

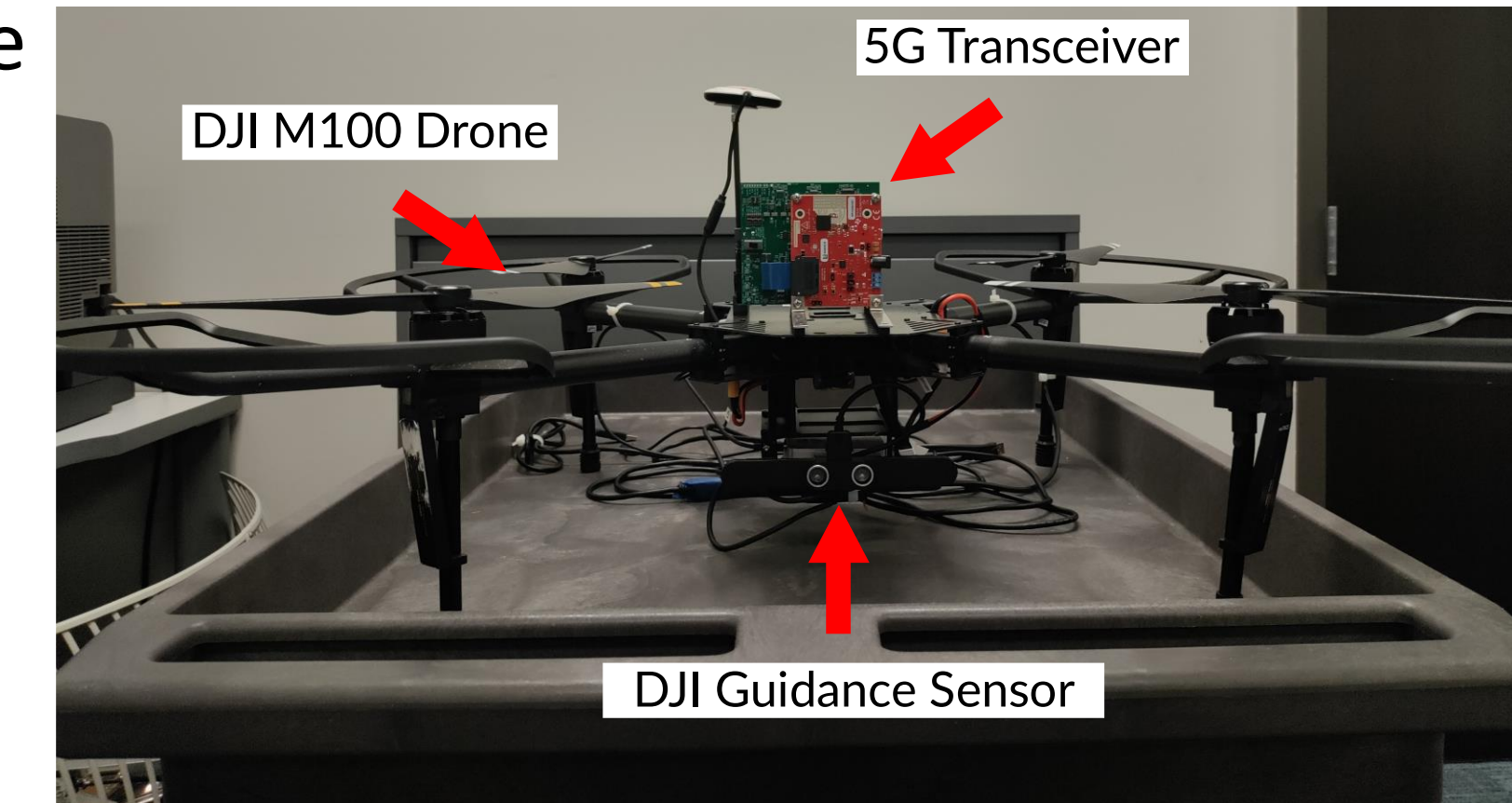


## Millimeter-Wave Propagation Survey Challenges

- **Millimeter-wave picocell network topologies are difficult to plan and deploy.**
  - **5G wireless networks** use millimeter-wave (mmWave) **picocells**, which are small, short-range base stations, usually placed on rooftops, utility poles, and other roadside infrastructures.
  - Picocells must be placed with careful planning, requiring extensive environmental surveys that are **costly** and **time-consuming**.
  - Minor location changes can cause **significant capacity loss**, which may require **redeployment**.

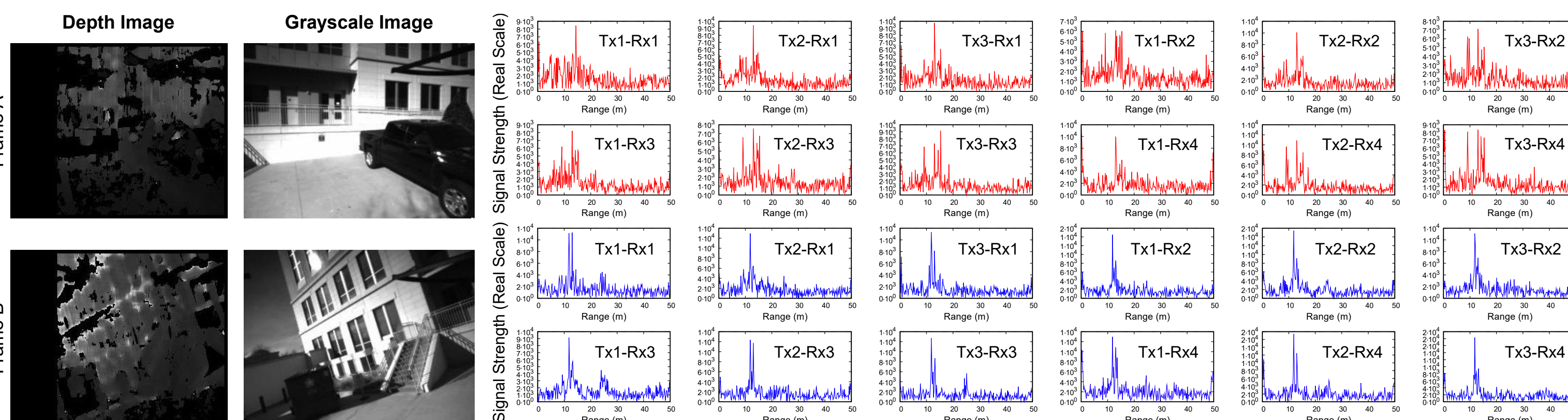
## MilliDrone System Design

- **MilliDrone facilitates fast and scalable surveys of outdoor environments.**
  - The **flight system** operates the Drone along a programmable flight path.
  - The **guidance system** collects depth, grayscale visual, and odometry data.
  - The **mmWave transceiver** collects signal reflections from 12 channels.
  - All these systems work together to collect data mid-flight to quickly survey an outdoor environment.



## Multimodal Data Post-Processing

- **After collection, data from different systems are synchronized and sanitized.**
  - Synchronization is based on the start and end times for each system and uses the **time difference** to offset the data.
  - Combination of **interpolation** and **decimation** to match rates across systems (piecewise-cubic interpolation and median decimation).
  - Verification based on back-to-back correlation between the mmWave signals and the depth maps.



## Key Points and Future Works

- **MilliDrone is a multi-modal mmWave data collection platform.**
  - Collects **visual, depth, odometry dataset** and **multi-channel mmWave reflections** during flight and **synchronizes** them for analysis and modeling.
  - **Ongoing and Future works:**
    - Collect dataset from various outdoor environments.
    - Test hypothesis: Do visually similar outdoor objects generate correlated mmWave reflections?*
    - Extend the Drone's field of view to **360 degrees** by mounting several **mmWave transceivers**.
    - Investigate methods to calibrate dataset by **modeling Drone's vibration** and **removing spiking noise** due to abrupt flight pattern change.

