Popular Science Summary

In the 21st century, the popularity of 4G networks has greatly improved people's quality of life. As a new generation of communication technology, 5G can bring better services than 4G to people's lives. With 5G technology, people can download a two-hour movie in tens of seconds and watch an HD live soccer match and demands for even higher transmission rates are increasing. The transmission rate, however, is limited by the available frequency resources. A range of frequencies used for signal transmission is called bandwidth. To achieve these higher transmission rates we, therefore need more bandwidth. However, the frequency resources are scarce and very expensive.

One solution is to pack more data to be transmitted in a limited bandwidth. If the data rate exceeds a certain limit, technically known as the Nyquist rate, we experience distortions in our received data. These distortions are caused by the overlap between adjacent signals, which is called intersymbol interference (ISI). We can, however, revert this interference at the receiver by a technique called equalization. We can therefore transmit faster than the Nyquist limit and use equalization to mitigate the resulting ISI. This kind of transmission is called faster than Nyquist (FTN) signaling.

However, because of noise when transmitting the signals, there will be some errors even after equalization. These errors can be corrected at the receiver if we use error-correcting codes, where controlled redundancy is added by the transmitter to enable the receiver to recover these errors. If the equalizer and error-correcting codes work separately the overall error-correction performance can be good, but even better performance can be obtained by the interaction between equalization techniques and error-correcting codes. This whole combination is called Turbo equalization.

Spatially-coupled codes are a kind of error correction codes that have shown good error correcting capability. In this thesis, we investigate the impact of using these spatially coupled codes for systems using FTN transmission. We show that, with spatially coupled codes, we can get higher data rates in limited bandwidth, using much lower energy at the transmitter compared to classical coding schemes.