Through-Wall Human Pose Estimation Using Radio Signals

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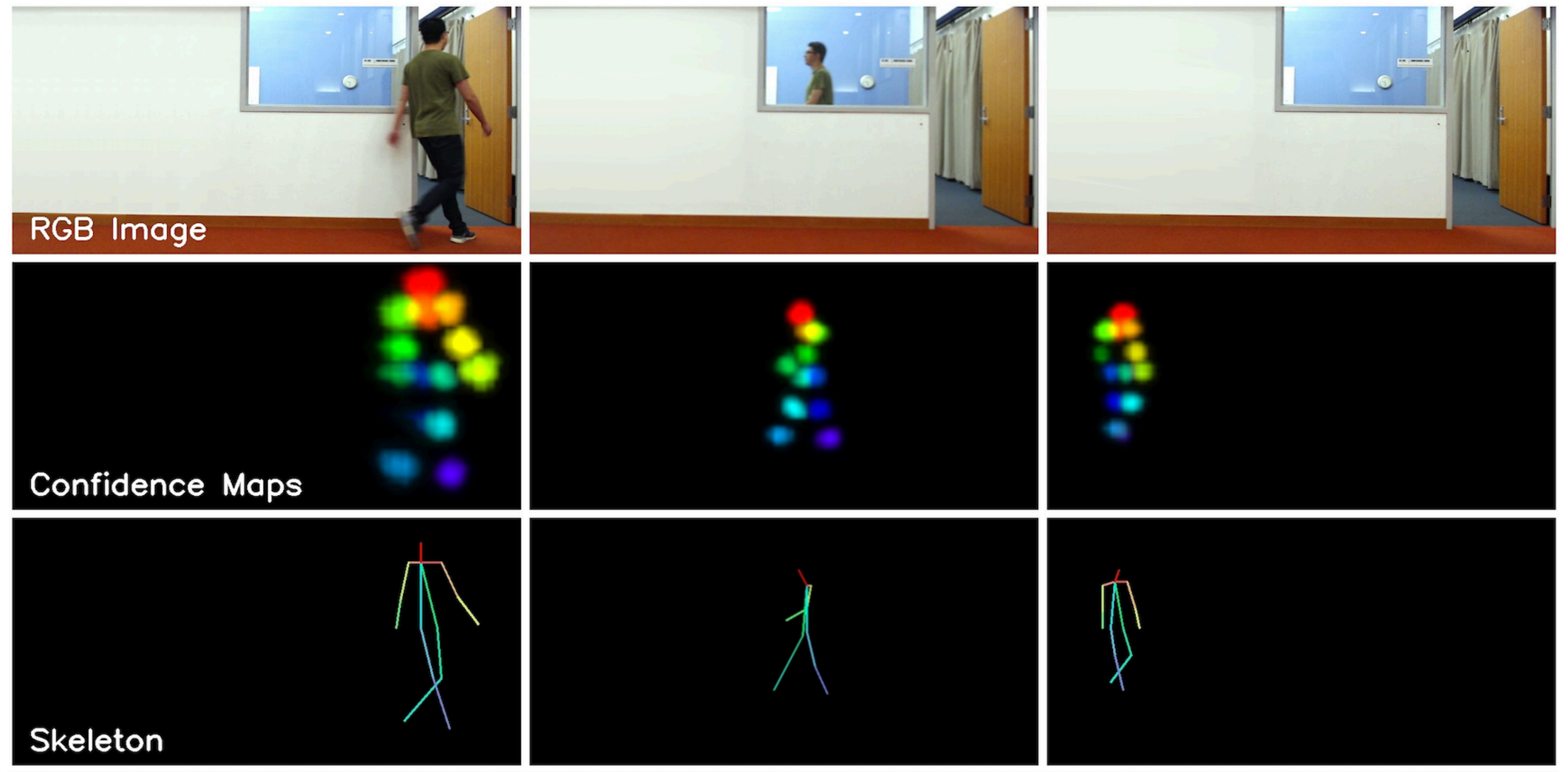
Through-Wall Pose Estimation

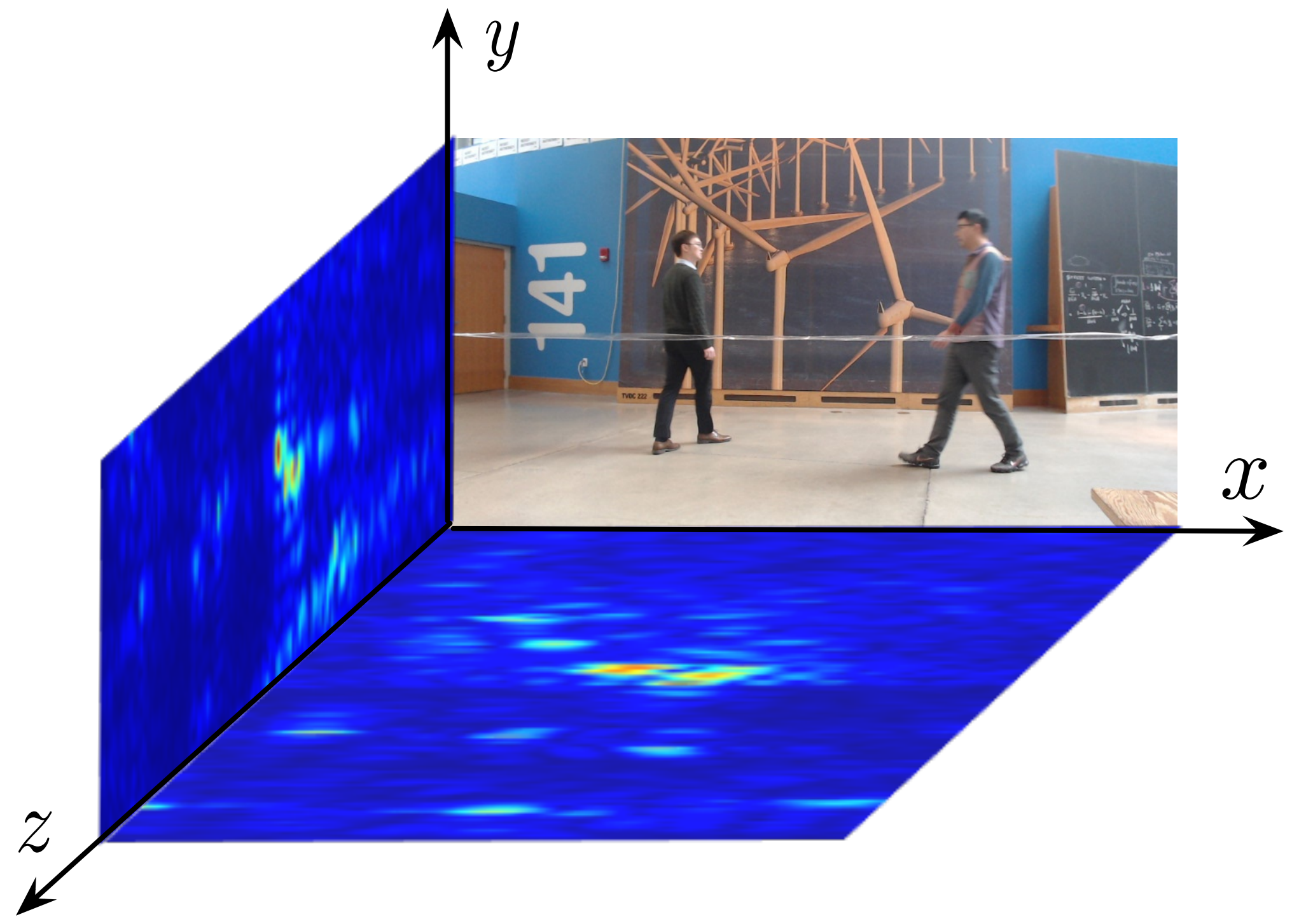
Goal: See human poses through walls and occlusions

Motivation:

- Visible Light blocked by walls and opaque objects
- Radio Frequency signals traverse walls and occlusions



Data Format



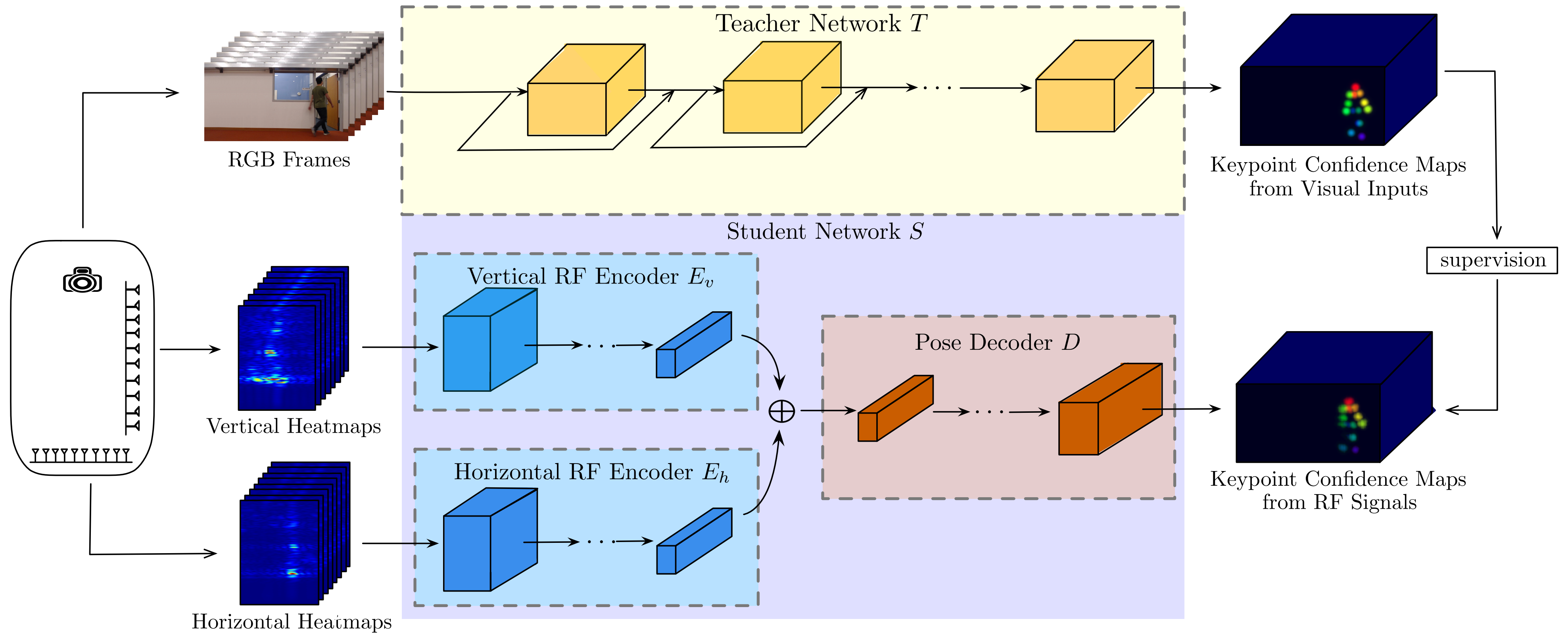
Properties of RF signals:

- Traverse walls but have low spatial resolution
- Human body is specular in the frequency range
- Complex numbers + different geometric perspectives

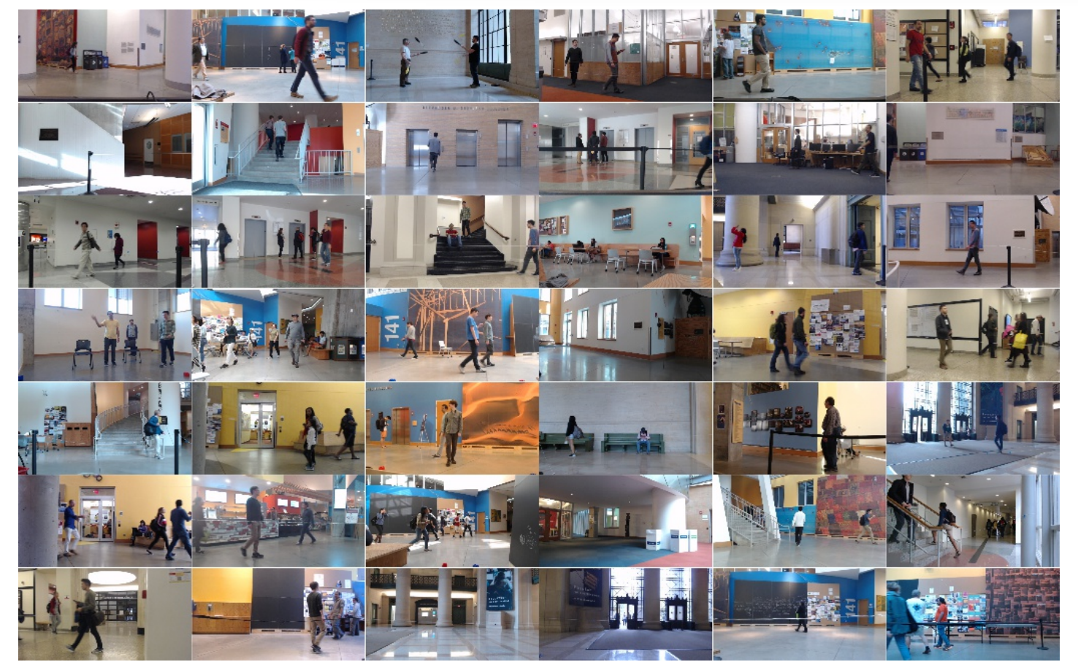
Main Challenge:

- Labeling RF signals is hard for human
- Solution: Using Vision modality to teach RF modality

Network Structure

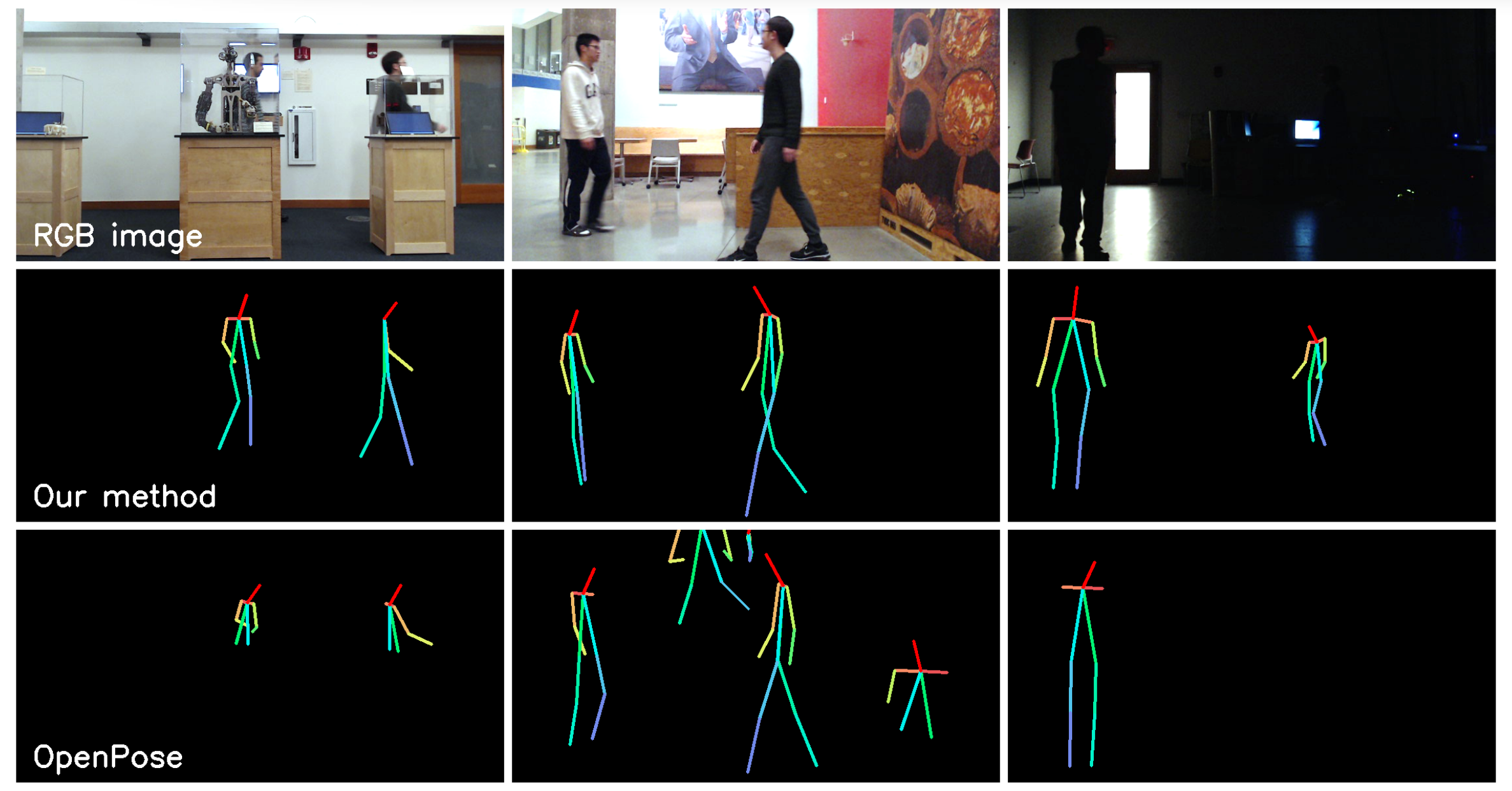


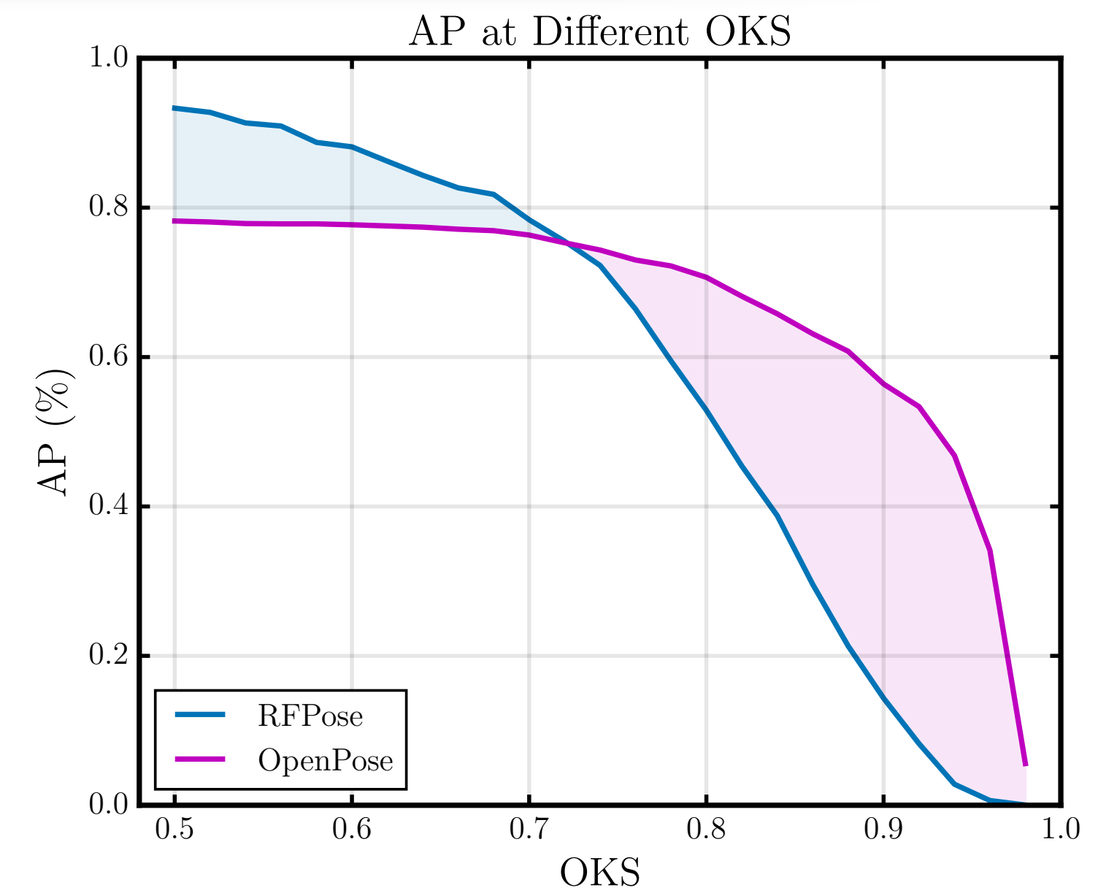
Large Scale Data Set



- Synchronized data from web camera and RF sensor
- More than 50 hours and 50 environments
- More than 1k different people
- Number of people in each frame: 0 to 14
- Various activities

Comparison with Vision System

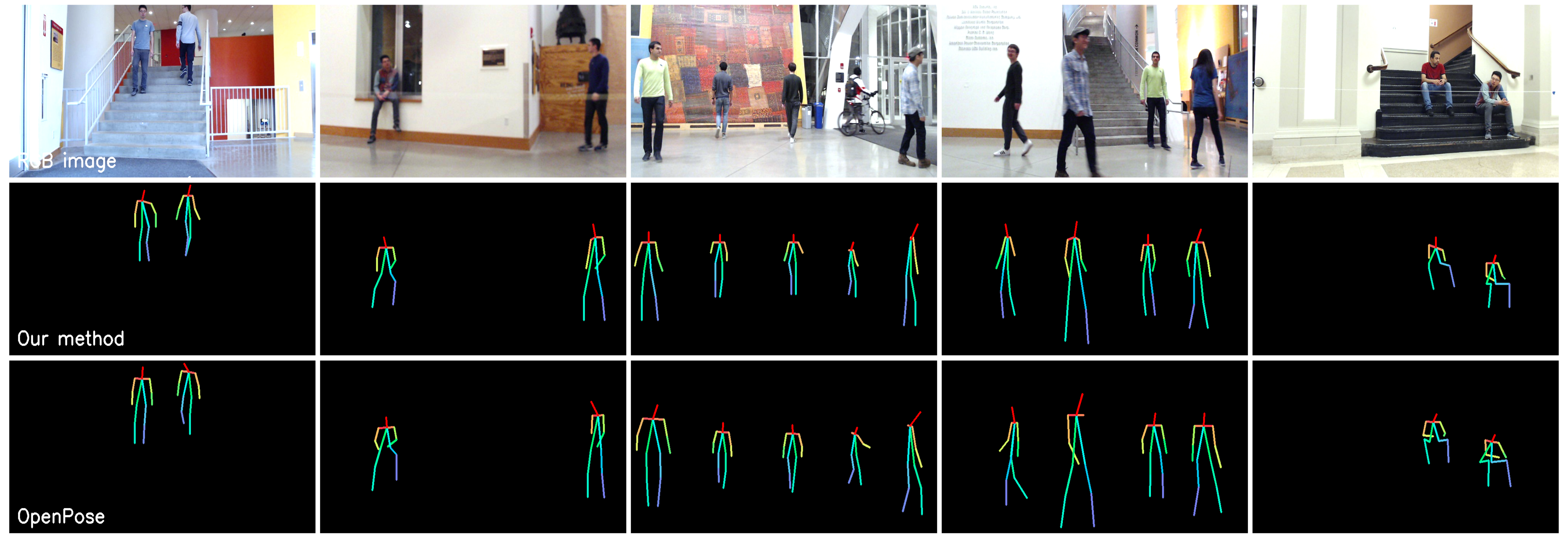




Non-through-wall Setting

Methods	Hea	Nec	Sho	Elb	Wri	Hip	Kne	Ank
RF-Pose	**75.5**	**68.2**	62.2	56.1	51.9	**74.2**	63.4	54.7
OpenPose	73.0	67.1	**70.8**	**64.5**	**61.5**	71.4	**68.4**	**68.3**

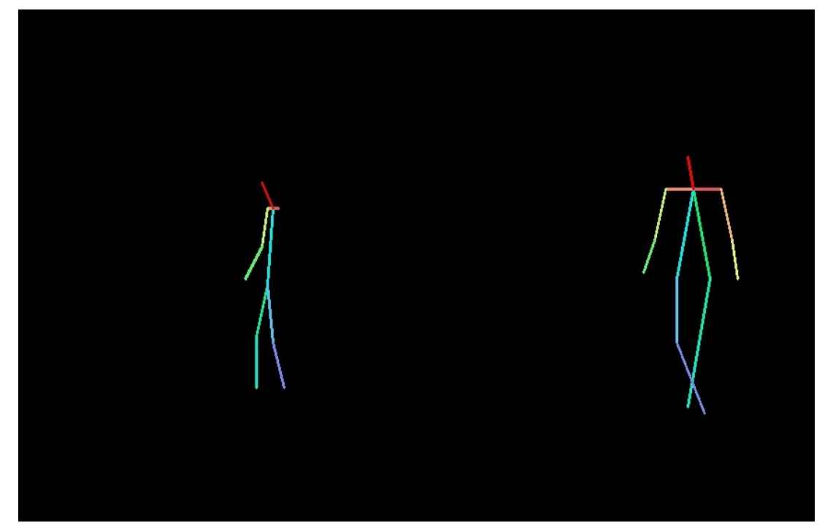
Results



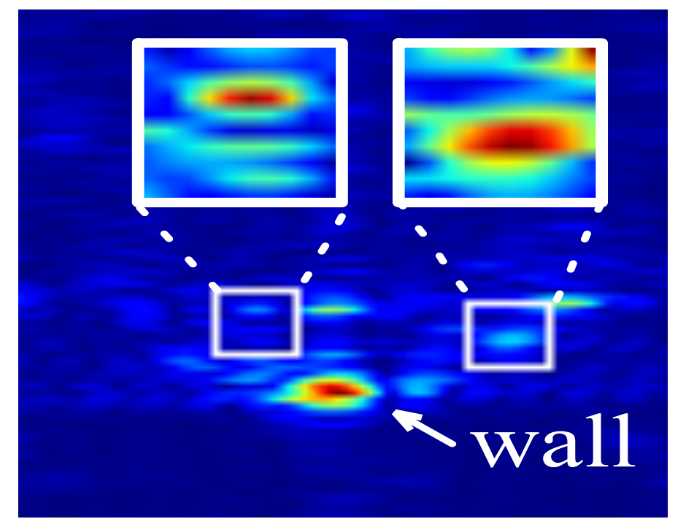
Analysis

Spatial Attention

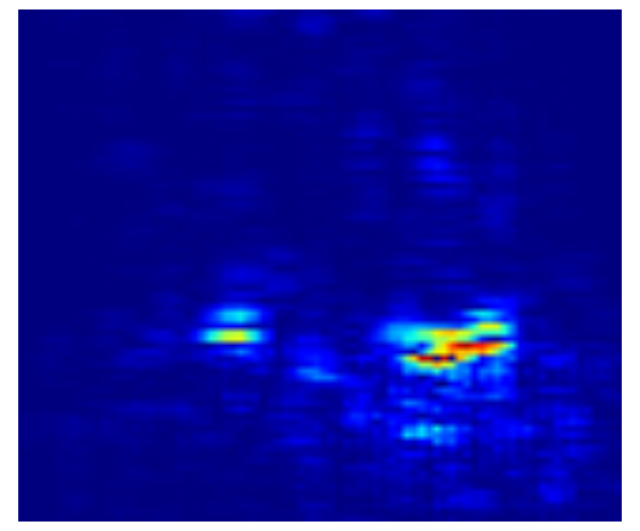
RGB image



Parsed poses

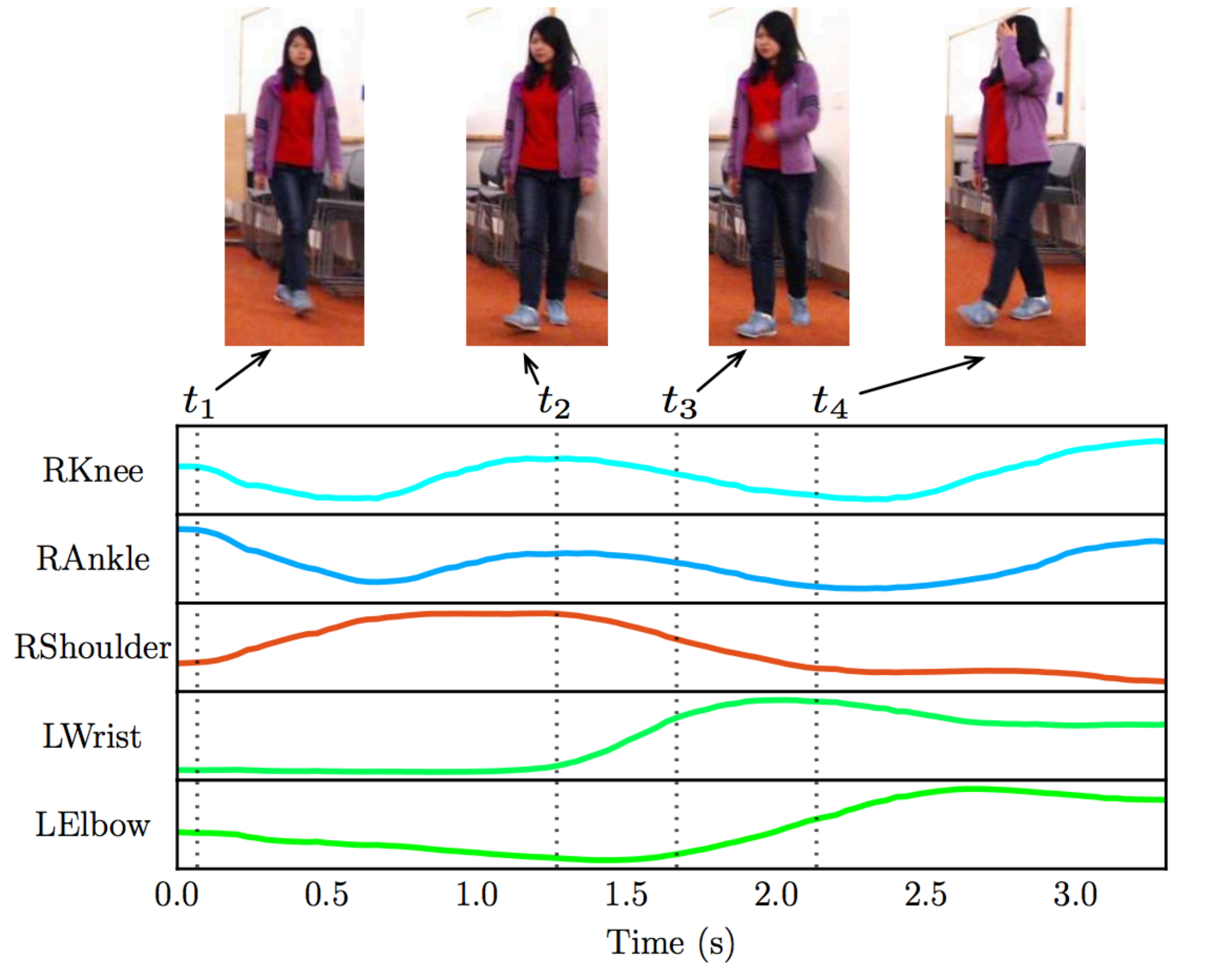


Horizontal Heatmap



Gradients

Temporal Attention



Application: Identification

Method:

- Extract skeleton heatmap using RF-Pose
- Identify people based on 50 consecutive frames of skeleton heatmaps

Accuracy: For 100 people, 84% in top-1 and 96% in top-5