How can OFDM based radio signals/system sense shallow or deep breathing with the help of beamforming?

Master Thesis Assignment / Student Assignment

Theme:	Propagation, Signal Processing
Application:	Healthcare, 6G
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I. Introduction:

Summary: Integrated sensing and communication (ISAC) is a key feature for 6G and future Wi-Fi systems. In ISAC systems, highly accurate sensing on surrounding environment is as important as high speed communications, providing added values for modern cellular/Wi-Fi infrastructure and enabling emerging services like autonomous driving, industry 5.0, and remote health monitoring. Depending on the integration level, ISAC systems could be designed in the form of collaborative co-existing radar and radio communication systems, or in the form of co-design by sharing as much as possible the radio hardware and waveforms.

II. Description

In this assignment, we are interested in ISAC systems with shared waveform for simultaneous communication and human sensing. Orthogonal Frequency Division Multiplexing (OFDM) is commonly used in high throughput and low latency communications, where subcarrier spacing is often small to optimize the spectral efficiency; while when using OFDM for sensing, often larger subcarrier spacing and broader bandwidth are required to improve range resolution, but often resulting in decreased coherent processing time hence reduced Doppler resolution. There is a tradeoff in order to optimize communication or sensing performances. Such tradeoffs are also reflected in pilot design and overhead, cyclic prefix length, etc. etc. In addition to the time-frequency resources, array/spatial resources also play a role.

III. Requirement courses, skills and supervision:

In this assignment, the student will study the requirement on ISAC system with OFDM and beamforming in order to sense chest movement accurately to be able to recognize deep or shallow breathing. We will start with human (chest) models, the interactions of radio waves with the chest, and the resulting signal/system models. It is possible to do measurement with soft-ware defined radio. Promising results will be presented in collaboration meetings with UWaterloo within our UT-UW SCG project.

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