Intelligent RGB-Depth-Radio Sensor Fusion for Radio Propagation Channel Prediction or for Localization and Sensing Applications

Master Thesis Assignment / Student Assignment

Theme:	Communication, Sensing
Application:	5G/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.

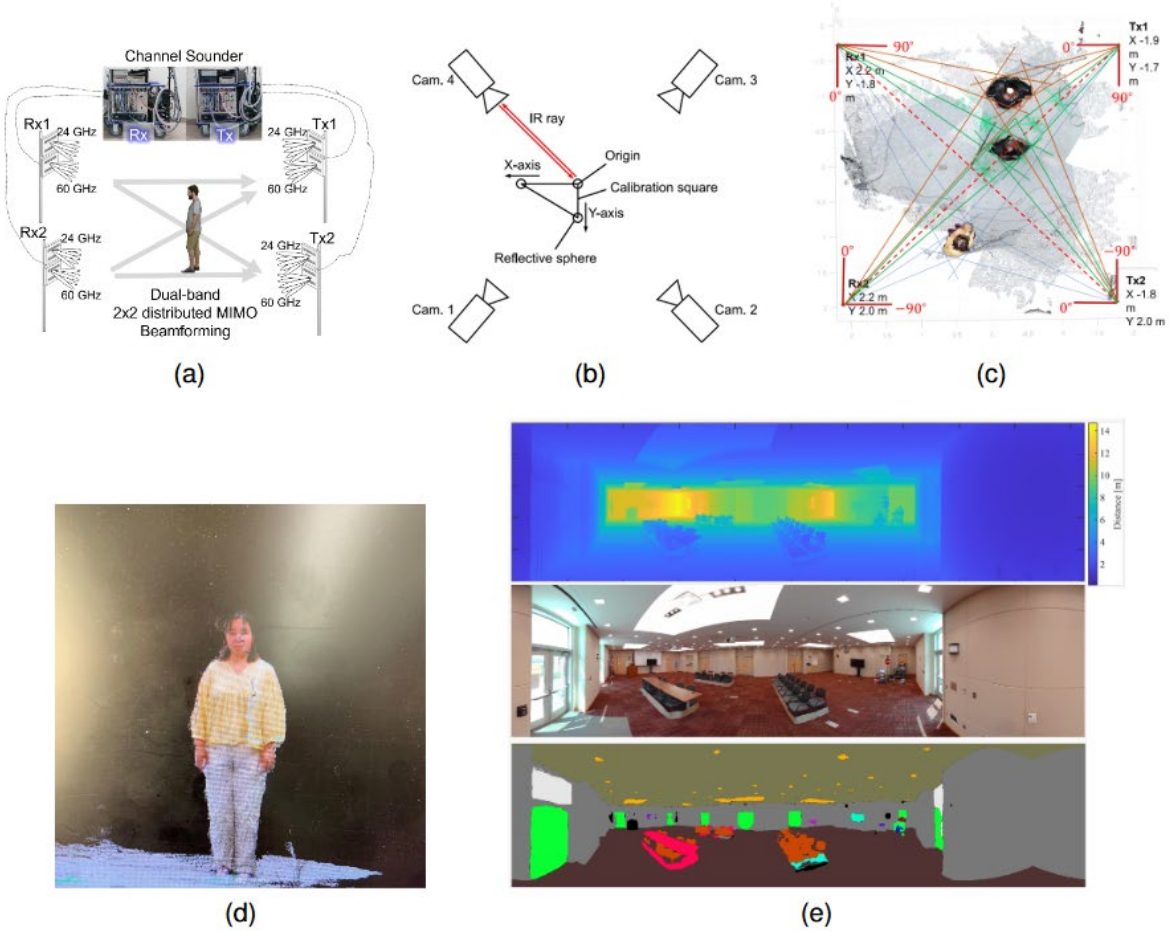

Fig. 1. Examples of 4D RGB-depth data capture along with radio channel measurement. (a) System configuration of dual-band distributed MIMO channel sounder from [4]. (b) System configuration of distributed RGBD cameras from [4]. (c) Groundtruth data with relative position of antennas and targets from [4]. (d) Groundtruth data with accurate target surface point cloud and color from [4]. (e) RGB-D data as well as masked image data of static environment from [5].

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II. Description

ISAC systems aim for simultaneous communication and radar sensing. Bistatic communication propagation channels are often modeled by geometry-based stochastic channels, while mono-static or bistatic radar sensing requires deterministic target properties along with possible random clutters. In this context, for 6G devices with ISAC functionalities, the identification of sensing target with environment awareness is essential for modeling the radio signals/channels and testing the radio systems. To this end, it is required to have temporal-spatial synchronized RGB-Depth data measured along with the radio signals/channels.

III. Requirement courses, skills and supervision:

Fundamental knowledge on radio systems and signals, antennas and radio propagation, signal processing, logical thinking and problem solving.

In this assignment, the student will further explore the approaches to exploit the RGB-Depth-Radio measurement and data for a certain purpose. The purpose could be as follows: 1) for radio propagation channel prediction, e.g., with known RGB-D-Radio data in one scene, how to predict the radio channel in another scene by given only the RGB-D data; 2) for people counting or localization or sensing or imaging (pose recognition): with certain training dataset of RGB-D-Radio, can we sense the environment or identify the target from only radio data?

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