



Miguel Xochicale

@mxochicale

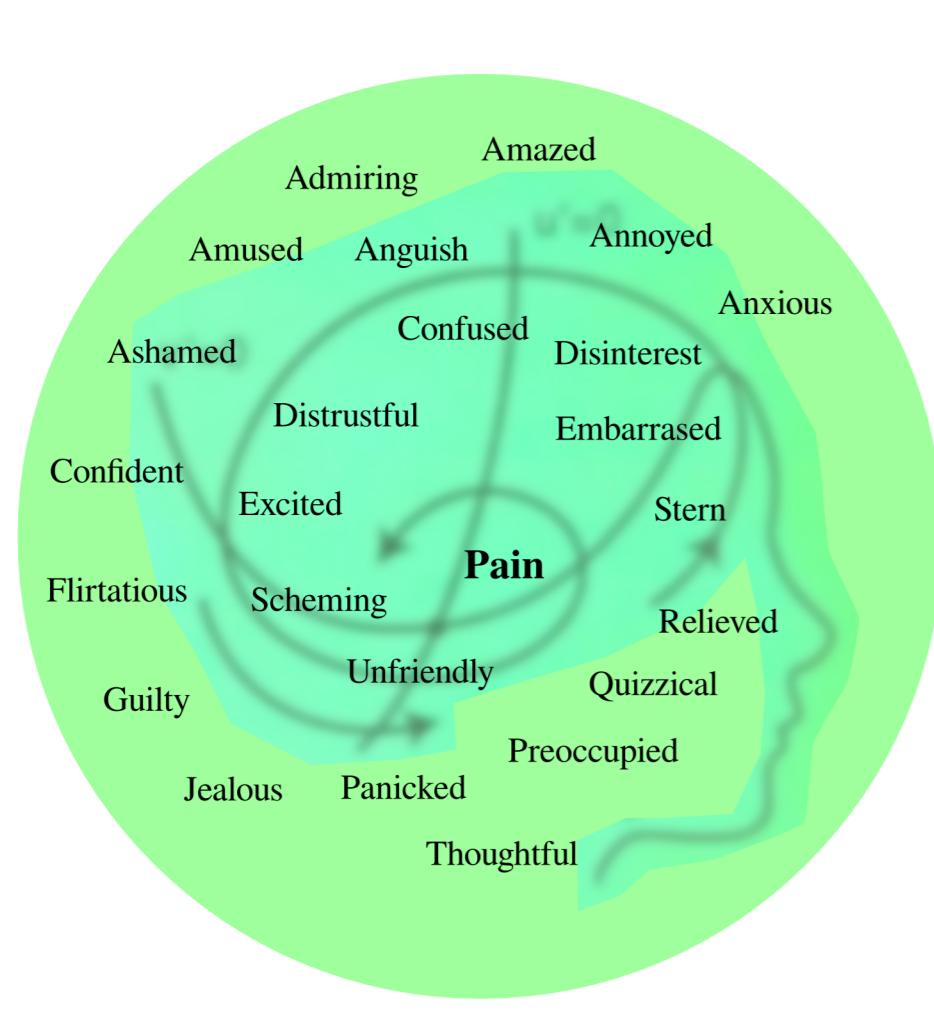
@_mxochicale

School of Engineering
University of Birmingham

Quantification of Dynamic Facial Expressions with Shannon Entropy in Human-Humanoid Interaction

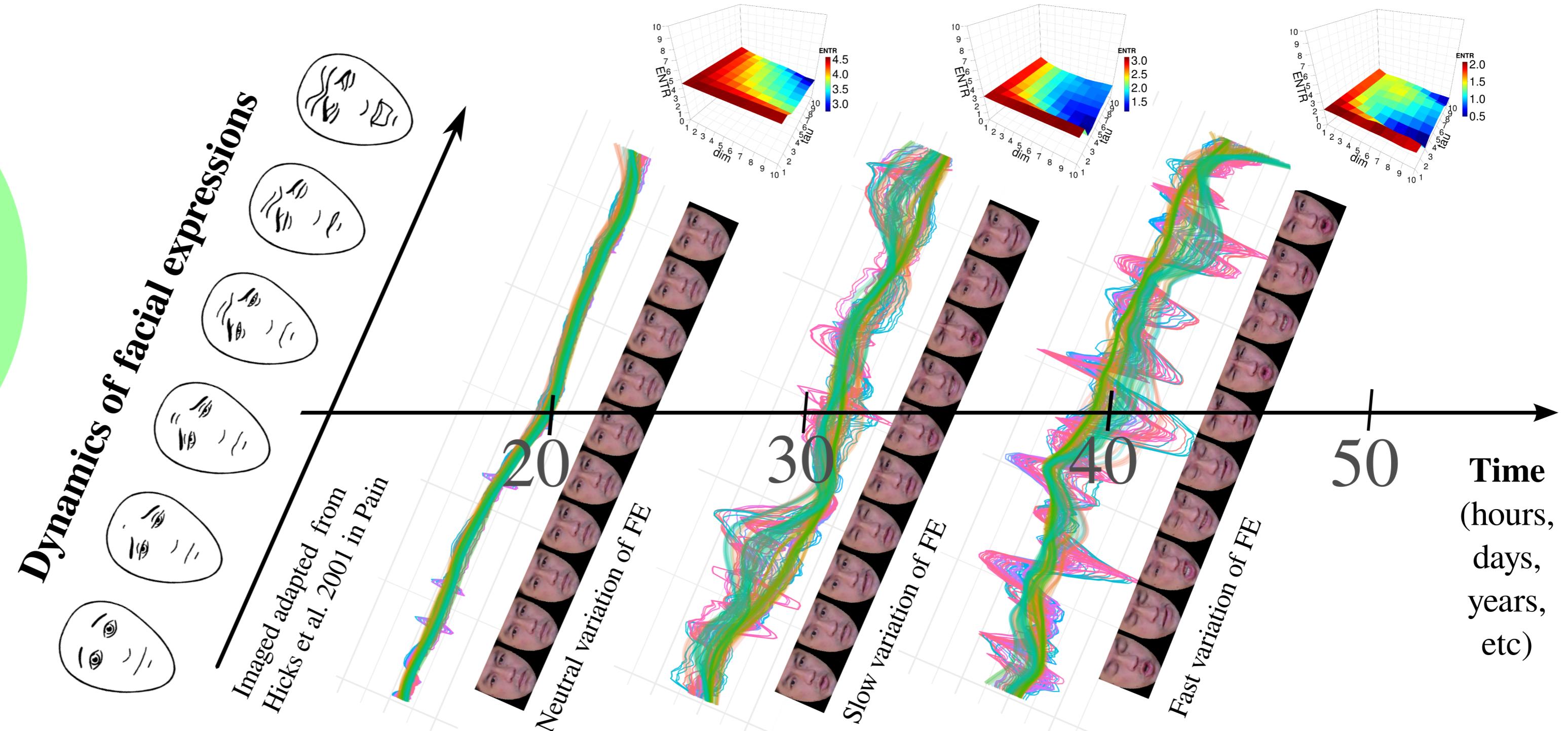
Research on understanding and quantifying movement variability with nonlinear analyses has been well established in the last three decades in areas such as biomechanics, sport science, psychology, cognitive science, and neuroscience [1]. This work is hence hypothesising that nonlinear analyses can be used to quantify subtle variations of facial expressions that can be related to different mental states (i.e. pain, distrustful, relief, etc) of a person [2].

1. INTRODUCTION



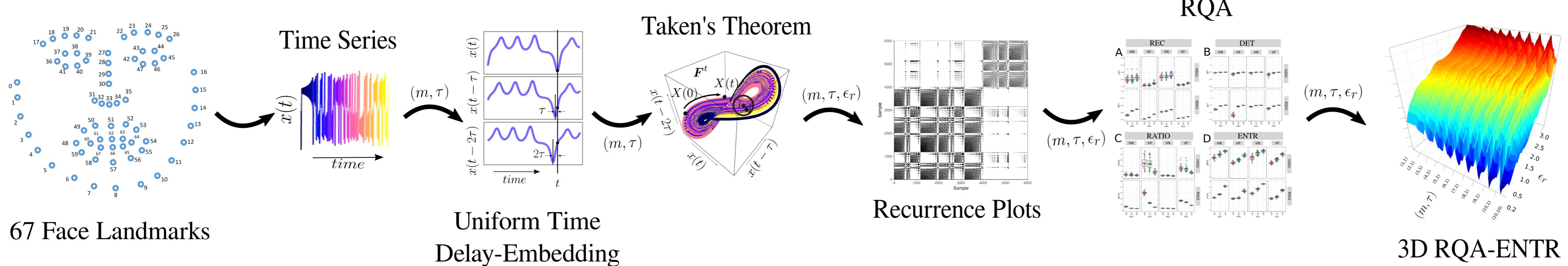
25 Mental States

Imaged adapted from
Izhikevich E. M 2007 and
Back et al. 2014

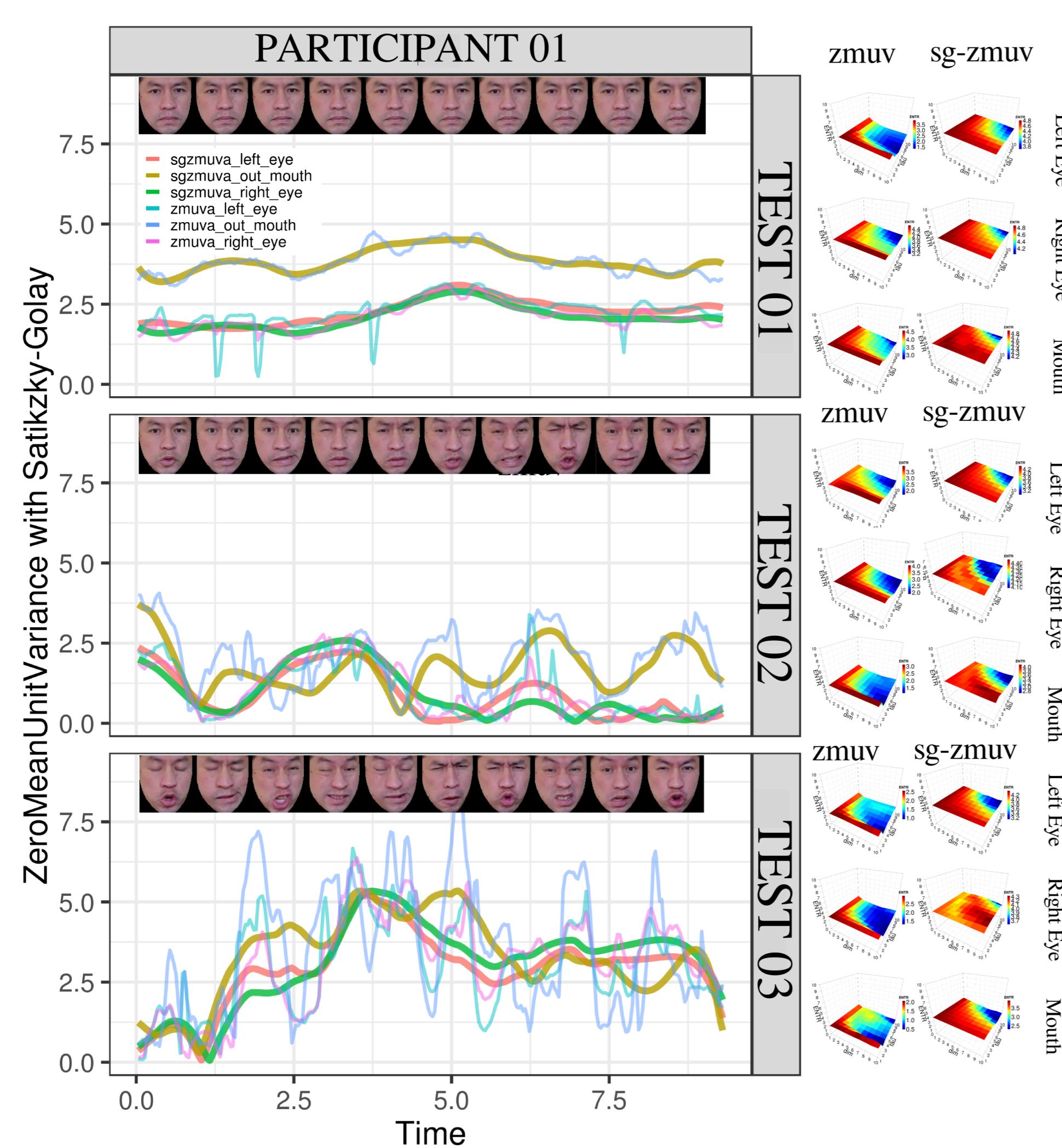


2. RQA ENTROPY

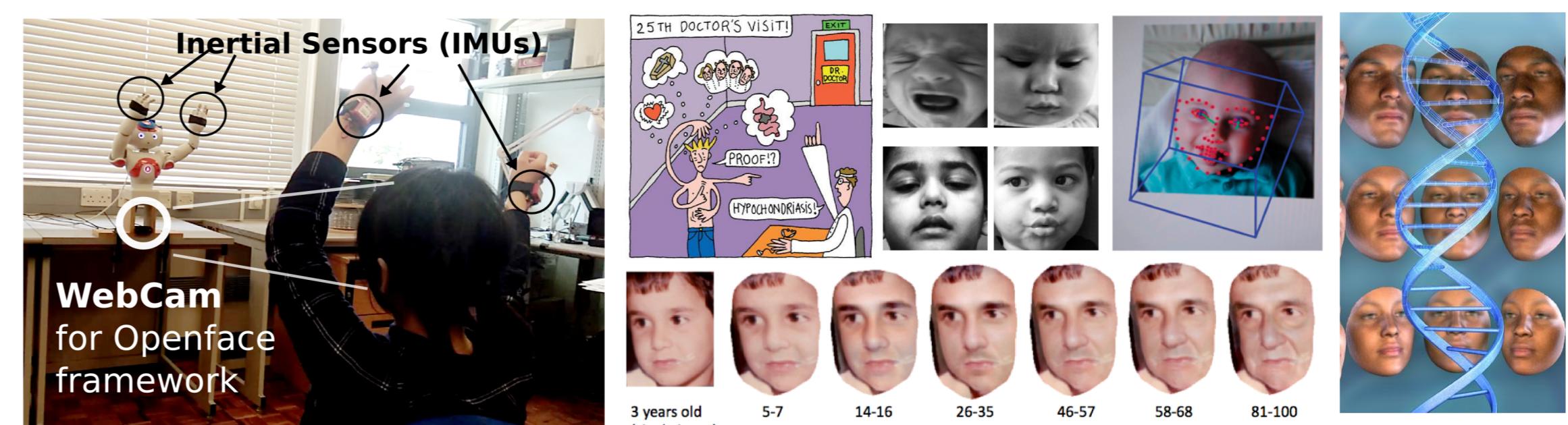
Considering that Recurrence Quantification Analysis (RQA) is a robust tool with real-world data time series (i.e. noisy, nonlinear and nonstationary) [3], this work is proposing the application of Shannon Entropy with RQA to quantify the complexity of face expressions landmarks from the openface framework [4].



3. RESULTS



5. APPLICATIONS



6. CONCLUSIONS AND FUTURE WORK

This work showed that Shannon Entropy from RQA can be used to quantify movement variability of face landmarks which can potentially be related to the persons' state of mind. The future work will test the robustness of RQA Entropy with different face expressions datasets. Also different classification techniques will be explored.

7. REFERENCES

- [1] Davids K., Glazier P., Araujo D. and Barlett R. (2003). Movement systems as dynamical systems. *In Sport Medicine*, 33(4):245-260.
- [2] Back E. and Jordan, T. R. (2014). Revealing variations in perception of mental states from dynamic facial expressions: A cautionary note. *In PLOS ONE*, 9(1):1-5.
- [3] Baltrusaitis T., Zedah A., Lim Y. and Morency L. (2018). OpenFace 2.0: Facial behavior analysis toolkit. *In 2018 13th IEEE Conference on Automatic Face and Gesture Recognition*. volume 00, pages 59-66.
- [4] Marwan N., Romano M. C., Thiel M. and Kurths J. (2007). Recurrence plots for the analysis of complex systems. *In Physics Reports*, 438 (5):237-329.
- [5] Xochicale M. (2018). Quantification of dynamic facial expressions with Shannon entropy in human-humanoid interaction. *In Symposium on Machine Learning and Dynamical Systems*. [<http://github.com/mxochicale/mlds2019>]