Walking in Sync:
Two is Company, Three's a Crowd

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Pedestrian Flocks

"A number of people walking together as a compact, coherent unit for some time."
(Kjærgaard et al., 2012)

- Flocks prefer to move together as a unit.

- They walk side by side as long as the space is not crowded.

- Typically, individuals in the same group will walk at the same speed and follow the same trajectories.

- They quickly reform after they become separated.

- Very often, they synchronise their gate!

Image by CRCA / CNRS / University of Toulouse

Intentional Gait Synchronisation

Unintentional Gait Synchronisation

Mile End Park, London

Mile End Park, London

Scenario 1

P1 P2

Mile End Park, London
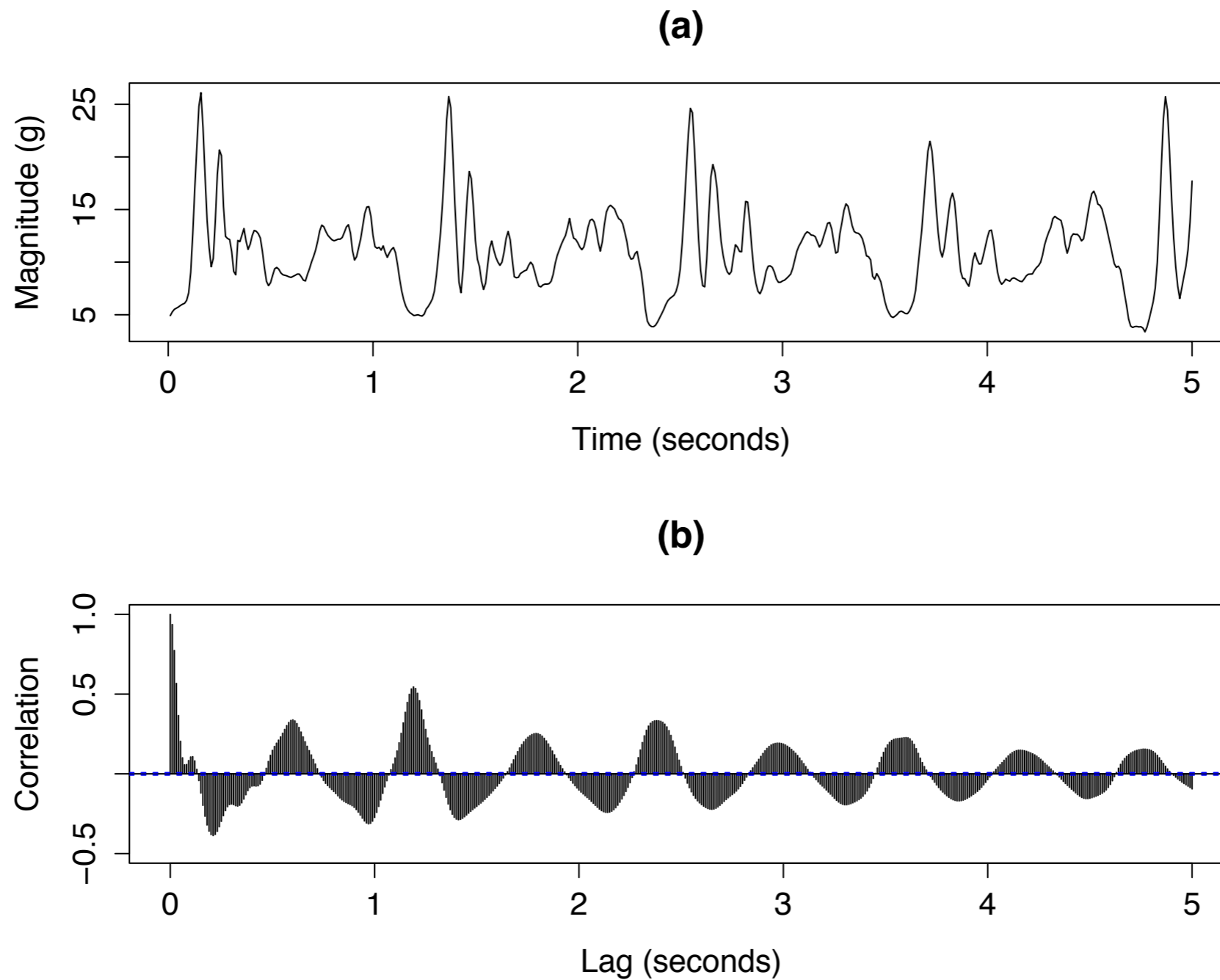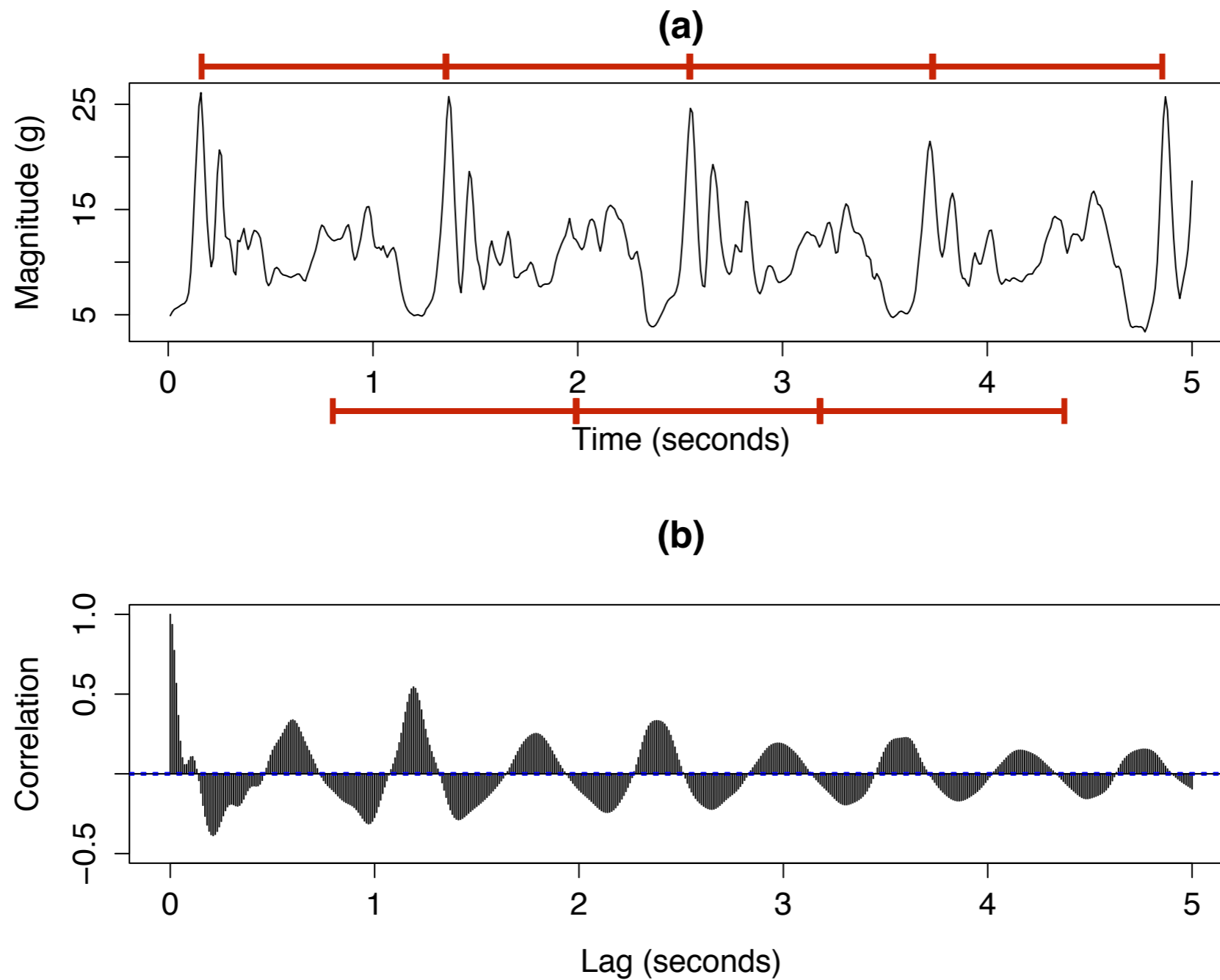
Scenario 2

P1 P3 P2

Queen Mary
University of London

Cognitive Science Research Group
http://cogsci.eecs.qmul.ac.uk

Mile End Park, London

Scenario 2

P1

P3

P2

Queen Mary
University of London

Cognitive Science Research Group
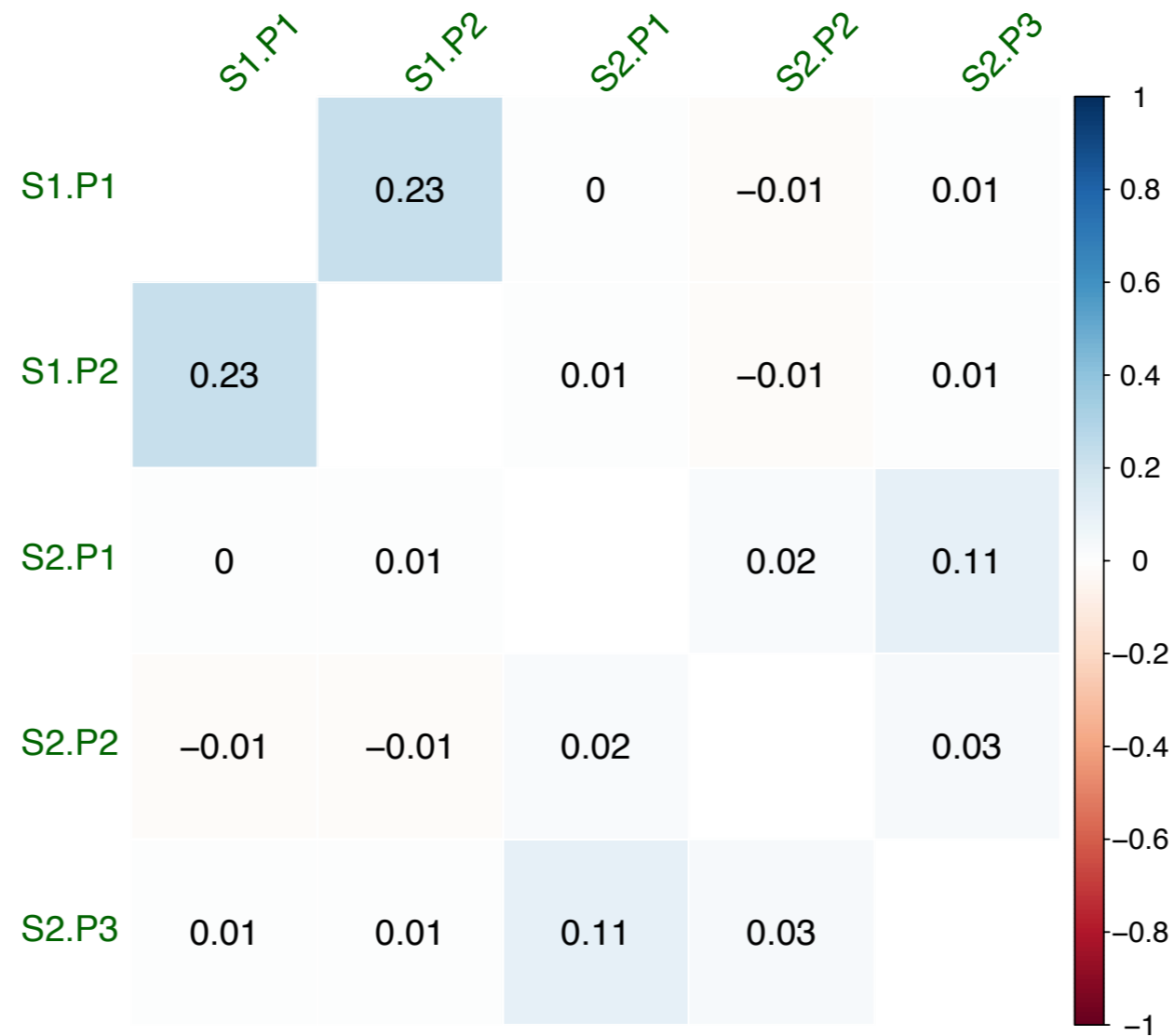http://cogsci.eecs.qmul.ac.uk

(a)

(b)

Acceleration Magnitude of 5 sec (a) and Autocorrelation (b) of Participant 1 in Scenario 1.

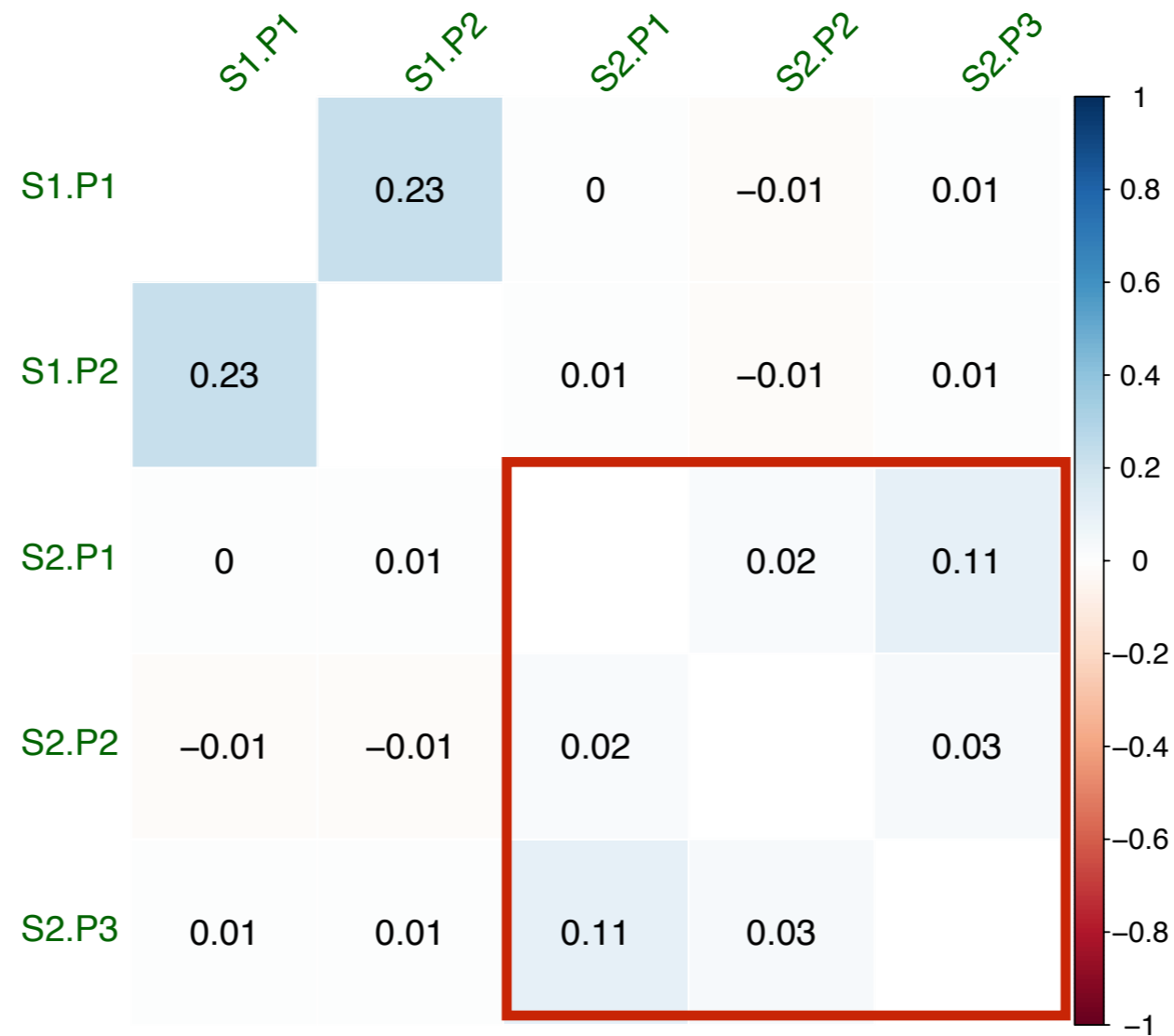*Acceleration Magnitude of 5 sec (a) and Autocorrelation (b) of Participant 1 in Scenario 1.*

Pearson Correlation matrix of all 5 datasets, visualised as a heat map plot.
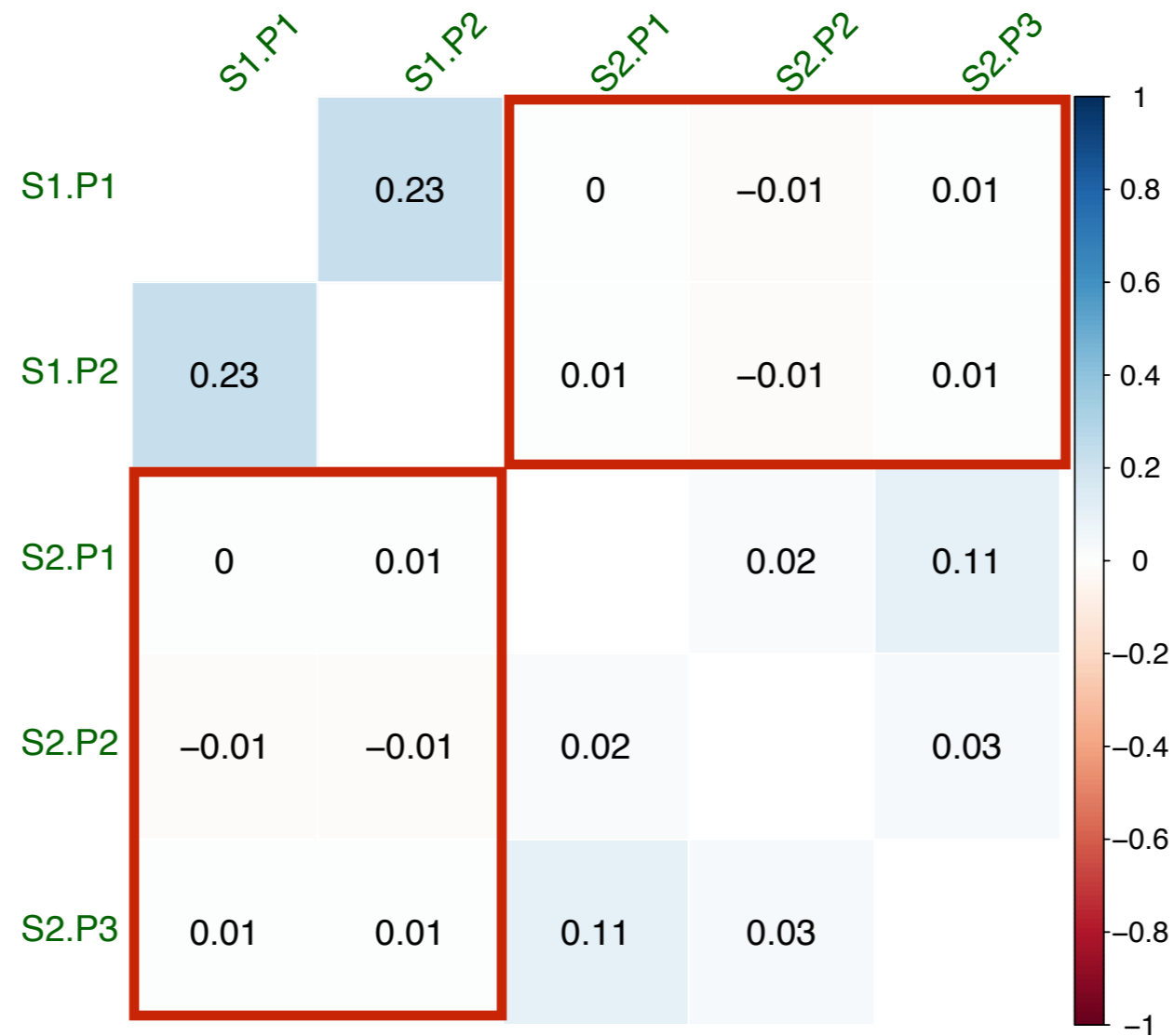
Scenario 1 (2 People)

	S1.P1	S1.P2	S2.P1	S2.P2	S2.P3
S1.P1		0.23	0	−0.01	0.01
S1.P2	0.23		0.01	−0.01	0.01
S2.P1	0	0.01		0.02	0.11
S2.P2	−0.01	−0.01	0.02		0.03
S2.P3	0.01	0.01	0.11	0.03	

Pearson Correlation matrix of all 5 datasets, visualised as a heat map plot.

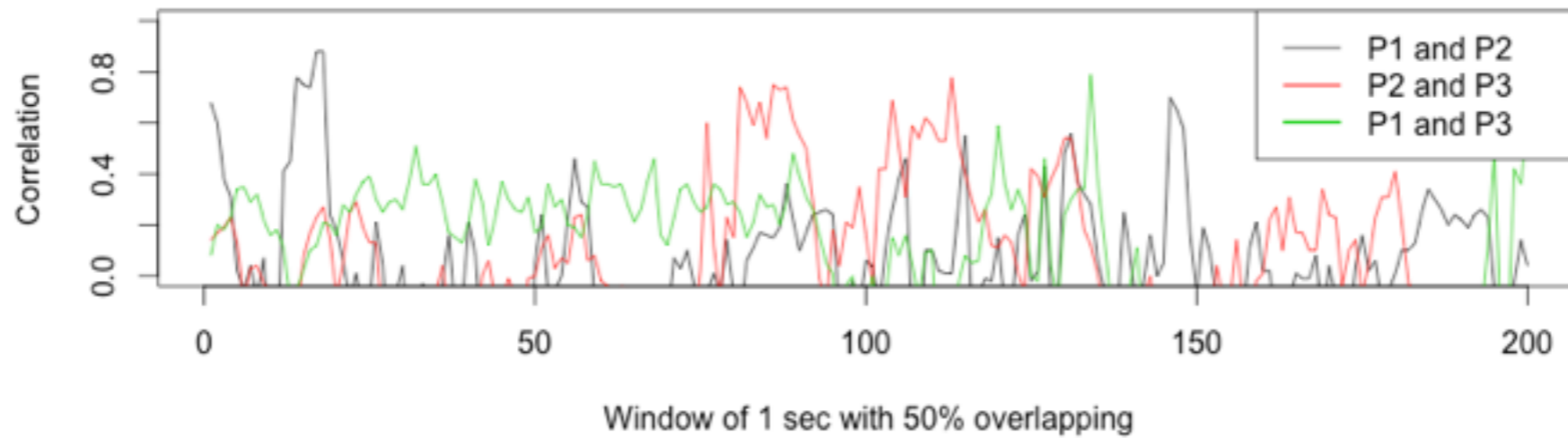*Pearson Correlation matrix of all 5 datasets, visualised as a heat map plot.*

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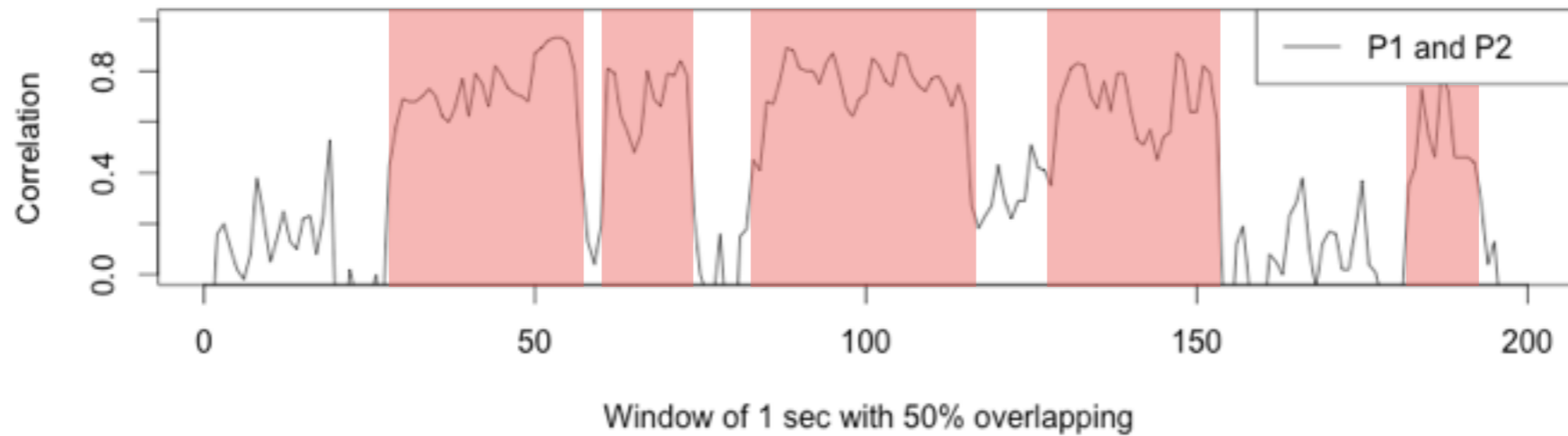
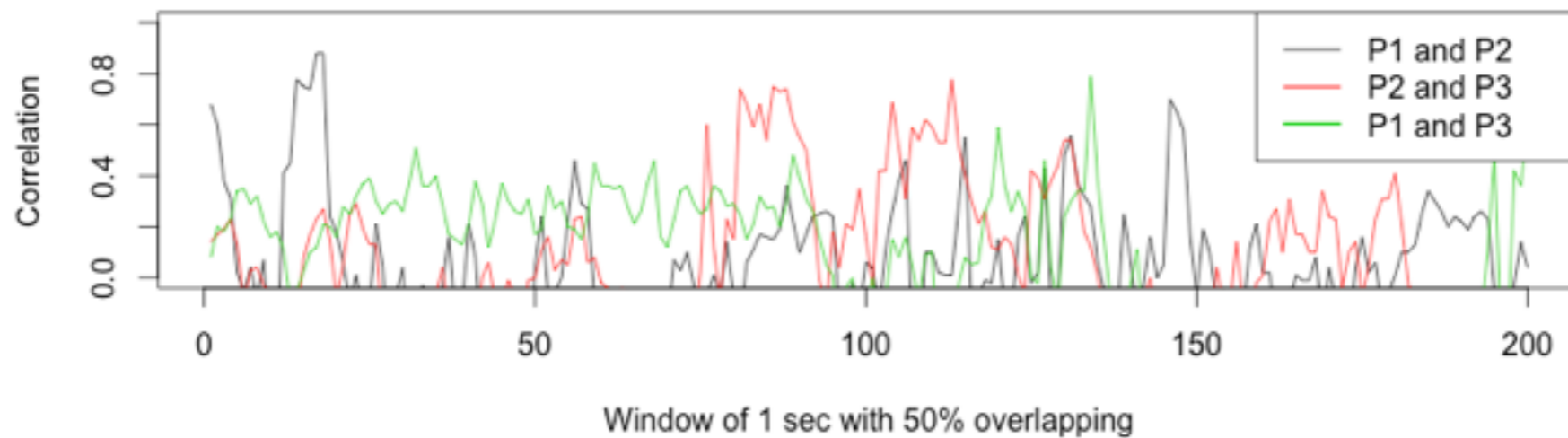(a) Scenario 1 (2 People)

(b) Scenario 2 (3 People)

Pearson Correlation applied to windows of 1 sec (with 50% overlap) for Scenario 1 (a) and Scenario 2 (b).
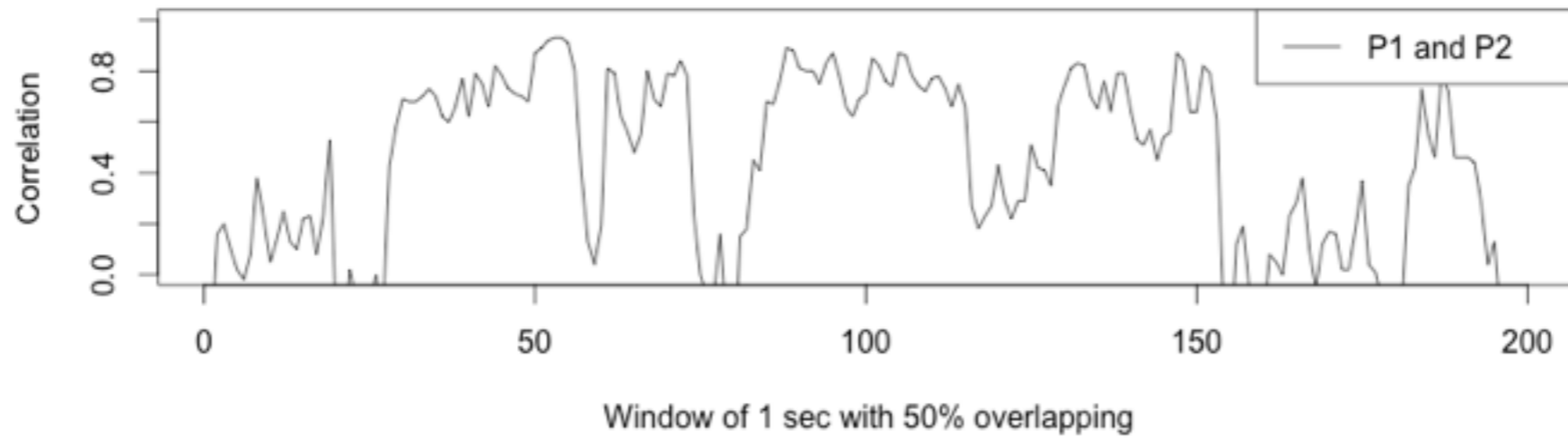
(a) Scenario 1 (2 People)

Window of 1 sec with 50% overlapping

(b) Scenario 2 (3 People)
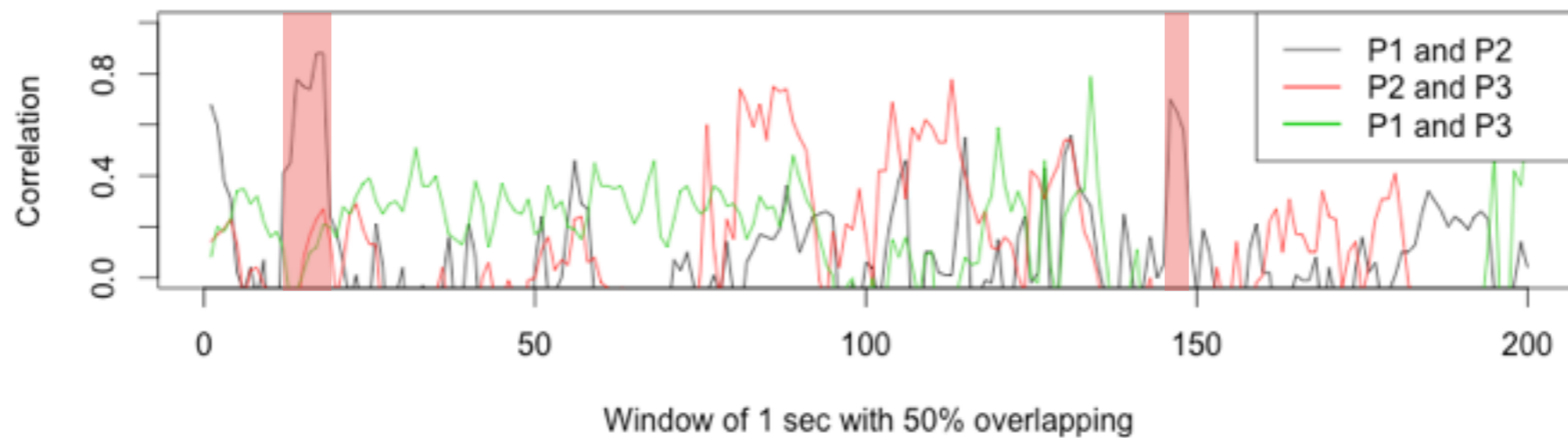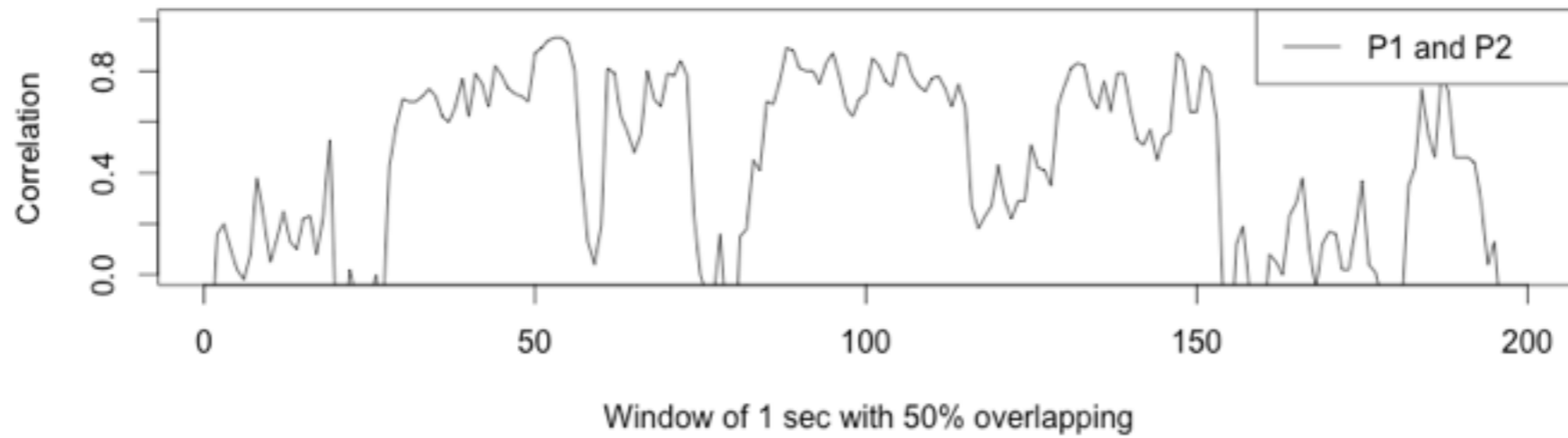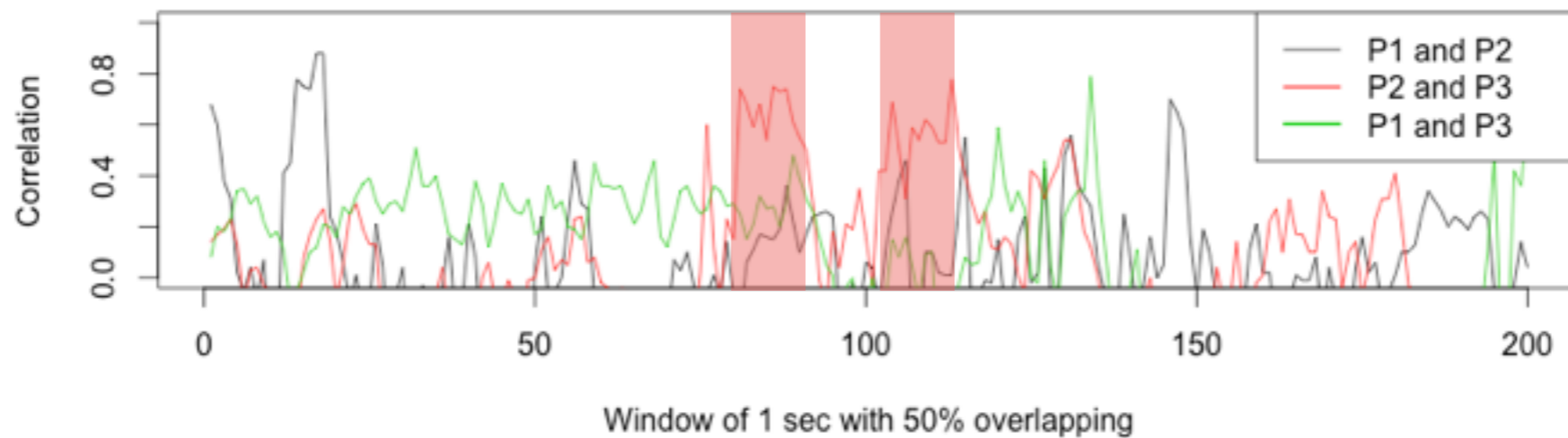
Window of 1 sec with 50% overlapping

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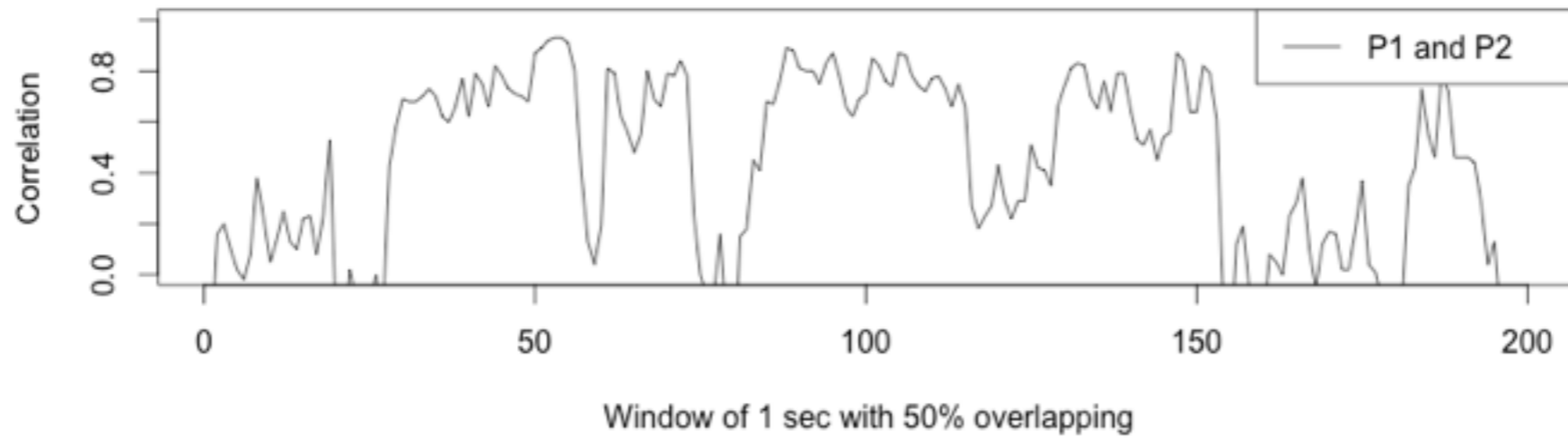for Scenario 1 (a) and Scenario 2 (b).*

(a) Scenario 1 (2 People)

(b) Scenario 2 (3 People)

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Conclusions

- Rich information about individuals' relationships, through analyses of subconscious actions such as gait synchronisation.

- Availability of highly sensitive smartphones enables us to capture these interactions with high accuracy.

- Non-verbal social signals such as **gaze**, **head orientation** and **gestures** between individuals play a significant factor in gait synchronisation.

- A third person can distort the synchronisation.

Future Work

- Use video recording for grounding.

- Investigate the required resolution of the data.

- Analyse negative gait synchronisation.

- Detect hidden individuals.

- Use of multiple sensors(e.g. iBeacon/Bluetooth Smart, Gyroscope, Magnetometer).
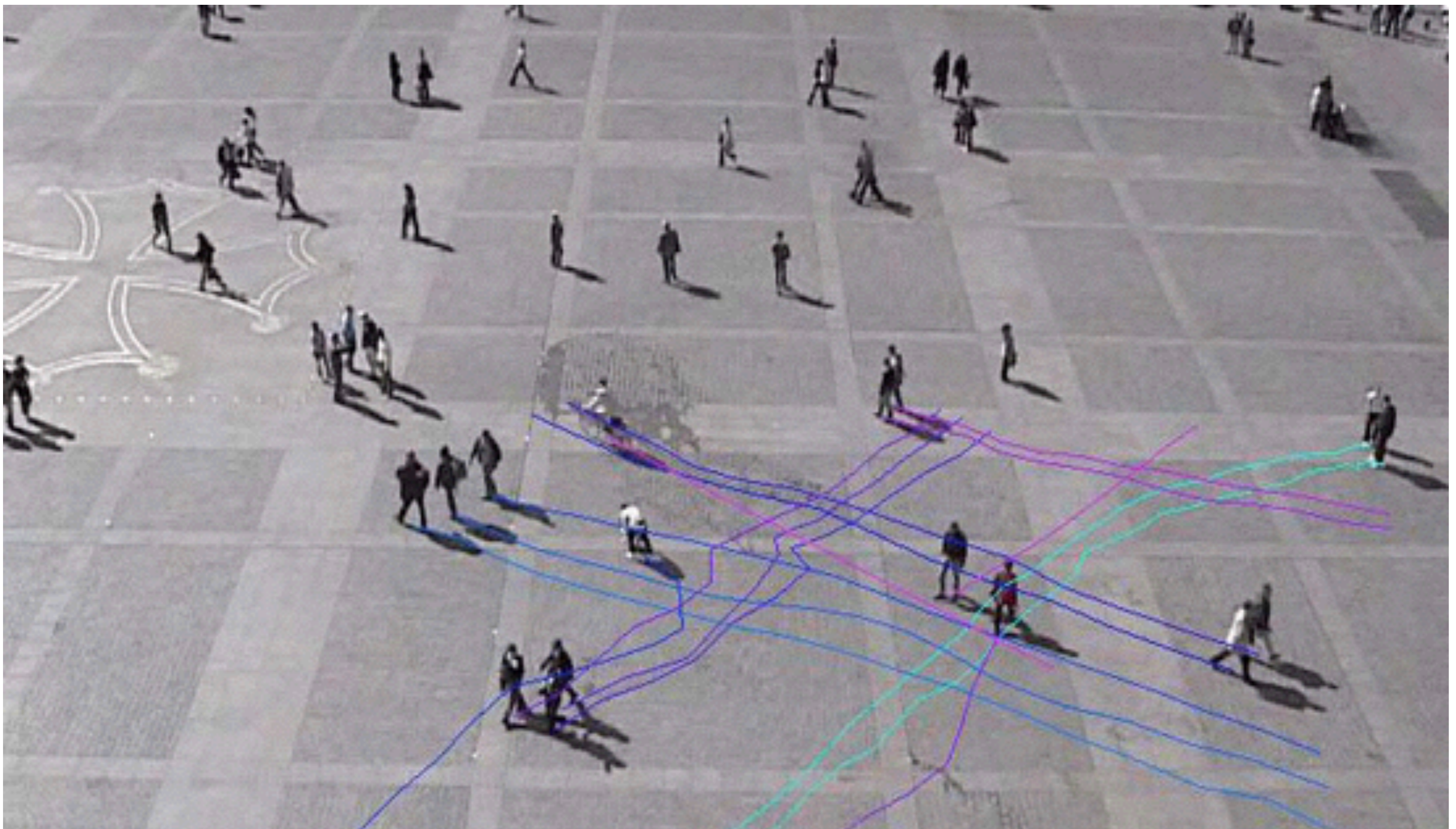
Future Work

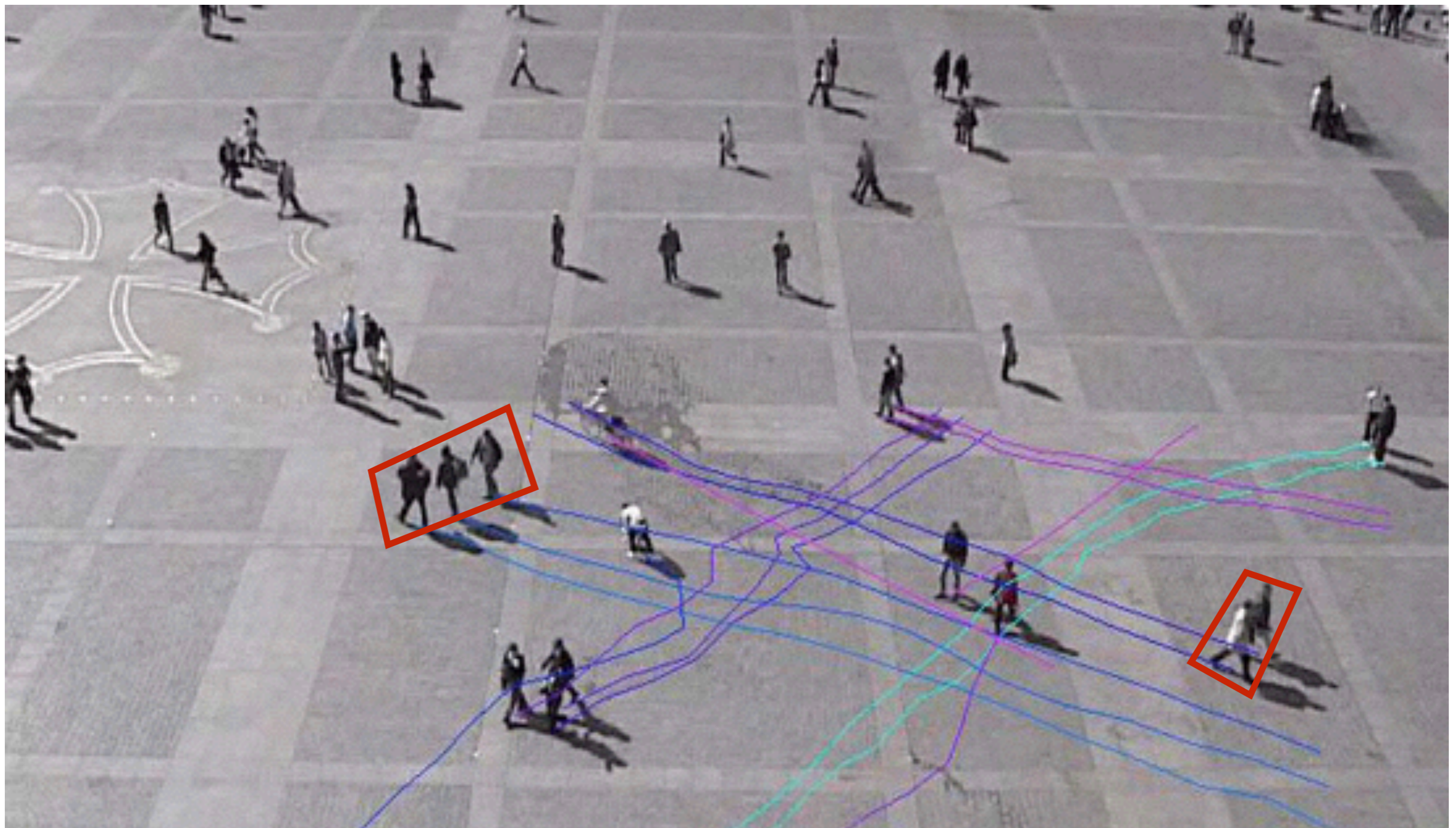Image by CRCA / CNRS / University of Toulouse

Future Work

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Future Work

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SensingKit: A Multi-Platform Mobile Sensing Framework

- Works in Android and iOS mobile systems.
- Captures Motion, Orientation, Activity, Location, Proximity, Audio (+more).
- Power efficient using Bluetooth Smart (4.0).
- Easily extensible using a modular design.
- Available in open-source at **www.sensingkit.org**.
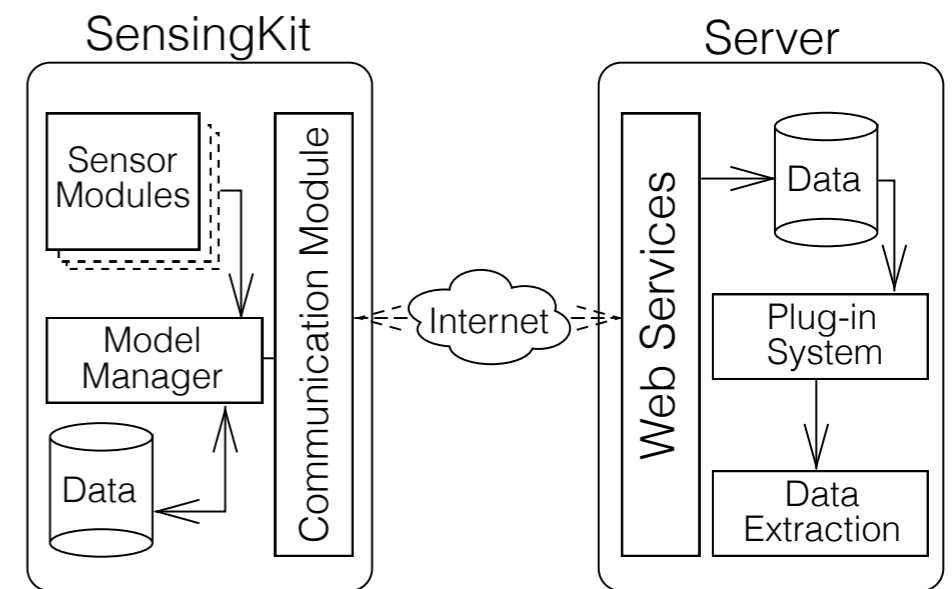
Kleomenis Katevas, Hamed Haddadi and Laurissa Tokarchuk, "Walking in Sync: Two is Company, Three's a Crowd", ACM MobiSys 2nd Workshop on Physical Analytics (WPA), Florence, Italy, May 2015.

Kleomenis Katevas, Hamed Haddadi, and Laurissa Tokarchuk. "Poster: Sensingkit: A multi-platform mobile sensing framework for large-scale experiments". In Proceedings of the 20th Annual International Conference on Mobile Computing and Networking, MobiCom '14, pages 375–378, New York, NY, USA, 2014. ACM.