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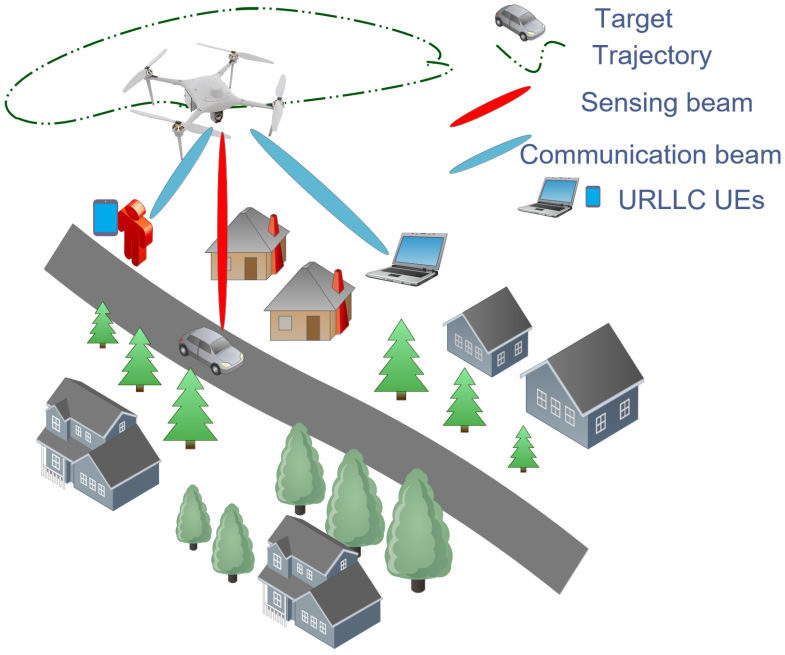
Master/Bachelor's Thesis

Target Detection simultaneous with serving sensitive packets in UAV-assisted networks

Abstract

Radar is an electromagnetic system used for detection purposes. It works by transmitting a specific type of waveform, such as a pulse-modulated sine wave, and analyzing the characteristics of the echo signal. As a result, radar systems are designed to detect and track targets by emitting signals into the environment and receiving their reflections. An effective parameter estimation method is crucial in radar detection theory. In recent years, multiple-input and multiple-output (MIMO) radars have garnered significant attention for their potential in future wireless networks. A MIMO radar utilizes multiple antennas to transmit several (often linearly independent) waveforms simultaneously. It also employs multiple antennas to receive the reflected signals, enabling the detection and tracking of multiple targets at the same time. The integration of sensing and communication functions into a unified infrastructure, called Integrated Sensing and Communication (ISAC), is a cornerstone of 6G networks. This integration makes MIMO radars more practical as they can simultaneously detect multiple targets while supporting multiple communication users. Research on MIMO radars and their detection procedures offers valuable insight into the development of future networks. In addition, time-sensitive users, such as those requiring ultra-low latency, demand fast data delivery from the network. ISAC technology presents a promising solution that enables the simultaneous support of such users while also performing target detection. In this context, we assume an Unmanned Aerial Vehicle (UAV) as the Dual-Functional Radar Communication (DFRC) unit. The UAV can provide a strong line of sight (LoS) link while also performing accurate sensing, making it an ideal platform to leverage the benefits of ISAC in future 6G networks. The goal of this project is to detect multiple targets within the environment while simultaneously supporting Ultra-Reliable Low Latency Communication (URLLC) users on the network.



Guidelines for the project

1- Understanding basic concepts of sensing and radar detection process

2- Literature review on radar sensing and ISAC and URLLC

3- Developing a framework for ISAC

4- Literature review on the mathematical optimization

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5- Simulation of the proposed algorithm in MATLAB

* If successful, this work may lead to a journal and/or a conference paper

Requirements

* Interest in communications and signal processing

* Basic knowledge of digital and mobile communication systems and estimation theory (e.g. background in courses like Digital Communications, Fundamentals of Mobile Communications, and MIMO Communications).

* Basic knowledge of ISAC will be considered as a superiority.

* Experience in MATLAB.