

Duplex Joint Radar-Communications System Based on FMCW MIMO Radar

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Introduction

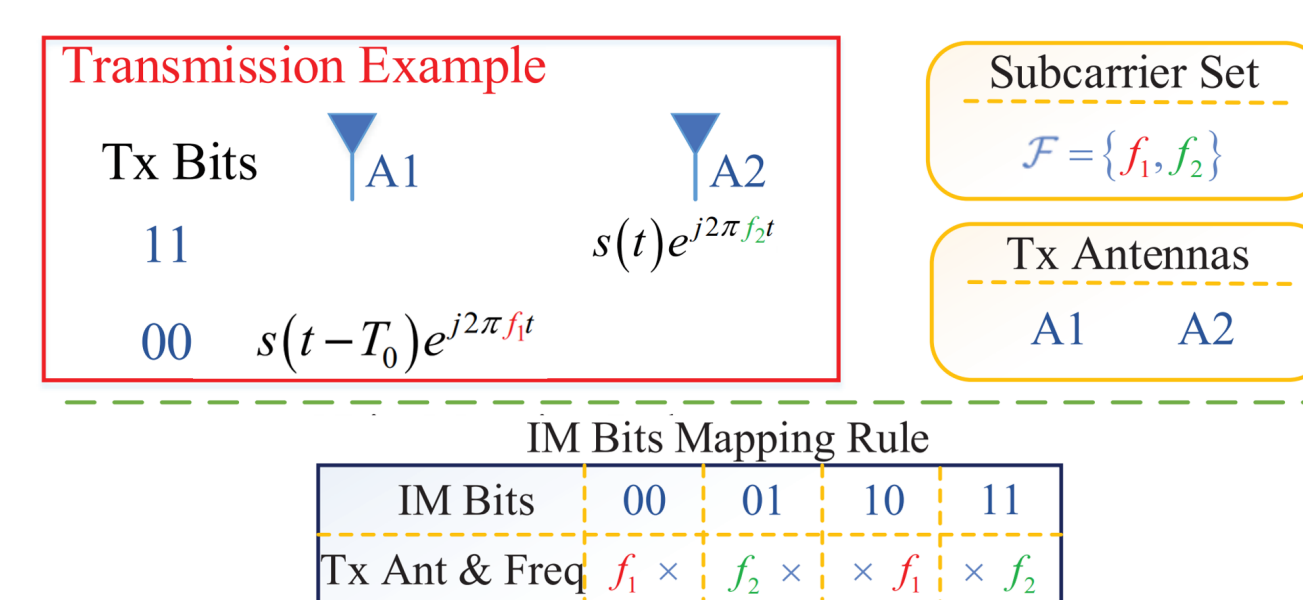
● Duplex DFRC Systems for Vehicular Applications

- Future cars implement both radar and communications on the same platform
- Two implementing approaches
 - Use **individual** systems
 - Jointly design a **dual function radar-communications (DFRC)** system
- Benefits of full-duplex DFRC systems
 - **Improve the spectrum efficiency**
 - **Reduce system size, weight and power consumption**
 - **High real-time**: Detect the target, transmit and receive the communication signal **simultaneously**

Theory

● Index Modulation based duplex DFRC System

- Index modulation (IM)
 - Embed message into the combinations of radar **waveform parameters**
 - Possible domains: Spatial, spectral and time
 - Have **minimal degradation to radar performance**
- Full-duplex technique
 - Separate communication signals and radar echo from mixed echoes
 - Two-way communication **in every radar pulse**



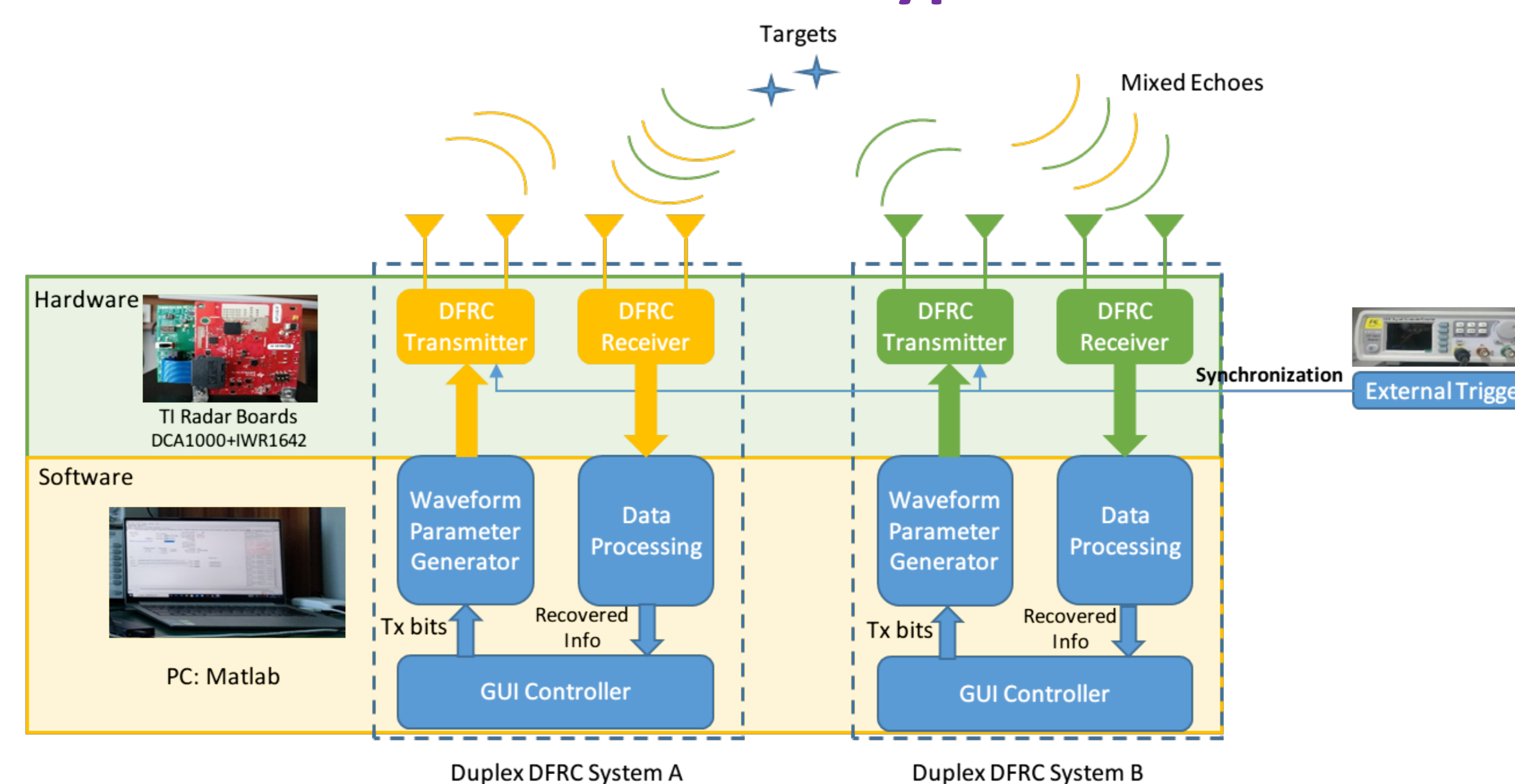
Contributions

● Contribution of This Prototype

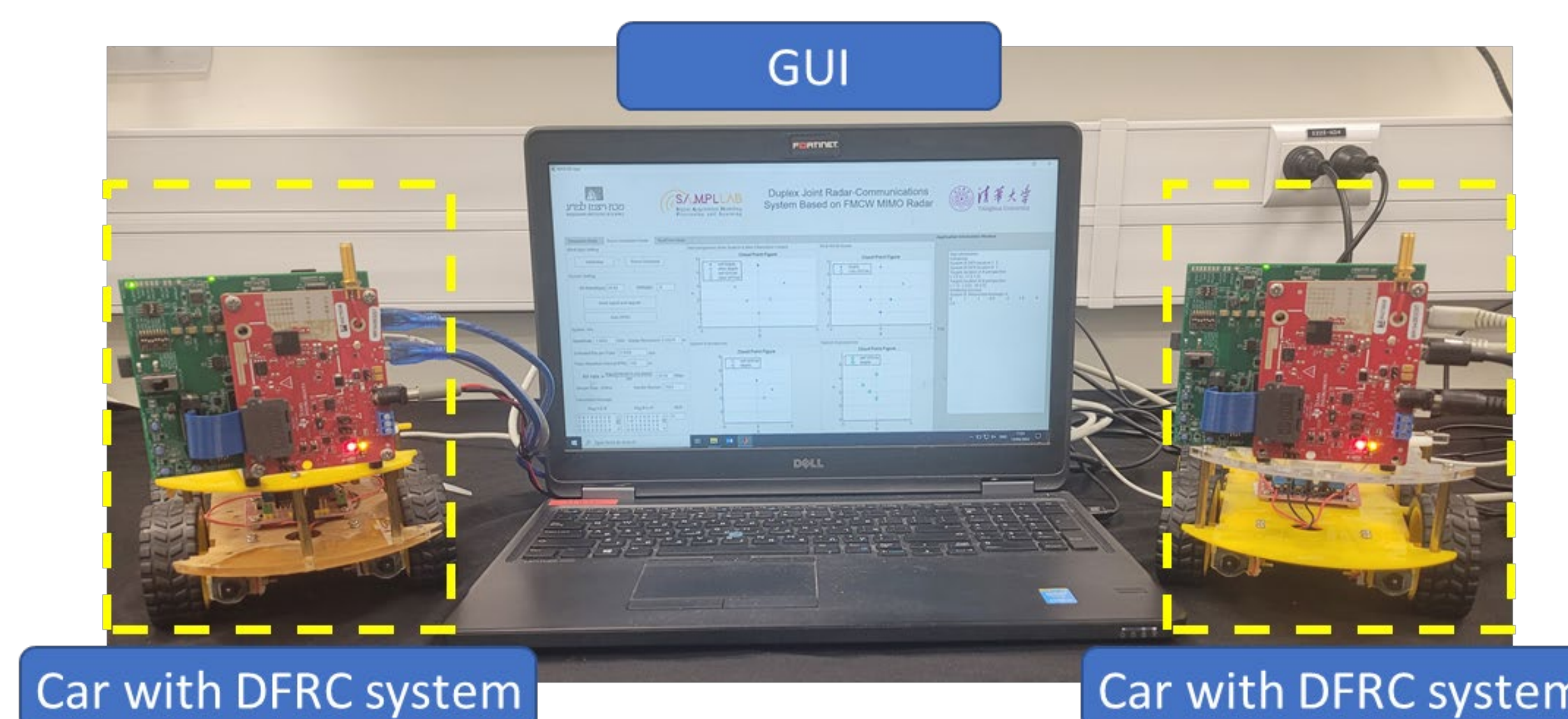
- **Full-duplex** design, realizes real-time information sharing and detection between users
- Implementing IM based DFRC system using **low-cost commercial automotive radar**
- Promising to be applied in **future intelligent transportation applications**

Hardware Implementation

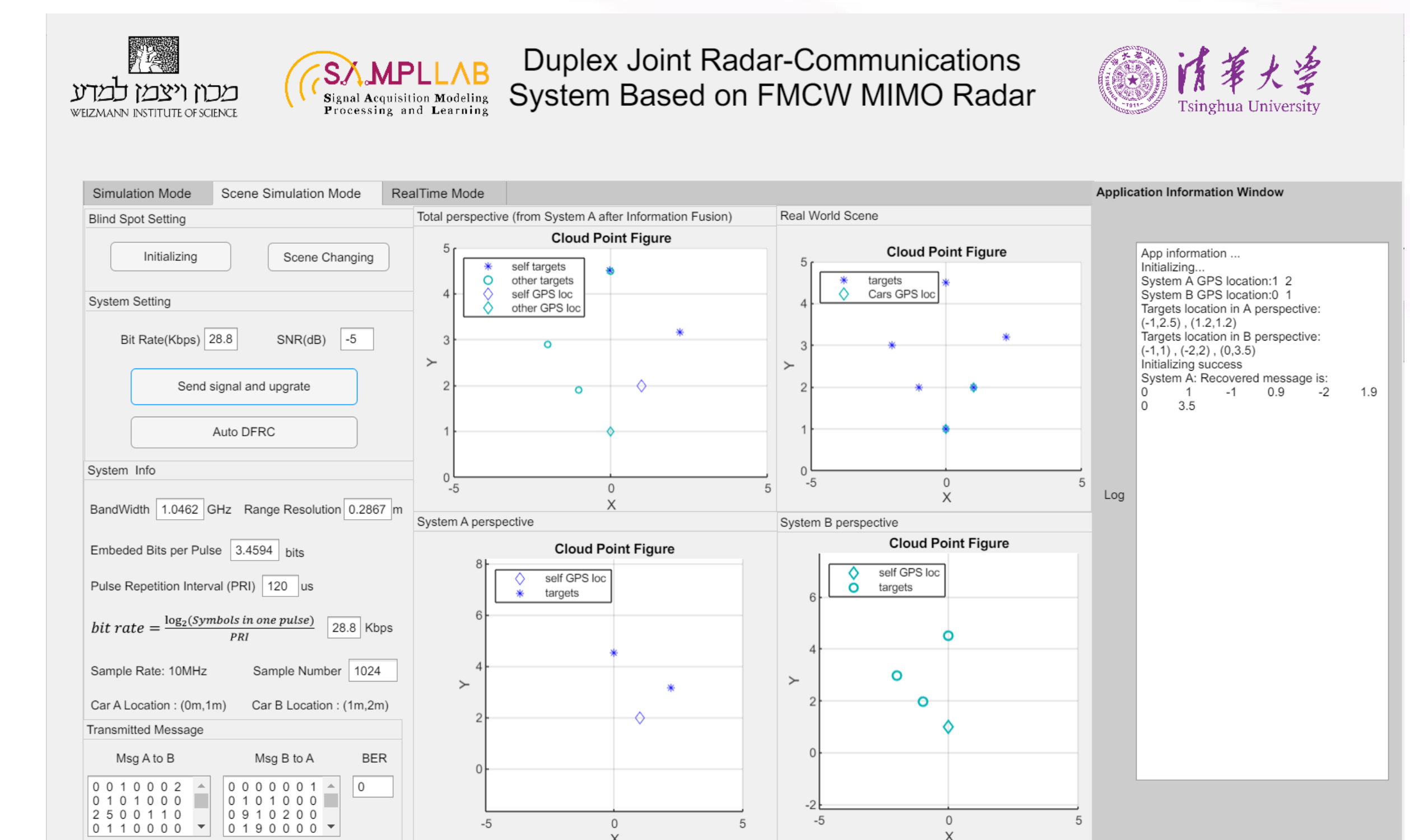
● Architecture of the Prototype



● Overall of the Prototype



Graphical User Interface



● Trade-off between Bit Rate & Radar Performance

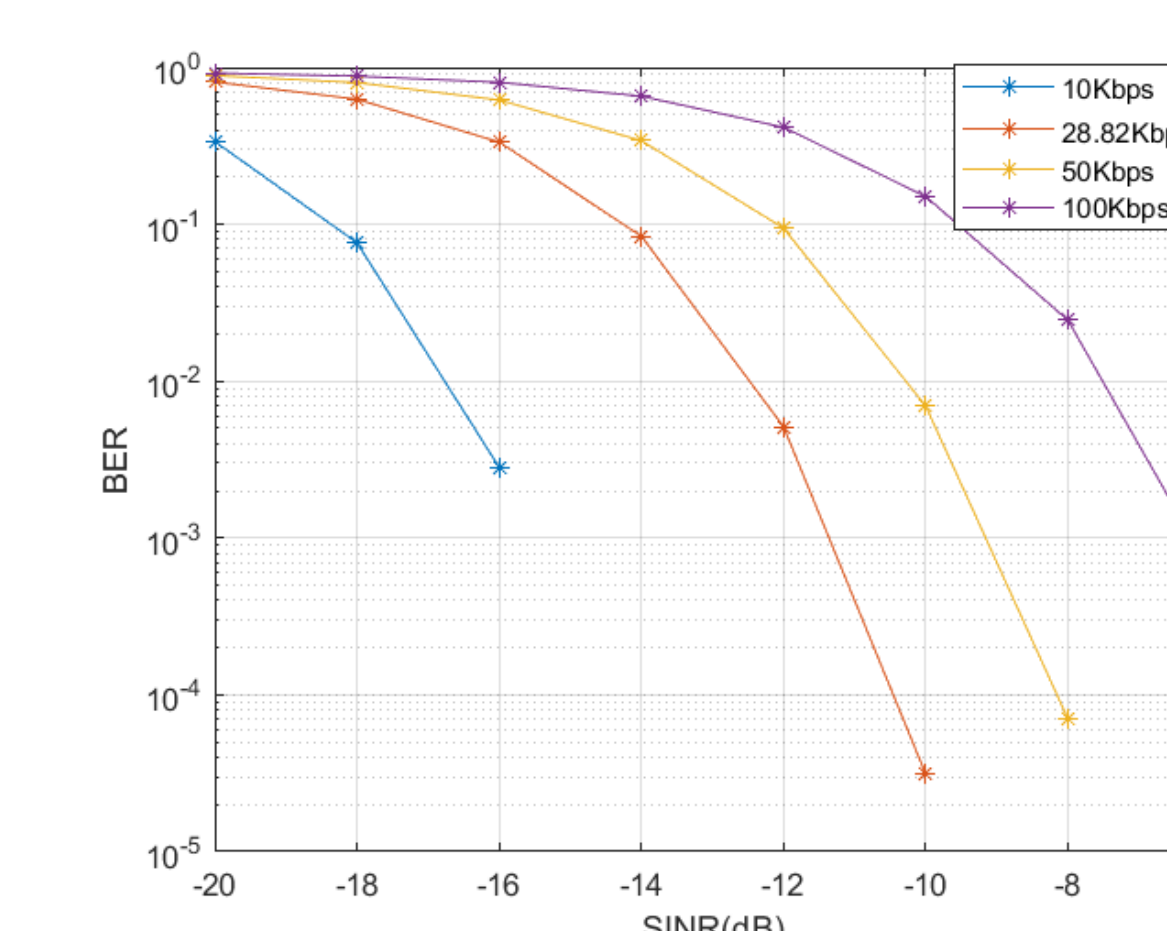
$$\text{bit rate} = \frac{\log_2 \text{Symbols}}{T_{chirp}} = R_{res} \frac{2 \text{ChirpSlope} * \log_2 \text{Symbols}}{c} \text{ bit/s}$$

Parameters in the prototype:

$$\text{bit rate} = 28.82 \text{Kbit/s} \rightarrow \text{Range resolution} = 0.286 \text{m}$$

Simulation Results

Communication BER



Radar Recovery

