



Automated Cell-free MIMO Communication System for 5G

using a new all-digital radio-over-fiber hardware solution

Background

Higher energy efficiency and higher capacity are two of the most important factors that drive development of new communication systems. Massive MIMO is a technique where base-stations with hundreds of antennas are used to reach these goals. Massive MIMO is therefore a key technology in 5G communication systems. It was recently suggested that performance could be improved dramatically if a *cell-free Massive MIMO system* is considered [1]. In this case, a large number of simple access-points (AP) coordinated by a central processing unit (CPU) form a distributed base station architecture. While simple to depict, it is challenging to realize in practice. One of the main problems is to maintain accurate synchronization of the RF signals between the widely separated APs. To the best of our knowledge, this is the first system to demonstrate *cell-free Massive MIMO* integrated with all-digital radio-over-fiber.

<p>Cell-free massive MIMO system where many simple access points (APs) are served from a central processing unit (CPU) [1]</p>	<p>You will use the implemented all-digital cell-free MIMO measurement setup including the automated receiver.</p>

Objectives

We have implemented a new all-digital radio-over-fiber testbed where digital communication signals are transmitted from a standard FPGA platform to remote radios while maintaining accurate RF signal synchronization (see above). The overall objective of this project is to realize a duplex (uplink & downlink) cell-free massive MIMO communication system using implemented all-digital radio-over-fiber system, broken down into the following tasks:

- Implement the uplink and integrate it with the developed MIMO communication system testbed
- Perform real communication measurements in realistic in- and outdoor environments with the *automated receiver*
- Evaluate the performance of a cell-free vs. traditional massive MIMO system

If successful, we aim to report the results in a joint scientific paper.

Qualifications

The project is very multi-disciplinary, including both hardware and communication system parts. The project is therefore suitable for 2 students with wireless & photonics and/or communication systems specialization. You will work closely with our multi-disciplinary research group at Chalmers.

Application and Contact information

The project is scheduled to start in Jan. 2018. Please send your application (including CV and transcript) as soon as possible! For more information please contact:

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References

[1] H. Q. Ngo et al., "Cell-Free Massive MIMO versus Small Cells," *IEEE Trans. Wireless Communications*, March 2017.