Real-Time System for Activity Recognition Using Wireless Signals
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MOTIVATION OBJECTIVE
- The capability of recognizing human activities can facilitate a broad range of real-world applications
- Activity recognition is a critical component on monitoring well-being and providing suggestions to improve health
- Objective: implement a real-time system using ubiquitous WiFi signals to conduct activity recognition in a device-free manner

CHANNEL STATE INFORMATION
- Describes how Wi-Fi signals propagate from transceivers and represent the combined effect of scattering, fading, and power decay with distance
- CSI expressed as an array of complex number streams, corresponding to different frequency bands that could be partitioned into 30 subcarriers
- Amplitude and phase at each subcarrier could be used for extracting representations of human movements

SEGMENTATION AND CLASSIFICATION
- Data segmentation is to determine whether a segment of CSI measurement contains human activities
- Utilize a sliding window function to calculate the variance and mean value to segment the large movements such as sitting, walking and running
- Segments are suitable for classification through an RNN - specifically an Long short-term memory (LSTM)
- LSTM takes the extracted CSI stream input in time and can flush its input buffer upon reaching the beginning of a new segment

IMPLEMENTATION OF REAL-TIME SYSTEM
- Hardware: two Dell laptops installed with Intel 5300 WiFi NICs, a server computer
- Transmitter: the system starts by transmitting WiFi packet
- Receiver: the receiver reports CSI and sends the CSI trace (binary CSI data) to the server computer via TCP/IP for data processing
- Server computer:
  - Decode the binary CSI received from the receiver
  - Segment CSI corresponding to human activities
  - Recognize activities based on profile matching
  - Visualize the activity recognition result

OBSERVATIONS
- Based on observations on CSI fluctuations, we find that different activities lead to distinctive patterns in CSI, which can be explored for activity recognition

REFERENCES

VISUALIZATION TOOL
- Visualize the real-time CSI with two Python libraries: QtWidgets and Bokeh

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