- Various 5G and Beyond telecommunication techniques.
- How to write a scientific document.

What we offer:

- You may publish your work as a scientific paper.
- You can implement and test your algorithm on electric cars.

Requirements:

- Background on linear algebra.
- Background on communication systems.
- Strong programming skills in Matlab and C++.
- Knowledge on estimation and detection theories is plus.

How to apply:

- Read the above mentioned paper. If you find it interesting, send an email with your CV and your performance overview (you will find it on the website of the Central Examination Office) to shahab.ehsan-far@etit.tu-chemnitz.de