

Thesis title:

Hybrid Beamforming-Based Massive MIMO systems

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1- Abstract

In the context of “smart City”, a very large number of sensors will be deployed everywhere in the cities. These sensors constitute several networks working in parallel in the same geographical area. In order to a massive deployment of sensors, a very low price per sensor is needed. Furthermore, in many applications the sensors should work on battery. We are interested in proposing the ways to decrease the transmitted power of sensors without adding complexity to them. In fact, all the complexity will be in the gateway level, which is supposed to be connected to the outlet. Decreasing the transmitted power will contribute indirectly in the overall interference diminution. One solution is to increase the number of antennas at the gateway in order to point the individual sensors. Because of the great number of sensors, a great number of antennas (massive MIMO) should be used, which increases exponentially the complexity with the number of antennas. In order to do beamforming for the important number of antennas, the hybrid methods are proposed. That is because a totally digital beam-former requires too many RF front-ends. On the other side, all-analogic beam-former does not allow a multi-stream transmitter, therefore not interesting for a multiuser network. Therefore, the beam-former is divided into two parts, analogic and digital, which is called “hybrid beamforming”. In fact, the analog part add complex coefficients at each signal path. Many sub-optimal analog parts have been proposed to simplify the analog structure. We will use LabVIEW as the programming environment because we will implement the developed programs into a USRP that can be programmed by LabVIEW. This thesis should give us a good insight about hybrid beamforming in sub-optimal beam-former case. We should simulate the transmitter with many antennas, including the digital and analog beam formers. The channels should be modeled and the received should be designed and simulated.

2- Keywords: massive MIMO, Hybrid beamforming, LabVIEW, USRP.

3- Thesis Plan

1. A report on the principles of hybrid beamforming
2. Identify sub-optimal methods
3. How the weights at the digital part and analog part are optimized using a joint optimization problem. In case of finite phase state at the phase shifter, the optimization transform on combinatorial optimization.
4. Simulation using LabVIEW
5. We increase the number of antennas and the number of RF front-ends. The theoretical studies about the performance and coefficient optimizations should be done.
6. The channel will be replaced by models of channel seen in the literature using a few scatterers in the medium.
7. Conclusion

4- The obstacles encountered so far:

1. Using LabVIEW
2. Assimilate the current techniques developed for hybrid beamforming
3. Using hybrid beamforming with millimeter waves, Massive MIMO...

5- Abstract Graphique

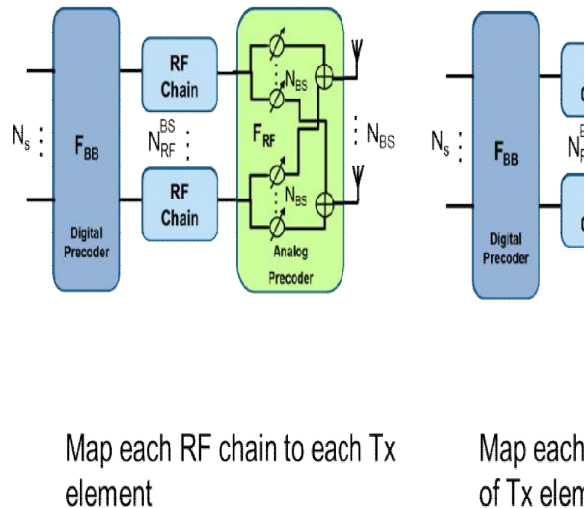


Fig. 1. Hierarchical Hybrid beamforming

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