Data integration and Learning

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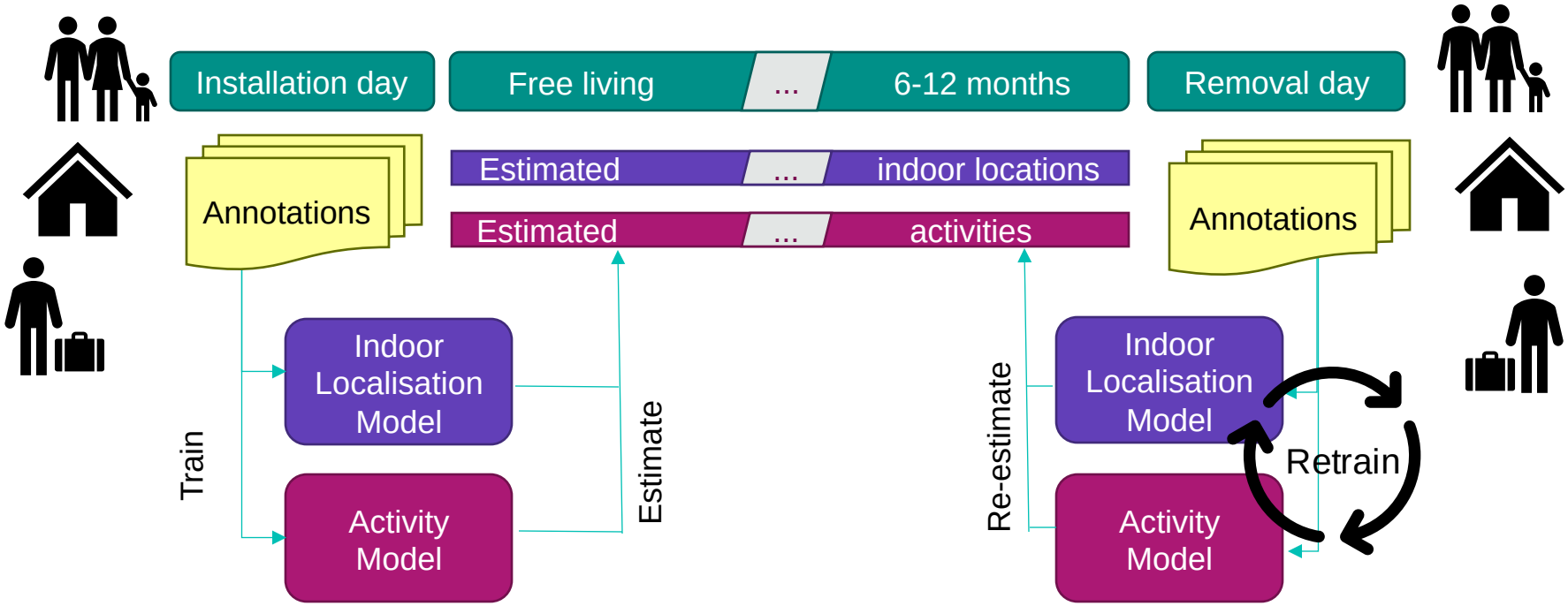
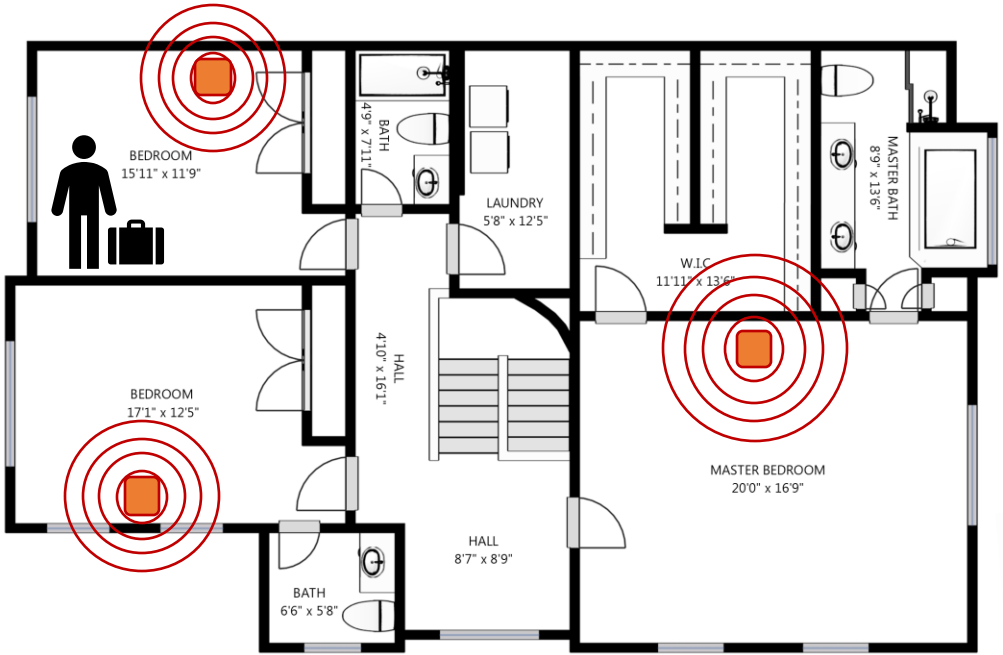
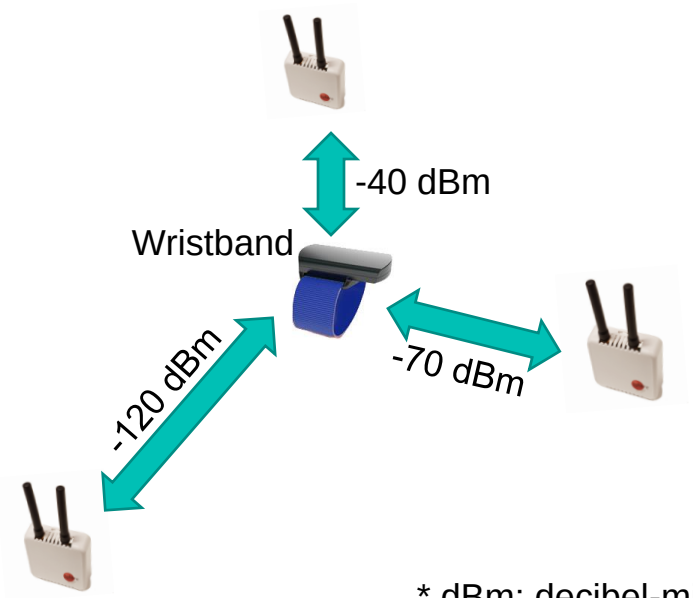
Making data work for everyone

Installation and annotation process



Localisation from Received Signal Strength

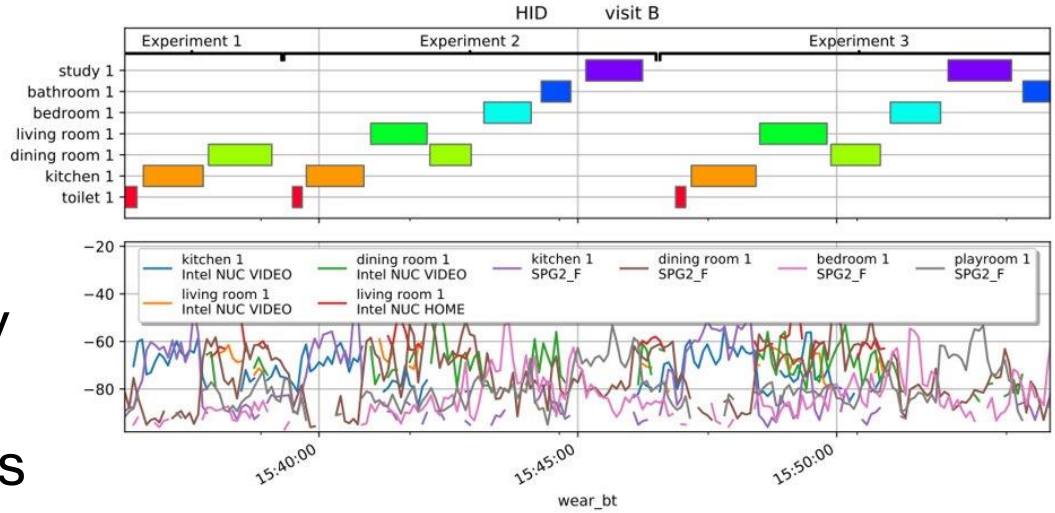




* dBm: decibel-milliwatts

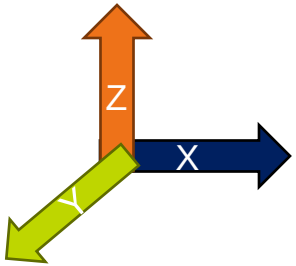
Example of location annotations

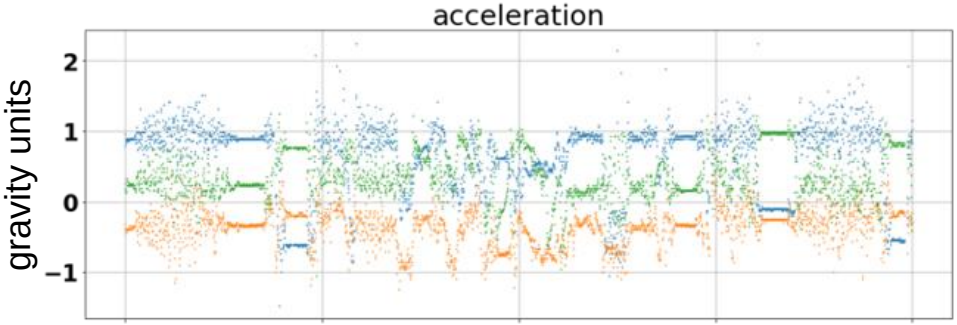
- At least 2 experiments per visit
- Visit every room and annotate the location
- We record the Received Signal Strength Intensity
- Train model and use to estimate indoor locations



Activity levels and recognition

Tri-axial acceleration

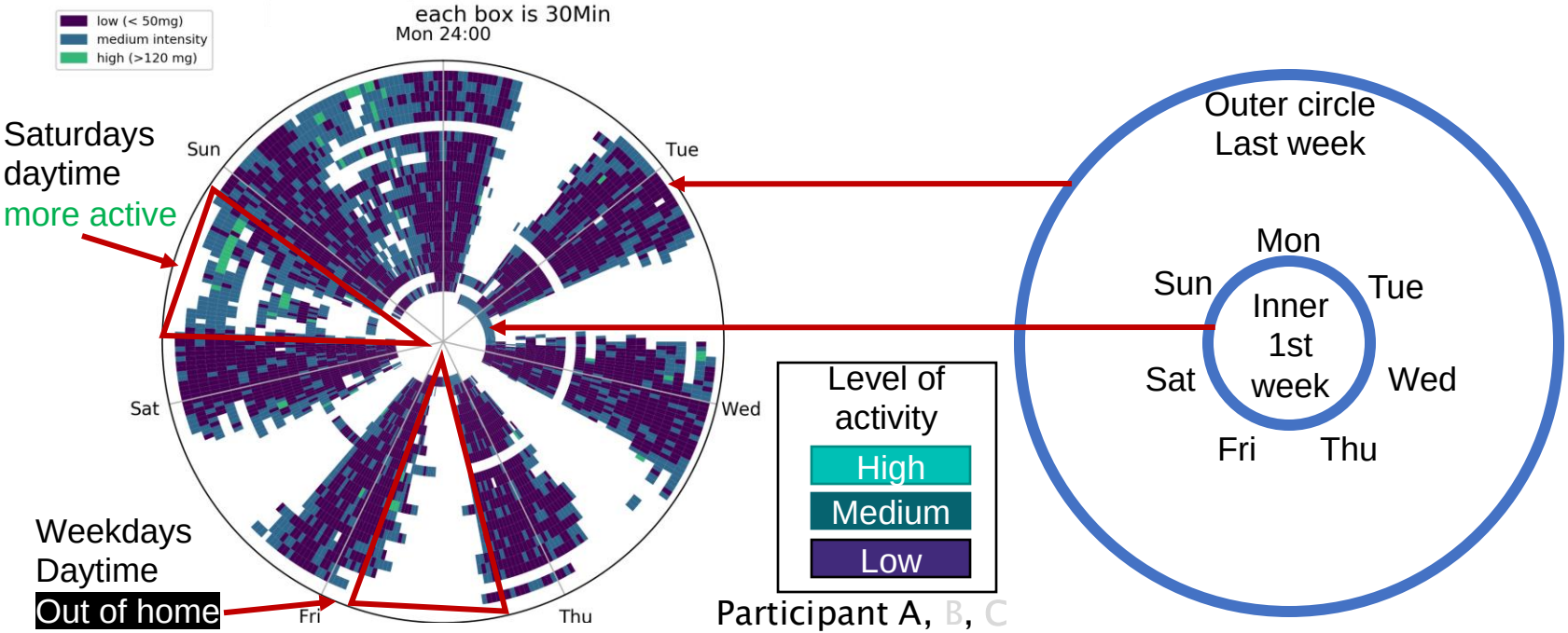




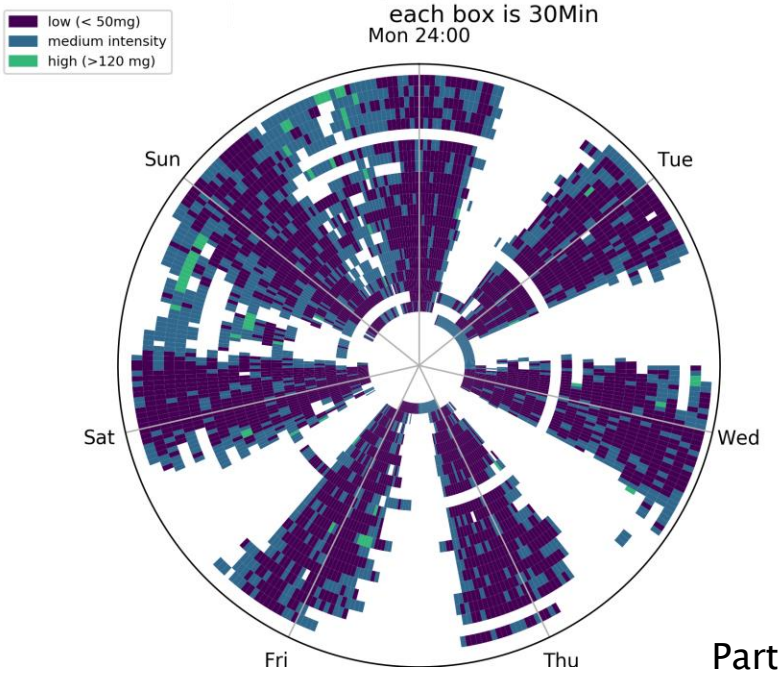
Day in fast forward with a head camera

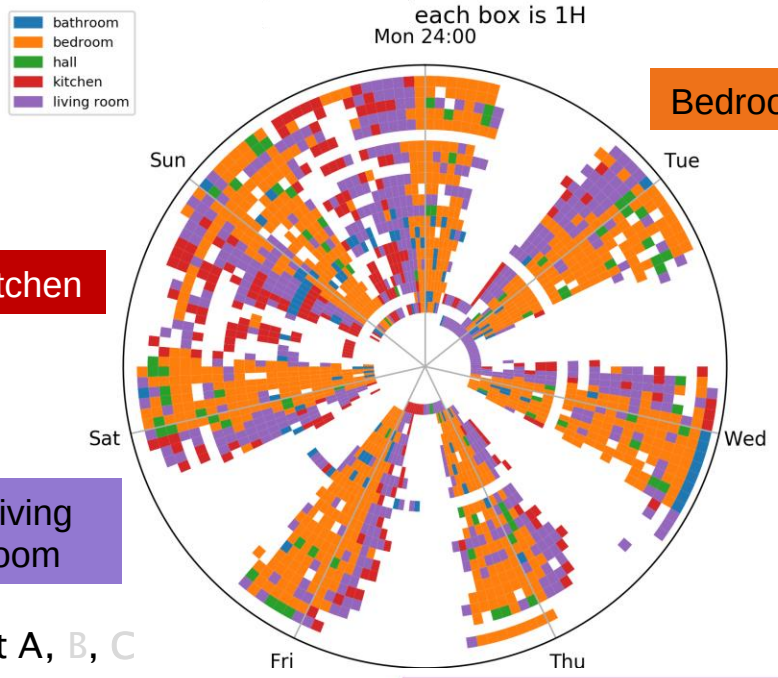
sit, still	stand, hand activities
	

Activity levels for the full period



Activity levels and localisation predictions:





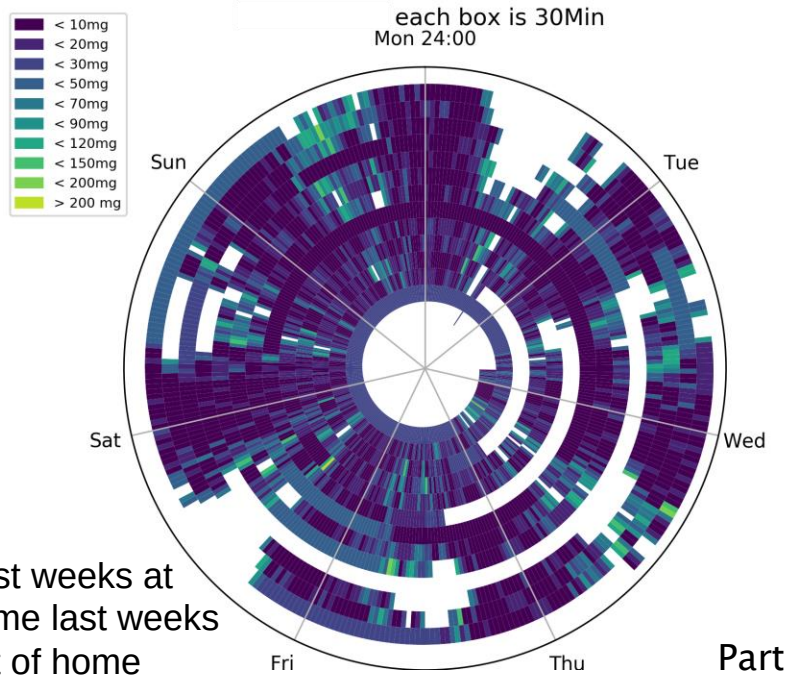
Bedroom

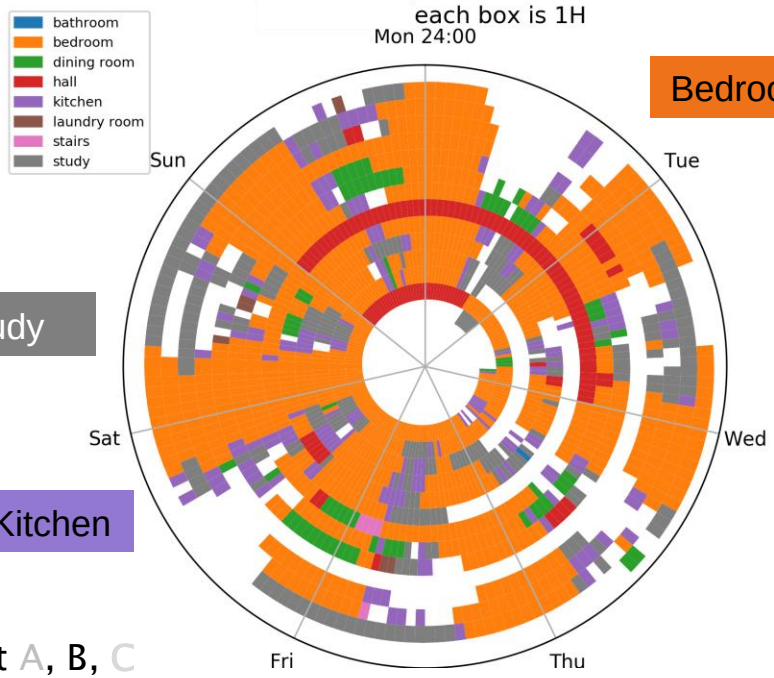
Kitchen

Living room

Participant A, B, C

Activity levels and localisation predictions:





Bedroom

Study

Kitchen

First weeks at home last weeks out of home

Participant A, B, C

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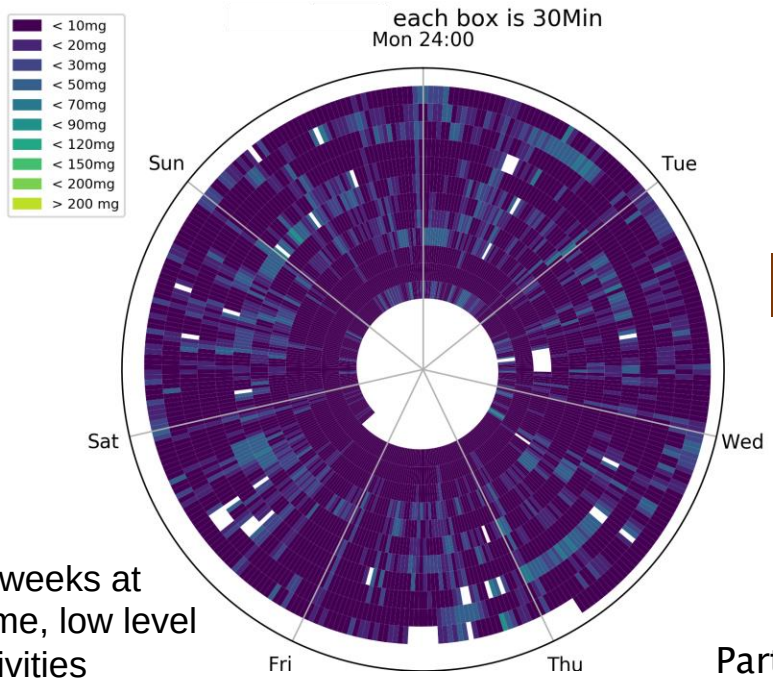
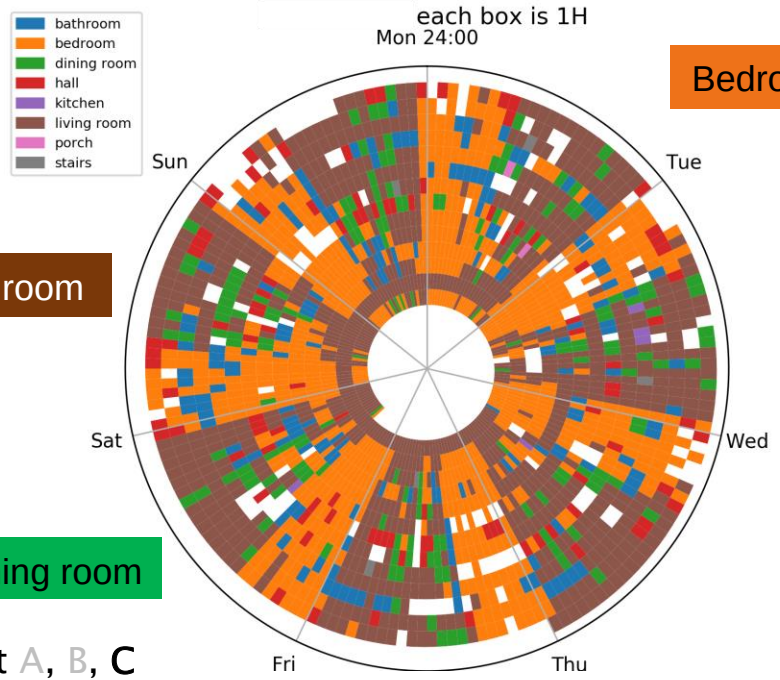
Activity levels and localisation predictions:



All weeks at home, low level activities



Bedroom

Living room

Dinning room

Participant A, B, C

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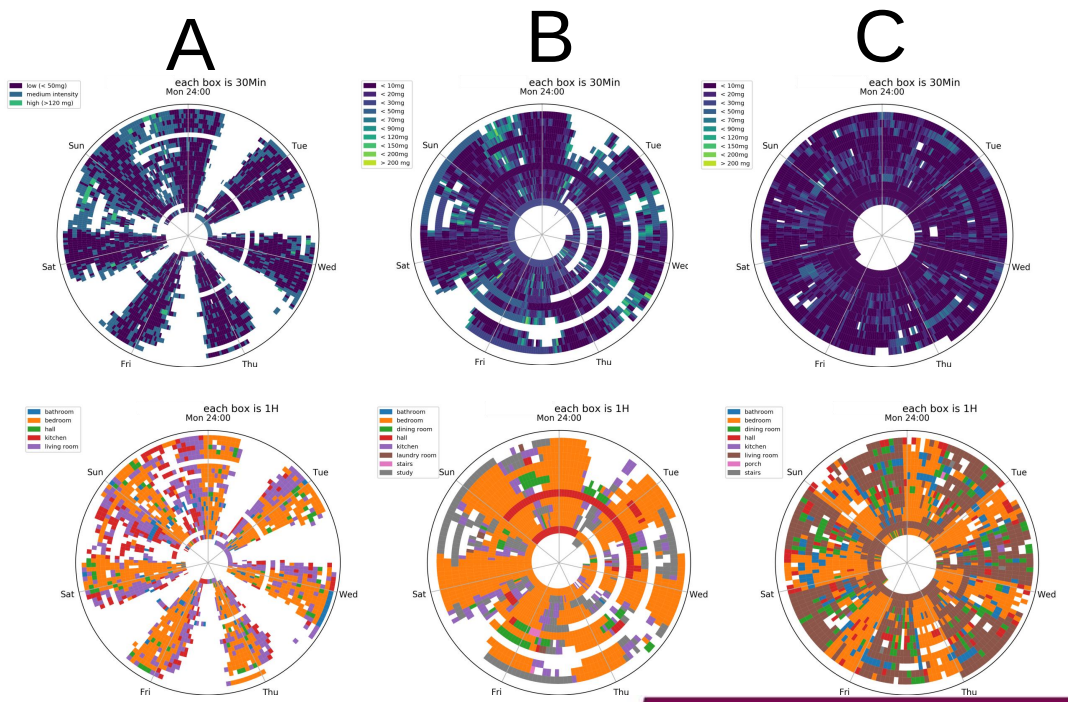
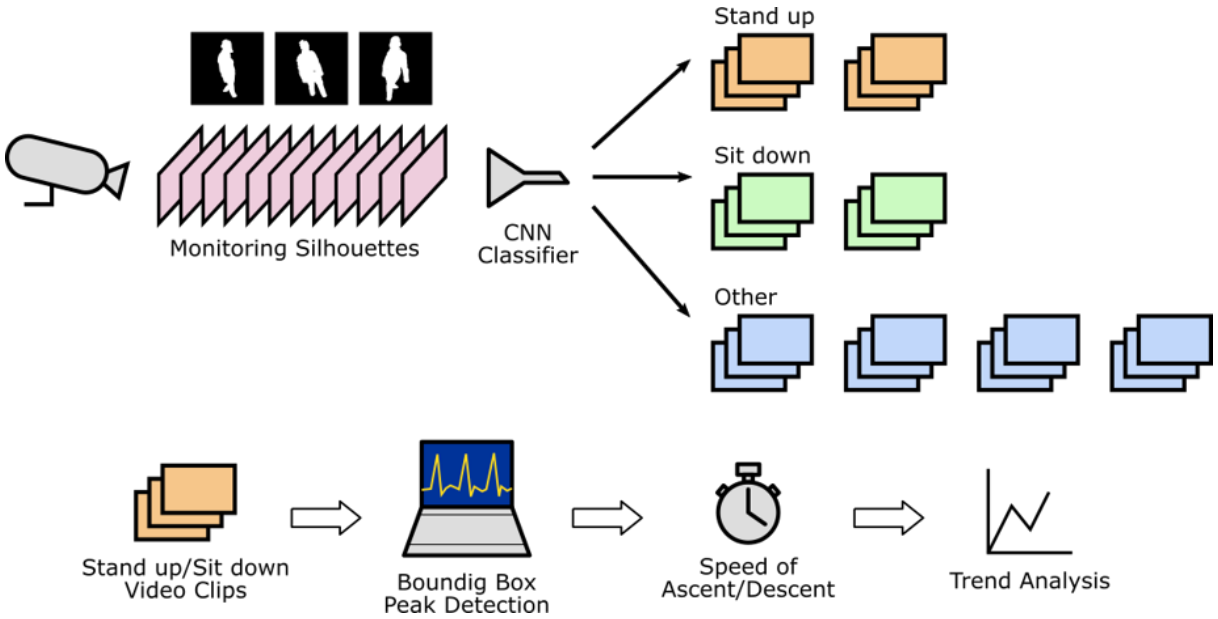
Activity and Locations overview

- A is a participant from the control group
- B and C are recovering from a hip replacement surgery
- B and C spend more time at home, and are generally less active

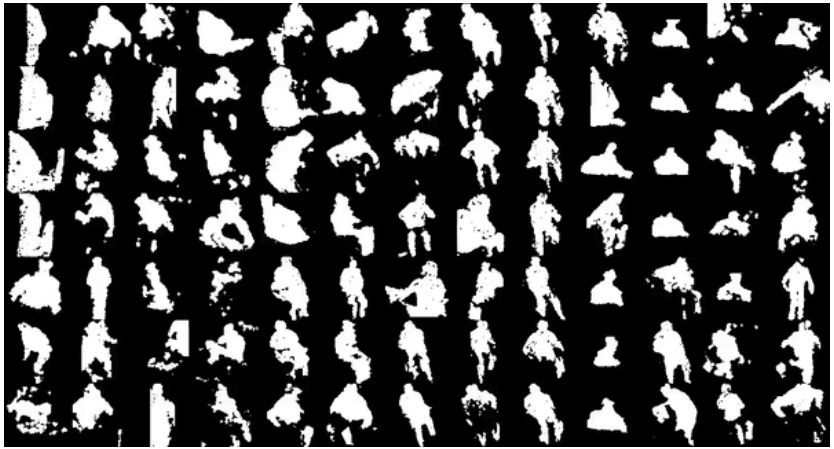


Sit to Stand as a surrogate of recovery

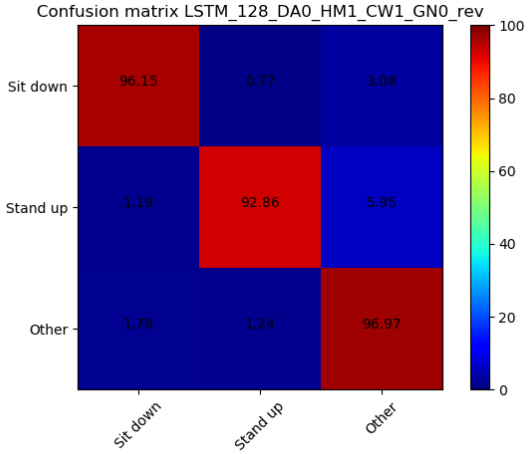


Sit to Stand Detector (Classifier)

- Using MuViLab, we have annotated 4 months of video data for STS transitions.
- Using a convolutional neural network we were able to achieve >90% accuracy in classifying video sequences:

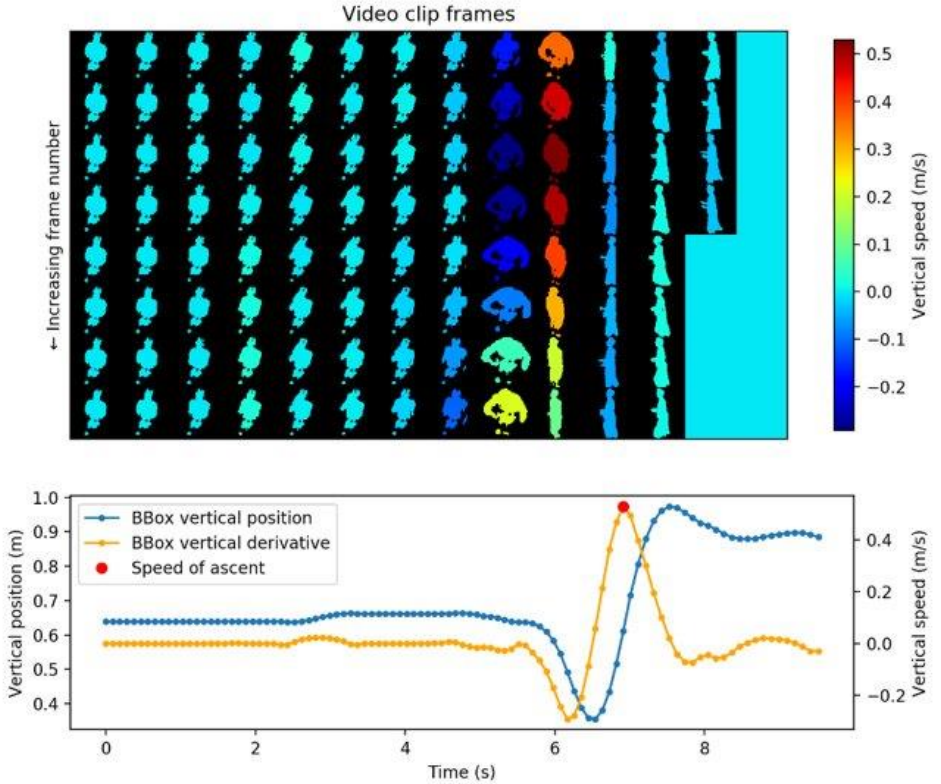


Examples of 4 seconds video sequences detected as stand up transitions.

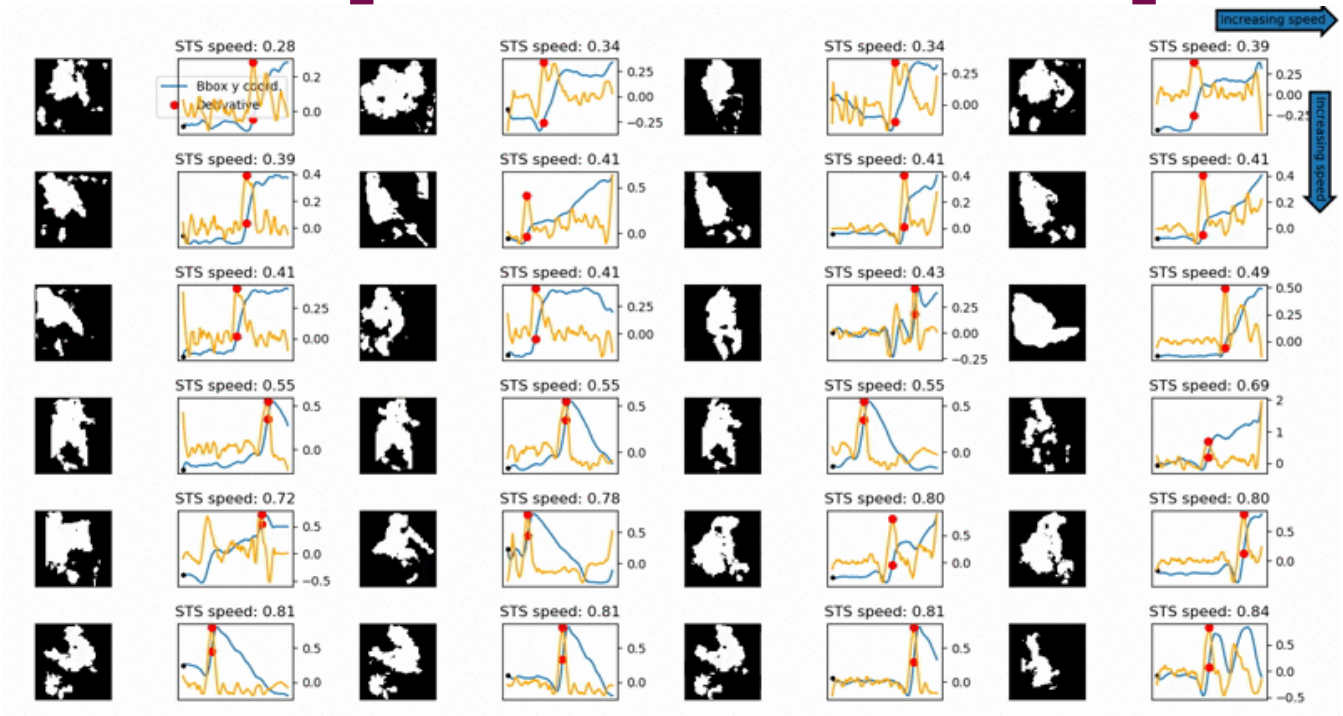


Bounding box peak detection

- The figure shows an example of analysis of sit-to-stand transition using silhouettes.
- On top are the frames of the video sequence of a person standing up, on the bottom the analysis derived from their movement.
- The red dot shows the speed of ascent, i.e. the maximum transfer velocity from sitting to standing position.

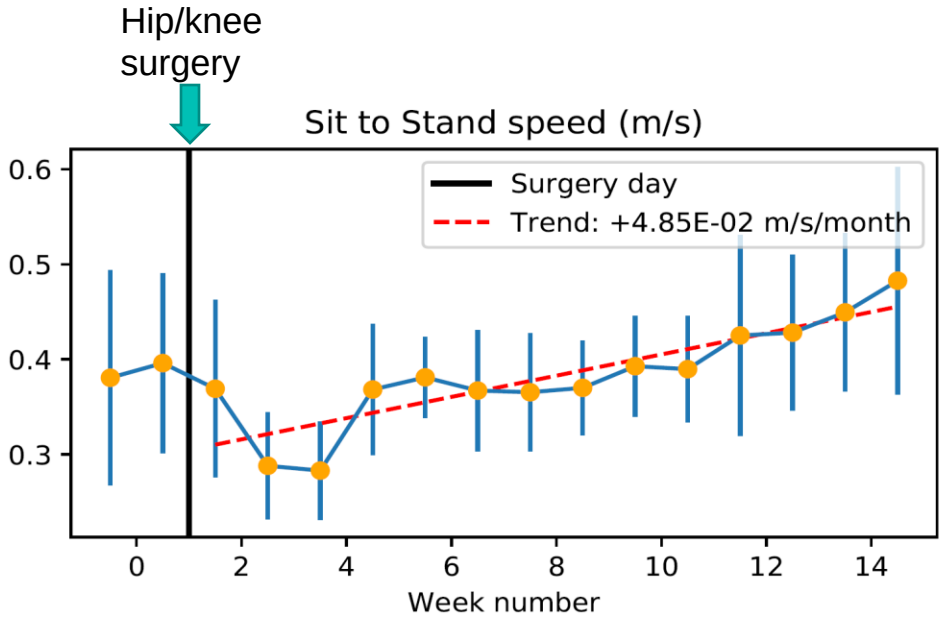


Several Examples of Sit to Stand Speed



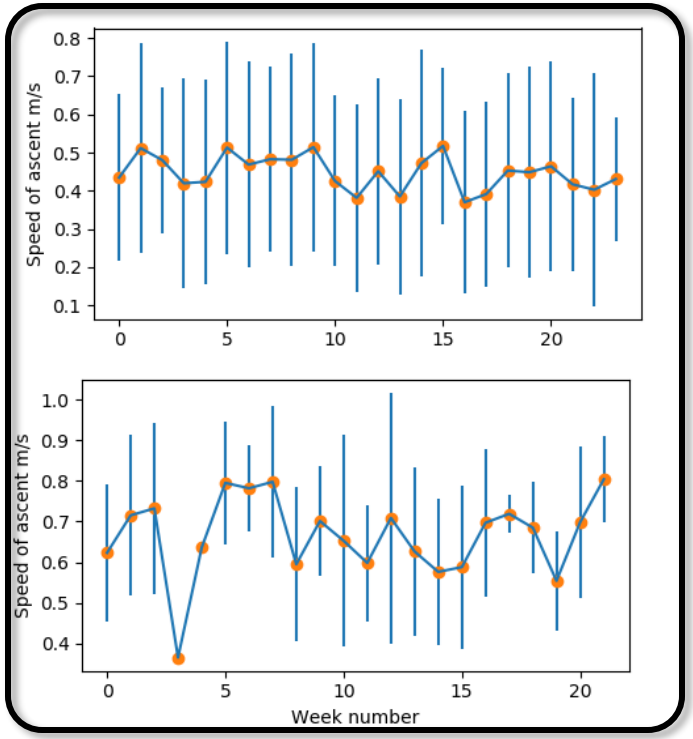
What Does This Look Like for a Patient?

- Recover from hip/knee replacement
- Sit to Stand speed decreases abruptly after surgery
- After that, the speed gradually increases

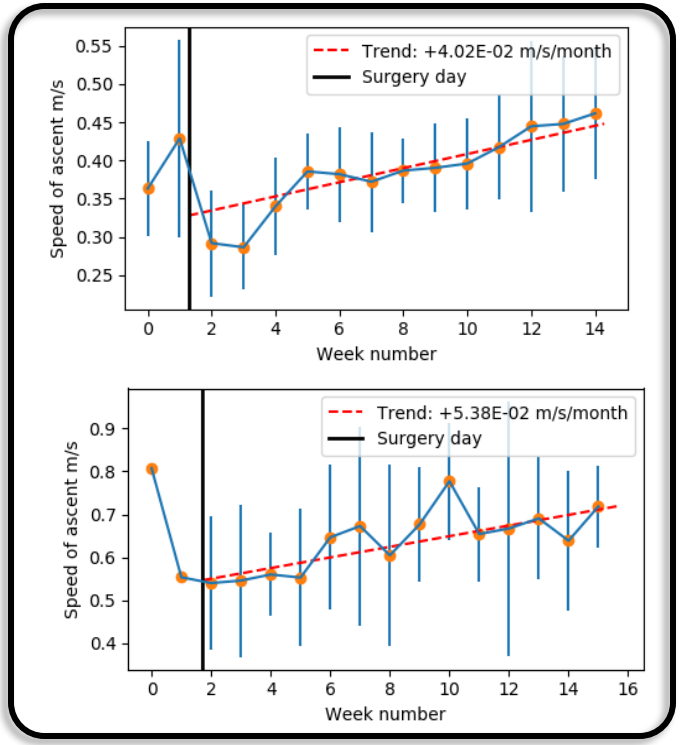


Comparison With Healthy Control

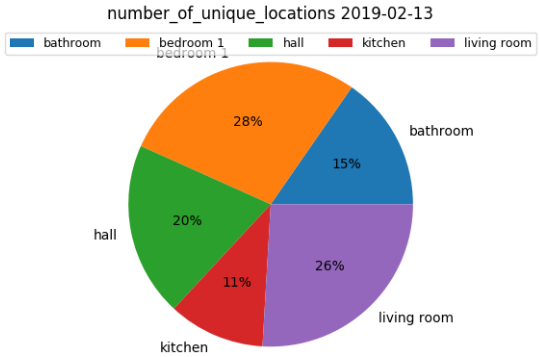
Healthy control



Surgery patients

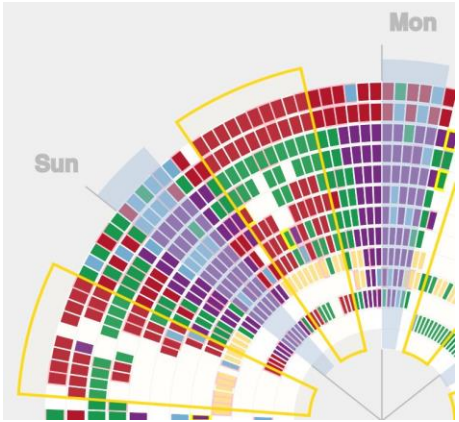


Other examples of available data

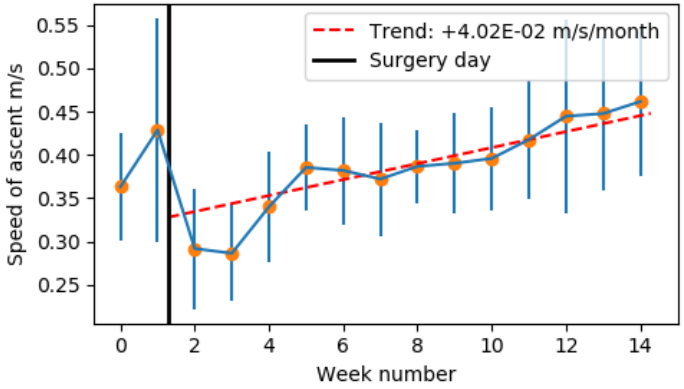


- Proportion of time spent in each room in one day (or several)

- Or Number of transitions between rooms



- Actigraphy for the study of sleep and circadian rhythms. Cut out of a circular plot showing the 10 most active hours (yellow box) and 5 less active (light blue) [2]



- Speed of ascent from sit to stand for a patient recovering from a hip replacement [3]

References

- [1] M. Holmes, H. Song, E. Tonkin, M. P. Nieto, S. Grant, and P. Flach, “**Analysis of patient domestic activity in recovery from hip or knee replacement surgery: Modelling wrist-worn wearable RSSI and accelerometer data in the wild**,” in CEUR Workshop Proceedings, 2018, vol. 2148.

- [2] M. Holmes, M. P. Nieto, H. Song, E. Tonkin, S. Grant, and P. Flach, “**Modelling Patient Behaviour Using IoT Sensor Data: a Case Study to Evaluate Techniques for Modelling Domestic Behaviour in Recovery from Total Hip Replacement Surgery**,” J. Healthc. Informatics Res., vol. 4, no. 3, pp. 238–260, Sep. 2020.
- [3] Masullo, Alessandro, et al. "**No Need for a Lab: Towards Multi-sensory Fusion for Ambient Assisted Living in Real-world Living Homes.**" VISIGRAPP (5: VISAPP). 2021.

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