Hybrid Sub-Connected Precoding Based on Millimeter Wave Massive MIMO-NOMA

Supervisor: Ahmed El-Mahdy

Project Overview:

Millimeter Wave (mmWave) cellular systems will enable gigabit-per-second data rates due to its large available bandwidth. Non-orthogonal multiple access (NOMA) has been recently considered in millimeter-wave (mmWave) massive MIMO systems to further enhance the spectrum efficiency. In addition, simultaneous wireless information and power transfer (SWIPT) is a promising solution to maximize the energy efficiency.

In this project, we investigate the integration of SWIPT in mmWave massive MIMO-NOMA systems. MmWave MIMO will likely use hybrid analog and digital precoding, which integrate small number of RF chains to reduce energy consumption. Hybrid precoding using sub-connected architecture is considered to improve the energy efficiency when compared to full connected architecture. We will apply SWIPT in Hybrid precoding-based MIMO-NOMA systems, where each user can extract both information and energy from the received RF signals by using a power-splitting receiver. Specifically, the cluster-head selection (CHS) algorithm is proposed to select one user for each beam at first, and then the analog precoding is designed according to the selected cluster heads for all beams.

Output: The performance of the mm wave MIMO-NOMA system is evaluated in terms of spectral efficiency and energy efficiency & compared with MIMO-OMA.

Eligible Departments:

Electronics	-
Communications	**X**
Networking	-

Software:

Matlab

Fully-Connected Hybrid Precoding Based on Millimeter Wave Massive MIMO-NOMA

Supervisor: Ahmed El-Mahdy

Project Overview:

Fully-connected hybrid precoding is considered for mm wave massive MIMO-NOMA to achieve high spectral efficiency. Hybrid precoding (HP) has been proposed to significantly reduce the number of required RF chains in mmWave massive MIMO systems without an obvious performance loss. The key idea of HP is to decompose the fully digital precoder into a high dimensional analog precoder (realized by the analog circuit) to increase the antenna array gain and a low-dimensional digital precoder (realized by a small number of RF chains) to cancel interference. Fully-connected architecture, where each RF chain is connected to all antennas, has higher spectrum efficiency.

In this project we implement the above system using simulation and evaluate its performance in terms of spectral and energy efficiency.

Eligible Departments:

Electronics	-
Communications	**X**
Networking	-

Output:

Obtain Spectral efficiency and Energy efficiency of the above system. Comparison will be performed with sub-connected system.

Software:

Matlab

Ultra-Broadband Terahertz Communications Toward Fast Networks Beyond 5G

Supervisor: Ahmed El-Mahdy

Project Overview:

THz systems can benefit from an extreme increase in the bandwidth, it comes at the price of suffering severe path-loss attenuation and channel particularities. As a consequence, conventional modulation schemes cannot fully benefit from the properties of the THz regime. In this context, novel modulation schemes, which take into account the channel particularities, have been presented in the open technical literature.

In this project, we provide a distance and frequency dependent adaptive modulation scheme, which is suitable for communication systems operating in the terahertz (THz) band.

Departments:

Electronics	-
Communications	**X**
Networking	-

Output:

Evaluate the rate-distance curve and the Bandwidth-distance curve for this receiver.

Software:

Matlab

Unmanned Arial Vehicles Assisted Wireless Communication Networks

Supervisor: Ahmed El-Mahdy

Project Overview:

Recently, unmanned aerial vehicles (UAVs) or drones have found a wide range of applications in package delivery, video surveillance, remote sensing, aerial communication platform, and many others due to high mobility. Integrating unmanned aerial vehicles (UAVs) into the cellular network as new aerial users is a promising solution to meet their ever-increasing Communication demands. Due to the high UAV altitude, the channels between UAVs and the ground base stations (GBSs) are dominated by the strong line-of-sight (LoS) links, which brings both opportunities and challenges. On one hand, a UAV can communicate with a large number of GBSs at the same time, leading to a higher macro-diversity gain as compared to terrestrial users. However, on the other hand, severe interference may be generated to/from the GBSs in the uplink/downlink, which renders the interference management with coexisting terrestrial and aerial users a more challenging problem to solve.

This project studies the uplink communication from a multi-antenna UAV to a set of GBSs in its signal coverage region. We propose a new cooperative interference cancellation strategy for the multibeam UAV uplink communication, which aims to eliminate the co-channel interference at each of the occupied GBSs and in the meanwhile maximize the sum-rate to the available GBSs.

Departments:

Electronics	-
Communications	**X**
Networking	-

Output:

Evaluate the sum rate of the system.

Software:

Matlab