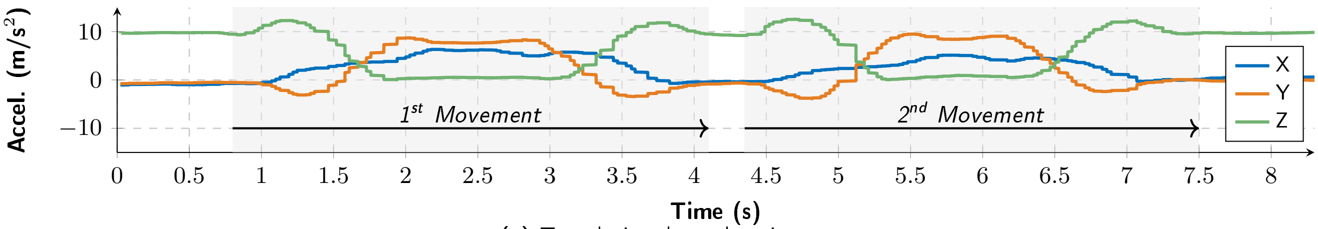
Supplementary Information

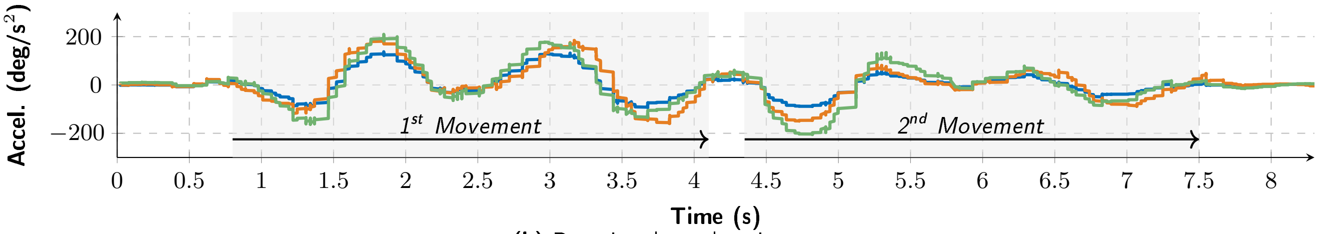
Truly Mobile Sub-Terahertz Communications Beyond 6G
via Just-in-Time IMU-Assisted Beam Management

Establishing Boundaries for IMU Sensor Data

To establish realistic parameters for the mobility scenarios used in this paper, we conducted two experiments to capture typical human motion profiles. An IMU was affixed to a smartphone case to record its motion during common user activities. The first experiment (Supplementary Fig. 1) captures a phone-raising gesture, consisting of lifting the device from rest to ear level to simulate answering a phone call and then lowering it back down, repeated twice. This hybrid motion combines both translational and rotational components, producing translational accelerations exceeding $10\,\mathrm{m/s^2}$ and rotational velocities up to $200\,°/\mathrm{s}$.



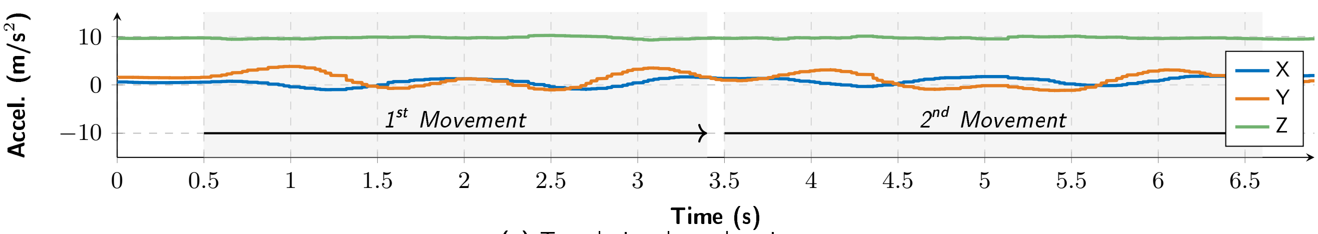
(a) Translational acceleration.



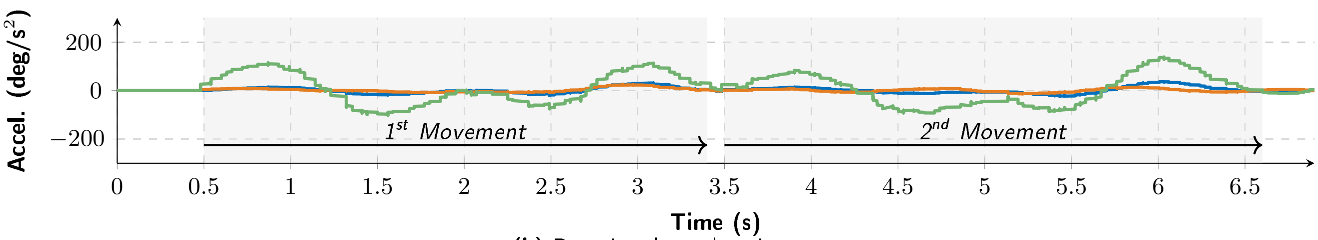
(b) Rotational acceleration.

Figure 1. IMU measurements for the phone-raising gesture (lift to ear level and lower), repeated twice. Subfigures show (a) translational acceleration and (b) rotational acceleration over time.

The second experiment (Supplementary Fig. 2) isolates rotational-dominant motion by capturing a $90°$ body turn followed by a return to the original orientation, repeated twice. Here, rotational velocities are comparable to those observed in the first experiment, but translational accelerations remain low, driven primarily by centripetal forces.



(a) Translational acceleration.



(b) Rotational acceleration.

Figure 2. IMU measurements for the $90°$ body turn and return, repeated twice. Subfigures show (a) translational acceleration and (b) rotational acceleration over time.

These measured profiles directly informed the evaluation ranges in the main study. The combined-motion sweep (Fig. 8) spans up to $5\,\mathrm{m/s^2}$ and $200\,\mathrm{deg/s^2}$, matching the upper range observed here, while the single-axis sweeps in Figs. 2 and 4 extend beyond the measured peaks to stress-test performance under extreme conditions. The "Typical acceleration" annotations in Figs. 2b and 4b mark the human-scale region captured by these experiments.