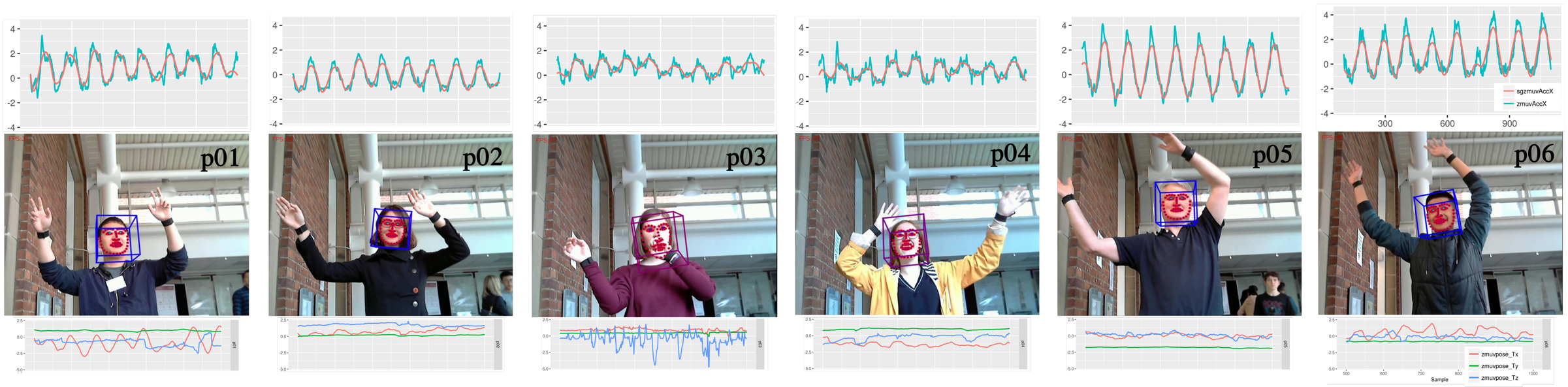
eMOTION: Analysis of Emotion and Movement Variability in the Context of Human-Robot Interaction

Miguel P Xochicale
@_mxochicale
School of Engineering
University of Birmingham, UK

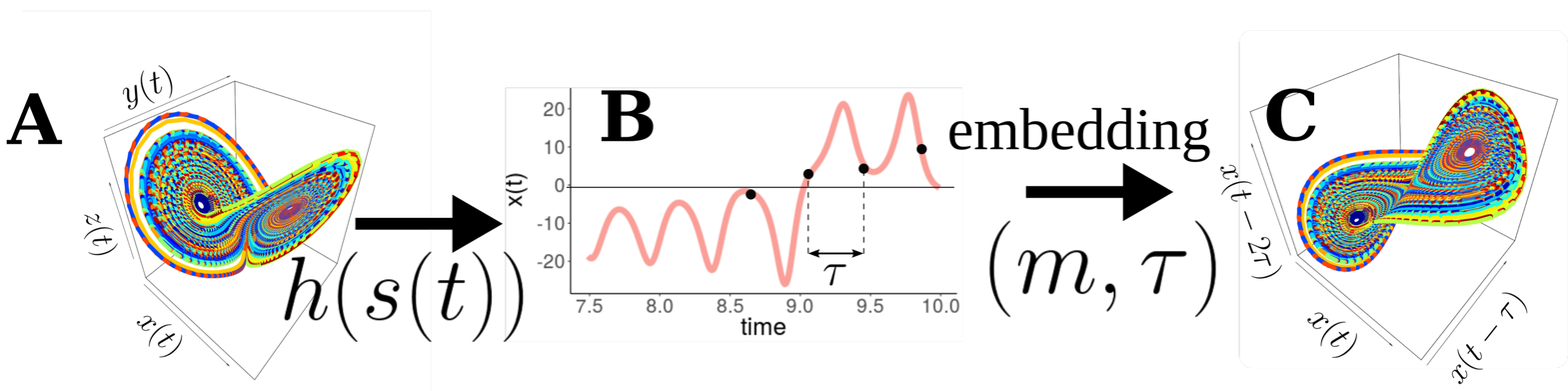


1. INTRODUCTION

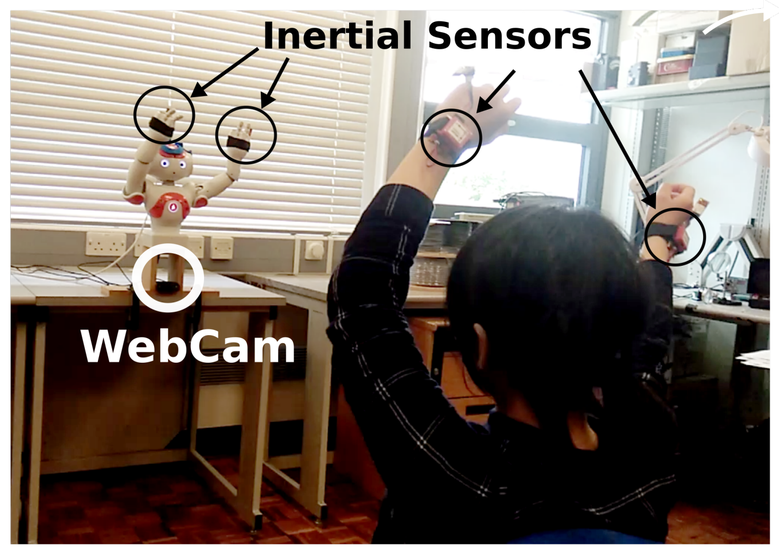
Movement variability is an inherent feature within and between persons. Research on measurament and understanding movement variability using nonlinear dynamics has been well established in the previous three decadesin areas as biomechanics, sport science, neuroscience and robotics to name but a few [1]. With that in mind, we hypothesise that the subtle variations of facial emotions and simple body movements can be quantified in a similar fashion as with the methodologies of movement variability.

2. TIME-DELAY EMBEDDING

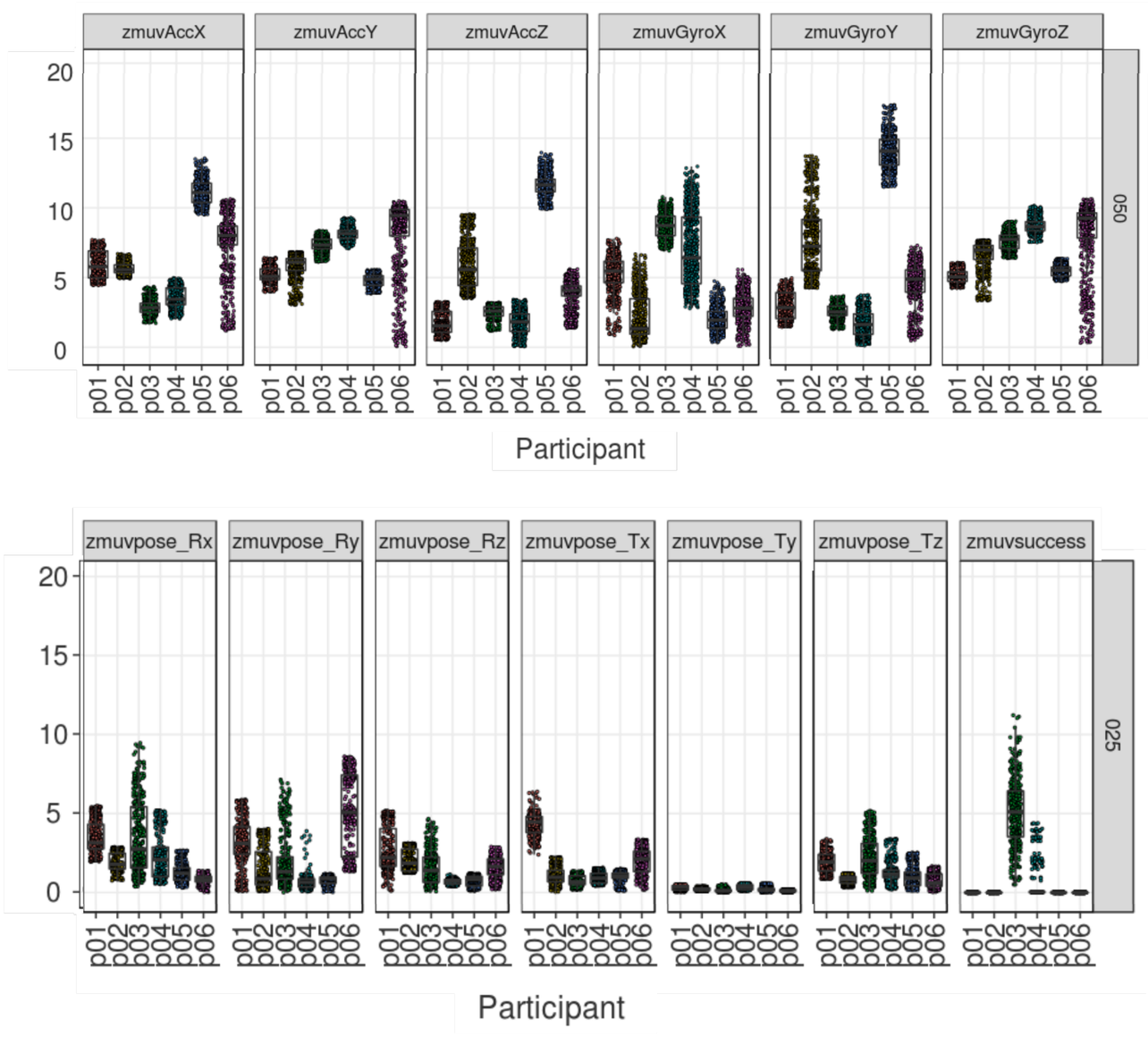
The purpose of Time-delay embedding theorem is to reconstruct an unknown M-dimensional state space from a 1-dimensional measurement function $x(t) = h(s(t))$. The theorem is based on m delayed copies of $x(t)$ uniformly separated by τ, and it is defined as a matrix $X(t) = \{x(t), x(t-\tau), x(t-2\tau),..., x(t-(m-1)\tau)\}$ where (m, τ) are the embedding parameters [2].



3. HUMAN-ROBOT IMITATION



4. RESULTS AND DISCUSSIONS



5. CONCLUSIONS AND FUTURE WORK

We not only presented visual differences of movement variability for arms and head pose between eighteen participants, but also we quantified such movement variability using the state space reconstruction's theorem We believe that such levels of human-humanoid imitation are promising for applications in rehabilitation, sport science, entertainment or education. In future experiments, we intend to investigate deep learning techniques for the automatic classification of the movement variability.

6. REFERENCES

[1] **K. M. Newell and D. M. Corcos.** 1993. *Variability and Motor Control.* Human Kinetics Publishers.

[2] **L. C. Uzal, G. L. Grinblat and P. F. Verdes.** 2011. *Optimal Reconstruction of dynamical systems: A noise amplification approach.* Physical Review E - Statistical Nonlinear and Soft Matter Physics 84, 1 (2011).

[3] **Tadas Baltrusaitis, Peter Robinson, and Louis-Philippe Morency.** 2016. *OpenFace: an open source facial behavior analysis toolkit.* In IEEE Winter Conference on Applications of Computer Vision.