**Motivation and Challenges**

- THz-band communication is a key technology to enable ultra-high-data-rate wireless links
- Due to high attenuation in high-frequency band, the range of THz communications is limited (~10m)
- Easily disconnected by beam misalignment of transmit and receive antennas in mobile environments

**How to achieve robust mmWave/THz-band communications in mobile environments?**

**Proposed Solution**

- **Goal:** Reduce the outage probability of the mmWave/THz-band wireless links
- We propose an echo state learning-based stochastic beam control scheme called **LeBeam** in the presence of multi-scale mobility uncertainties of the flying UAVs

**What does LeBeam do?**

- **LeBeam** dynamically predicts the best beamwidth $\theta$ based on statistical information of the UAV mobility pattern
- **Input:** Mobility information of UAV Tx and UAV Rx
- **Reservoir:** Hidden layer acting as a nonlinear high-dimensional expansion and a memory of the input
- **Output:** Predicted optimal directivity angle $\theta$ for UAV Tx

**Mobility Measurement**

- Three mobility uncertainties - Micro-scale, Small-scale, Large-scale
- Weather Conditions – Windy and Non-windy
- Intel Aero drone along with android smartphone was used to measure the mobility uncertainties

**Results**

**THz Link SNR with different beam alignment latency (BAL)**

- BAL 1 - Highest SNR (on average 10.85 dB) is achieved with directivity angle of 1
- BAL 100 - THz-band link is disconnected frequently (probability of 13%-82%) - because of the misalignment

**Prediction accuracy of LeBeam**

- Nearly optimal (over 99%) link capacity can be achieved with beam alignment latency of up to 125 ms.
- This verifies the effectiveness of LeBeam in improving the robustness of THz-band wireless links in the presence of beam alignment latency

**Conclusions**

- We proposed a stochastic beam control scheme LeBeam, which can predict the optimal beamwidth based on the first and second-order moments of the drone mobility
- LeBeam can achieve nearly optimal link capacity with low and moderate-level beam alignment latency

**References**