In our research project, we as a group studied the major physical layer technologies which form the base for 5G networks. These physical layer technologies were subdivided into three major technologies (Non-Orthogonal Multiple Access Technology, Polar Code and Filtered-OFDM and massive-MIMO technology) among the three members of our group by our mentor.

Non-Orthogonal Multiple Access Technology is discussed among the New Radio (NR), which is a study item focussing on the design of next generation air interface. It is an upcoming multiple access technology specially designed for supporting 5G and future wireless communication scenarios which has improved features over traditionally used multiple access technologies in terms of better spectral efficiency, ability to accommodate larger number of users etc by virtue of its unique property of non-orthogonal resource allocation. NOMA can accommodate much more users via nonorthogonal resource allocation by allowing controllable interferences. Massive MIMO systems have shown potential to become a candidate for the next generation wireless technologies including 5G.
communication technology. Massive MIMO can be understood as an arrangement of MIMO systems having large quantity of antennas at base station and at terminals and these large number of antennas at base station work for fewer antennas at the terminals making use of same time and frequency resources. The growing number of served users and the increasing demand for large amounts of data opened the doors for this technology. The scaling of MIMO technology to large scale is to increase the capacity by 10 times so as to have the capability of supporting the future generations wireless networks. Polar codes, presented by Arıkan, are a class of error-correcting codes that are proven to achieve channel capacity for long block codes. They have been designated for the next generation of wireless communication standards. The 5G standardization process is putting its main focus on improved error-correction performance, lower power consumption, lower latency and higher throughput. For example, machine-to-machine communications in 5G require massive connectivity among a huge number of devices, on a scale much higher than the most bandwidth-demanding applications in 3G and 4G, with a limited power budget. Therefore, consistent and efficient encoding and decoding methods need to be constructed.

We studied various research papers and also performed simulations on MATLAB and Simulink platform for understanding the key features, advantages and various research trends related with this technology. The important facts were then presented in form of poster and a detailed report for final submission in the Armour R&D Expo. Apart from this, our research group also got an opportunity to work on a research problem related to future generations wireless communication assigned by our mentor regarding an efficient constellation scheme for transmission of symbols from large number of users with optimized average energy and maximised distance between adjacent symbols. We presented a mathematical formulation for this problem and a developed a MATLAB code for testing the constellation characteristics based on the various input symbols from different users and then observed and compared the different constellation shapes and presented the findings to our mentor.
Polar Codes and Filtered OFDM

INTRODUCTION

The growing demand for higher data transmission rates and the increasing use of wireless communications is making wireless networks the backbone of daily life activities and industries. These networks play an important role in every field.

Polars codes are an intriguing solution of direct encoding techniques with the power to approximate the capacity of a channel. A significant challenge has been designing the best procedure of achieving this transmission.

APPLICATIONS

- 4G/5G Multicell Networks
- D2D/ICN Networks
- Wireless Access in Microwave
- Underwater Communication
- Cable Networks
- Mesh Networks

F-OFDM: A New Concept for OFDM

- Enhanced spectrum efficiency
- Simplified transmitter and receiver architecture
- Improved performance in frequency selective channels

FILTERED OFDM

- F-OFDM is a spectrally boosted modulation format suitable for different transmission scenarios.
- It reduces the interference between different subcarriers.
- It improves the spectral efficiency of the system.

BIBLIOGRAPHY


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