

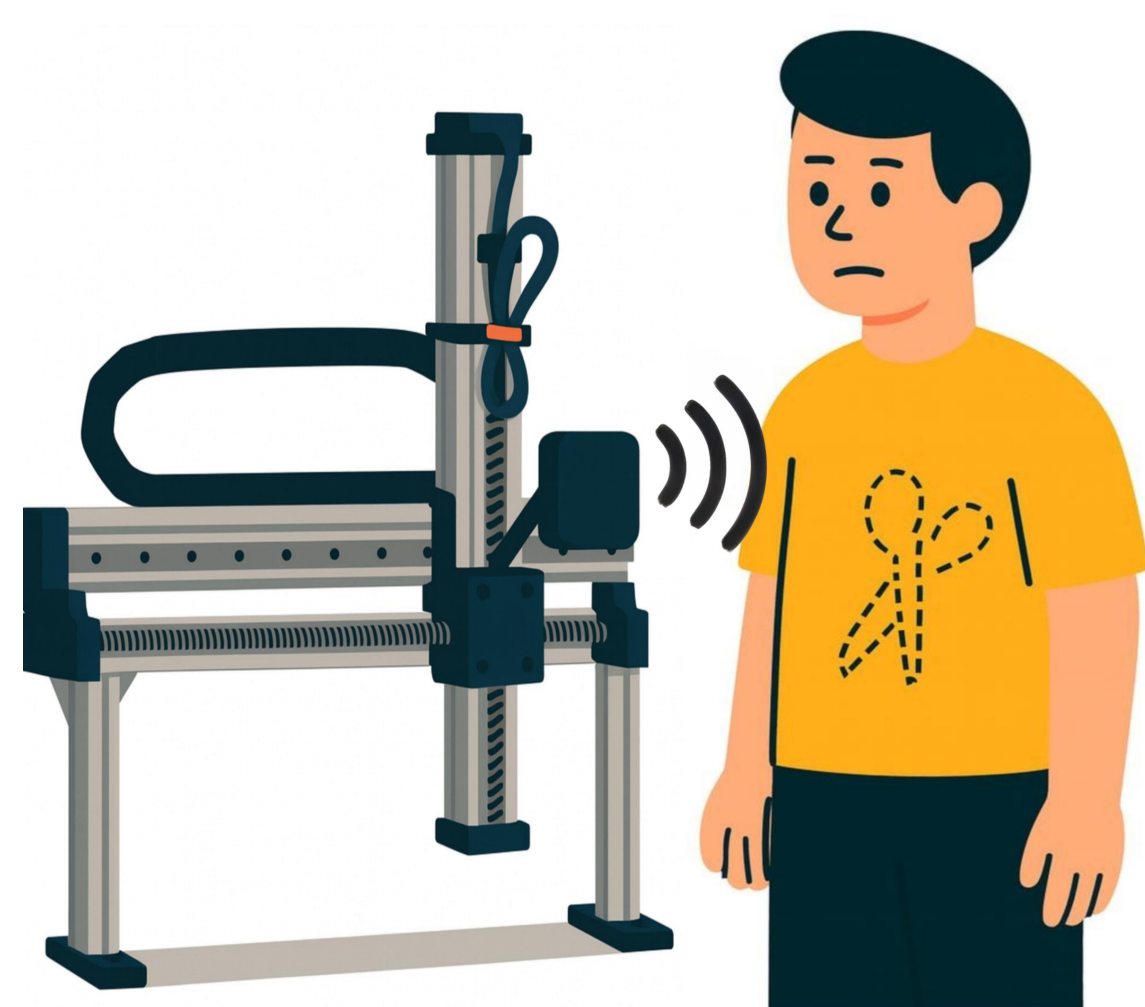
TwinFocus: Autofocus for Handheld mmWave SAR Imaging via Physical and Digital Twin References



Yadong Li, Xinghua Sun, Qiancheng Li, Akshay Gadre
University of Washington

MOTIVATION

Mechanical Imaging



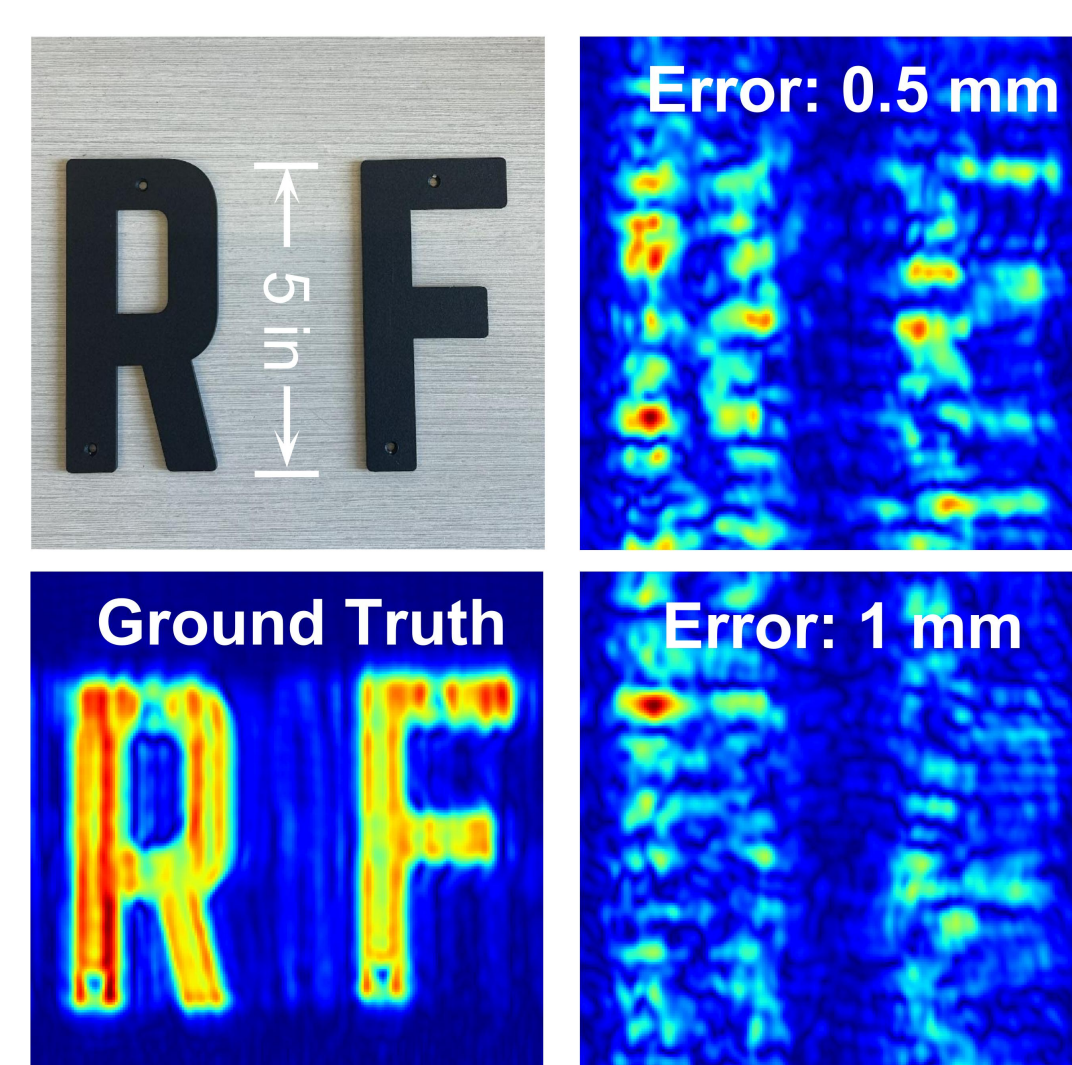
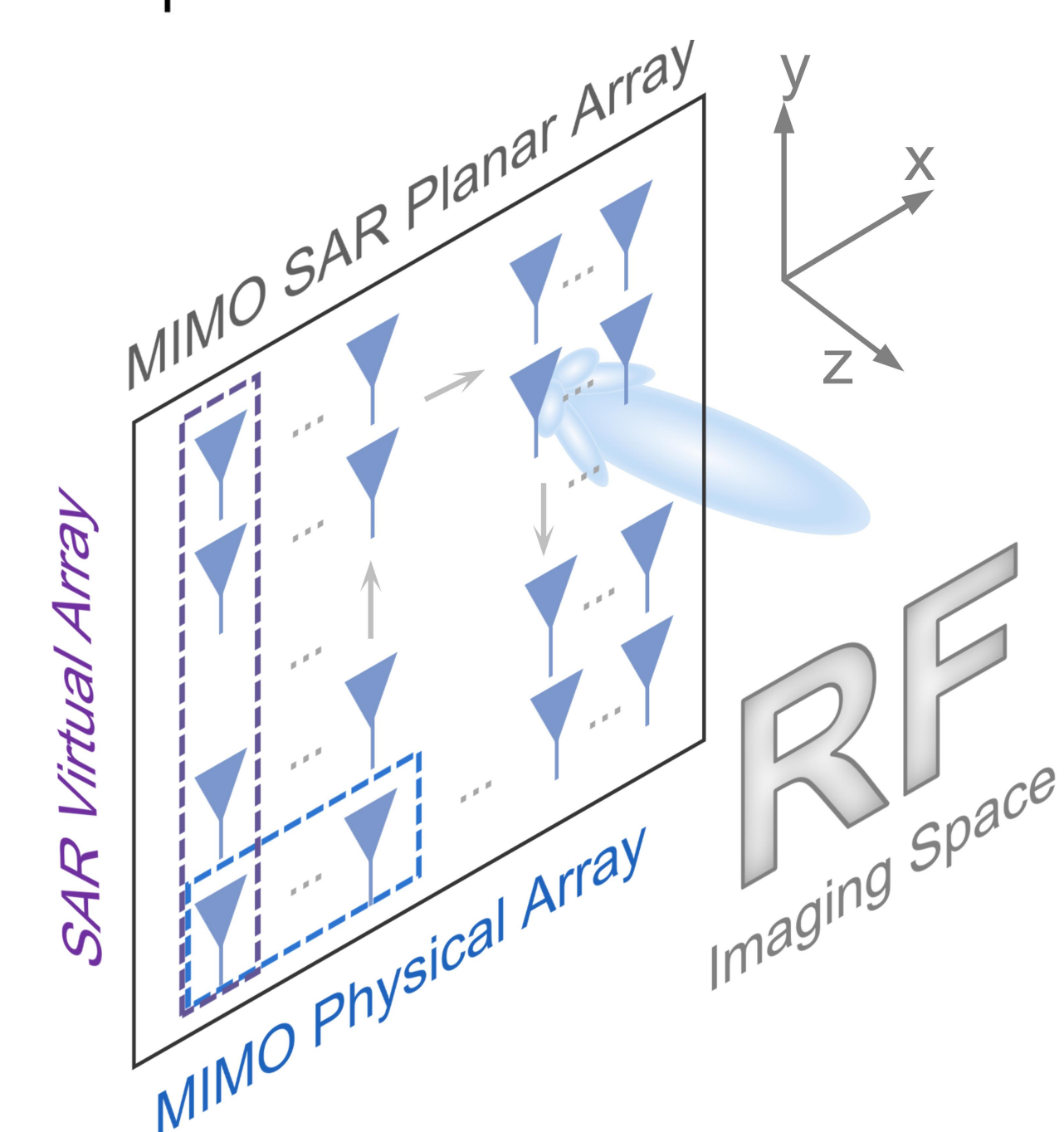
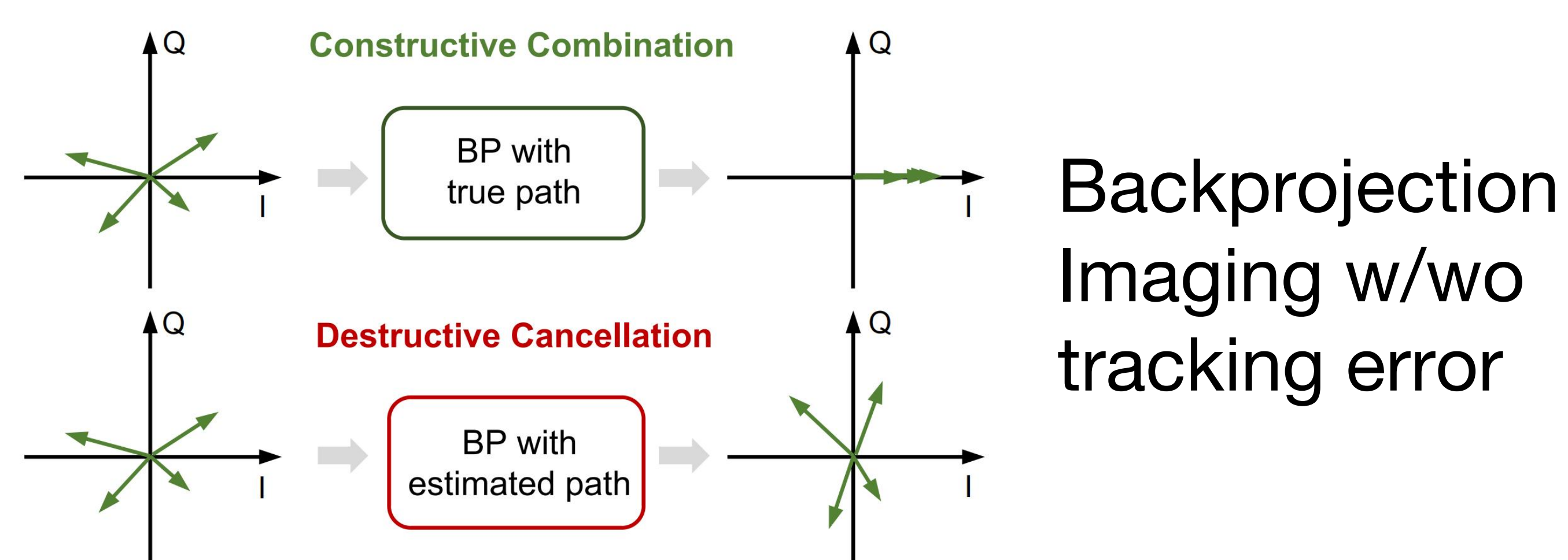
Handheld Imaging



- mmWave radar can image **NLOS** objects
- Conventional imaging rely on motion stage, making them bulky and expensive.
- Handheld imaging is **compact, mobile, and cost-effective**.

CHALLENGE

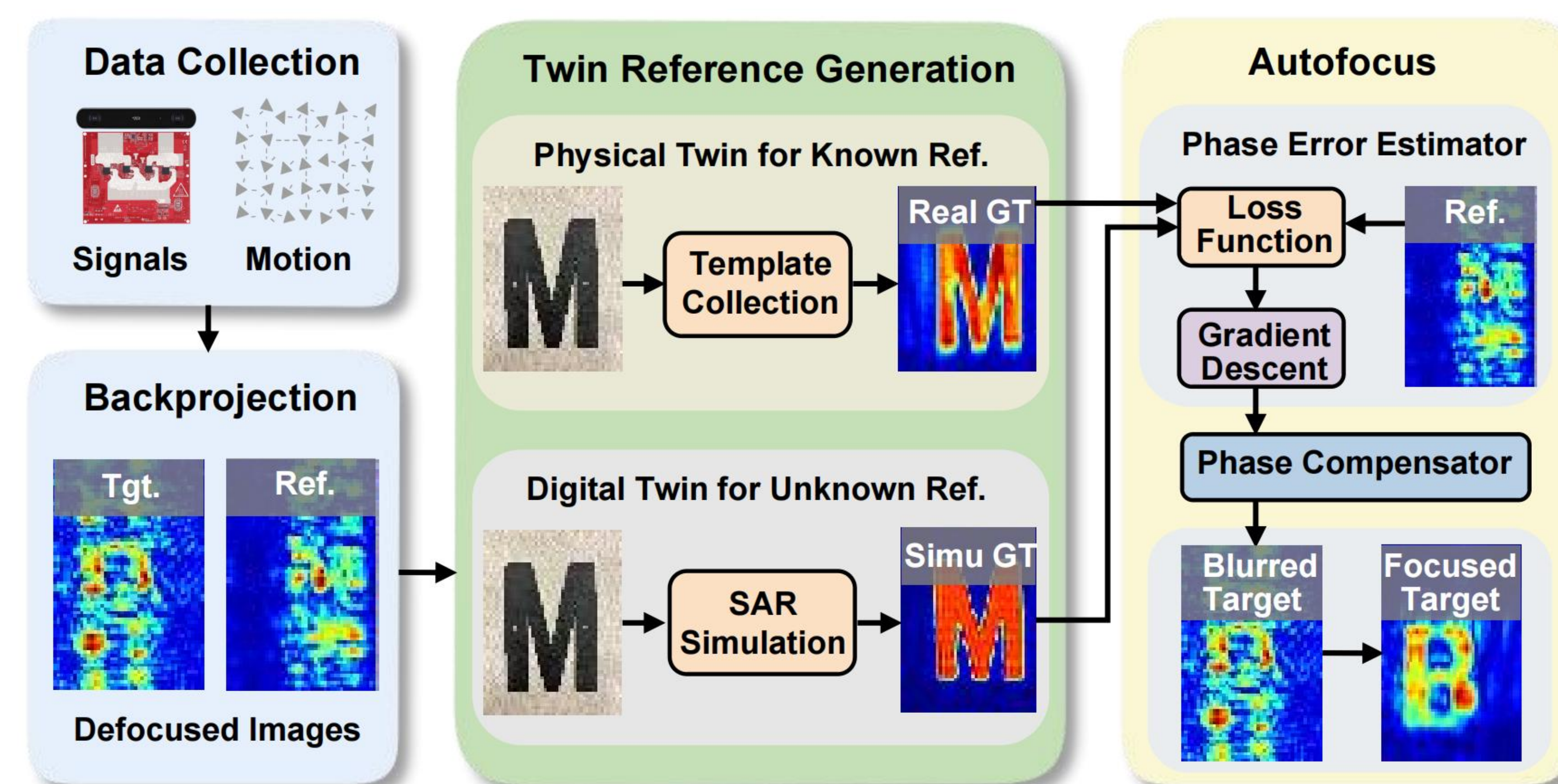
Even sub-mm-level tracking errors cause severe phase errors and image distortion.



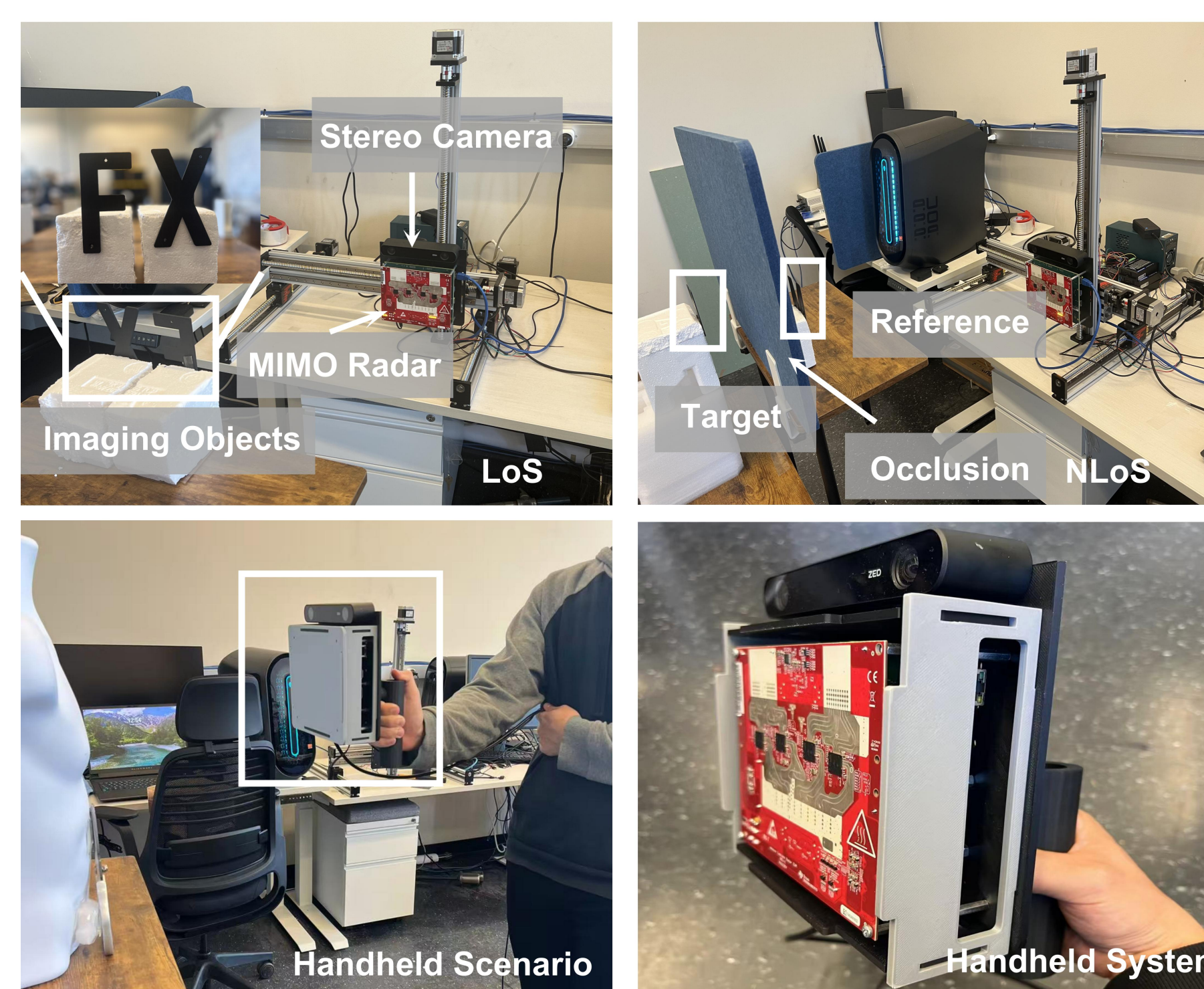
TWINFOCUS DESIGN

Key idea: infers and corrects motion-based phase errors by minimizing the discrepancy observed from a reference object visible in the environment.

Method: amplitude-domain alignment estimating phase error of cooperative references; a lightweight digital-twin pipeline to extend it for non-cooperative references.



IMPLEMENTATION AND EVALUATION

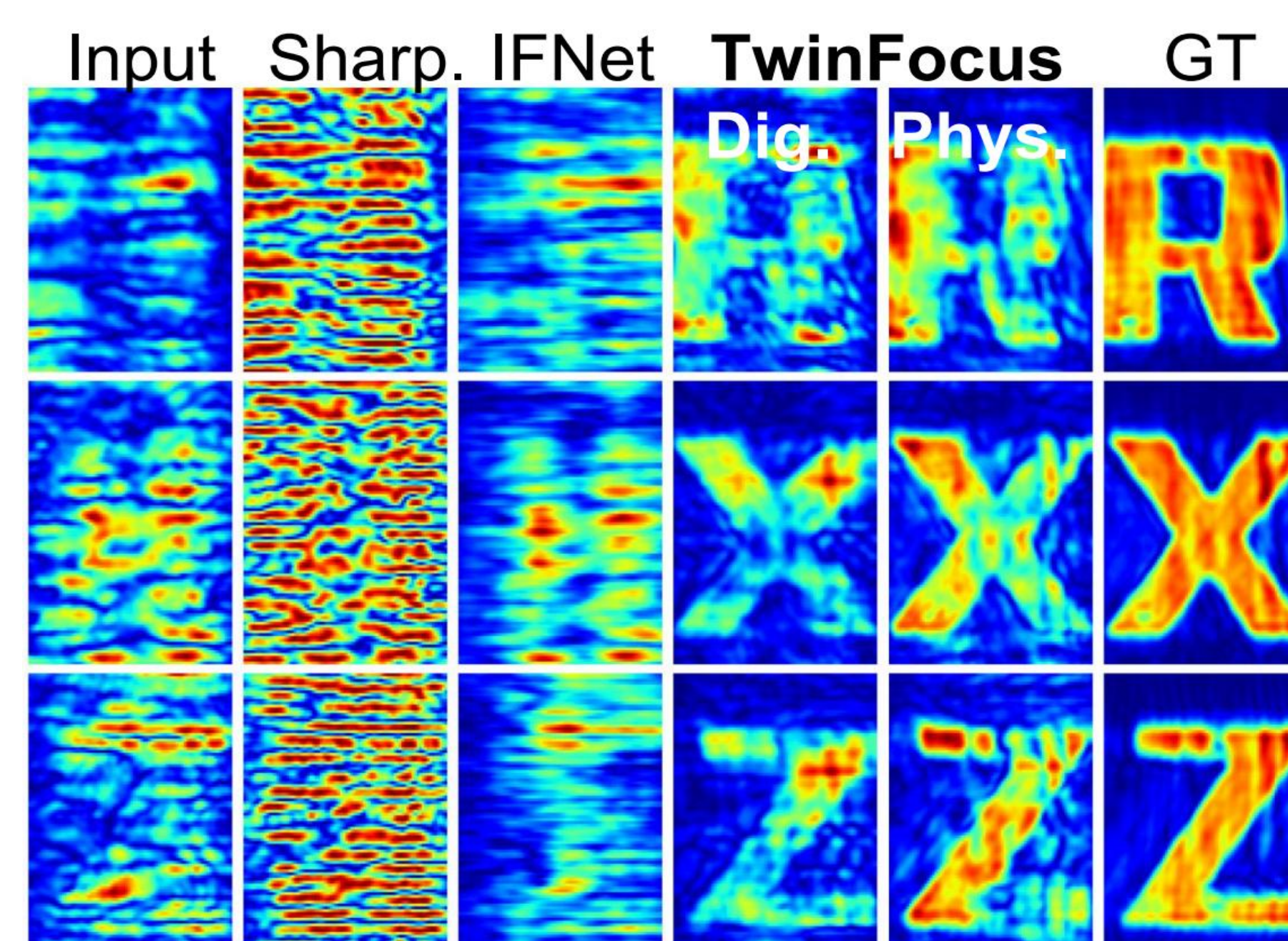
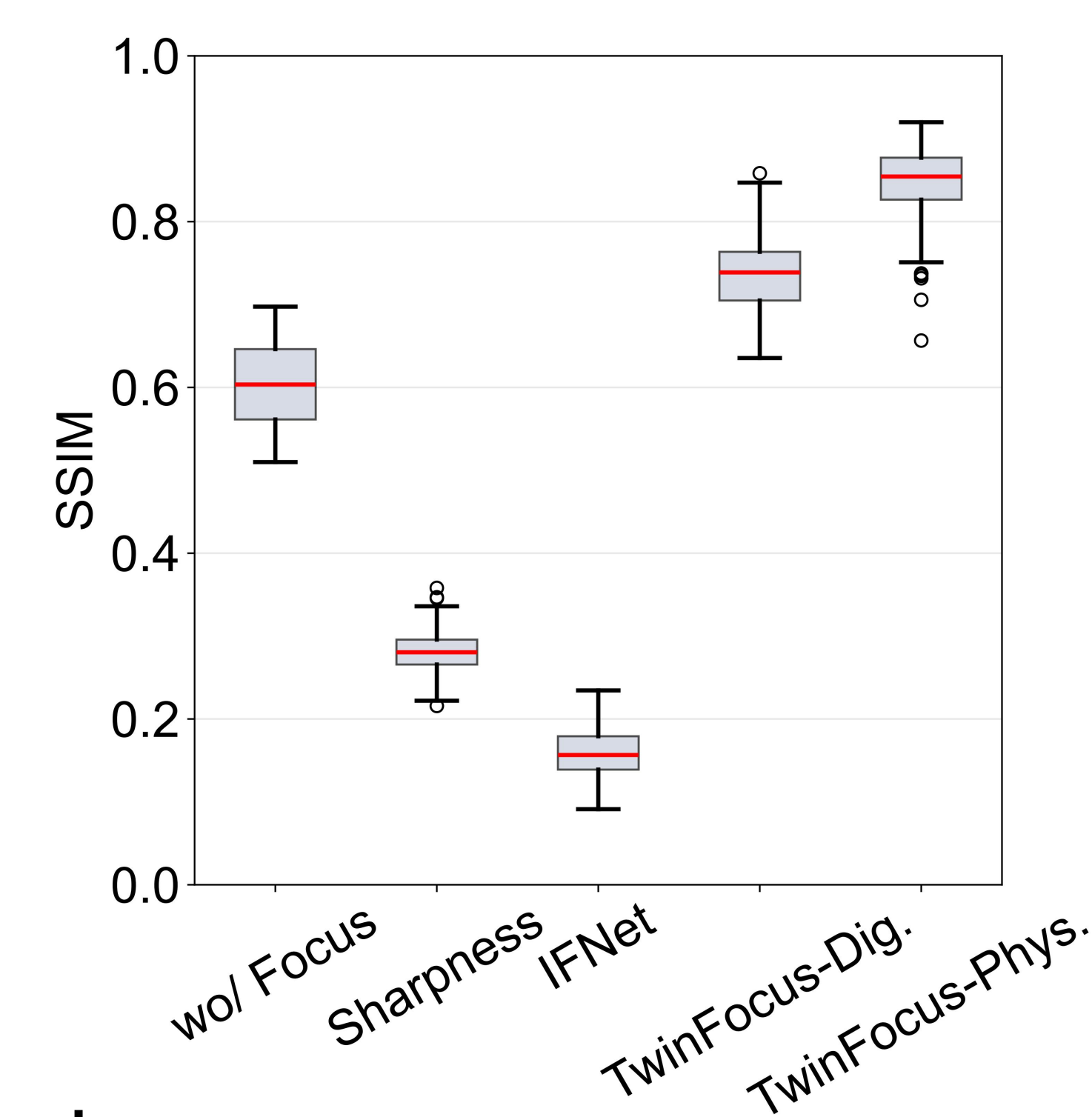


Experimental Setup:

(1) TI MMWAVECAS Radar: 76-81GHz, 12 Tx, 16 RX. (2) ZED 2i Stereo Camera for visual inertial tracking.

Quantative Results:

41.7%/23.3% improvement when using a physical twin for known references/digital twin for unknown references.



User Case Study

