Analysing Complexity of Movement Variability for Facial Expressions with Nonlinear Dynamics

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1 Introduction

Movement variability is an inherent feature within and between persons. Research on measurement and understanding of movement variability has been well established in the last three decades in areas such as biomechanics, sport science, psychology, cognitive science, neuroscience and robotics [Xochicale and Baber, 2018]. With that in mind, I hypothesise that the subtle variations of facial expressions can be quantified in a similar fashion as with the methodologies of movement variability. Hence, I am interested in quantifying the complexity of facial expression that one person or multiple can present in scenarios of human-robot interaction, particularly I am interested in these two questions: (i) can the quantification of the variation of facial expressions tell us something about the state of health or the state of mind of a person?, (ii) how the quantification of facial expressions can be related with the complexity of facial expressions?.

2 Methods

Considering the work of my Ph.D. thesis for quantification of movement variability using nonlinear dynamics methods [Xochicale, 2018], I am proposing to work with Recurrence Quantification Analysis (RQA). RQA computes measurements based on the recurrence points density of diagonal or vertical line structures in Recurrence Plots. Such measurements of dynamics can determine the dynamics of a system, e.g. the determinism (predictability) or Shannon entropy (complexity) [Marwan et al., 2007]. Hence, I am proposing to use Shannon Entropy measurement from the recurrent quantification analysis (also known as RQAEntr) to quantify the complexity of face expressions.

3 Preliminary results

Fig 1 shows the proposed methodology with some preliminary results of one participant performing three levels of face expressions.

References

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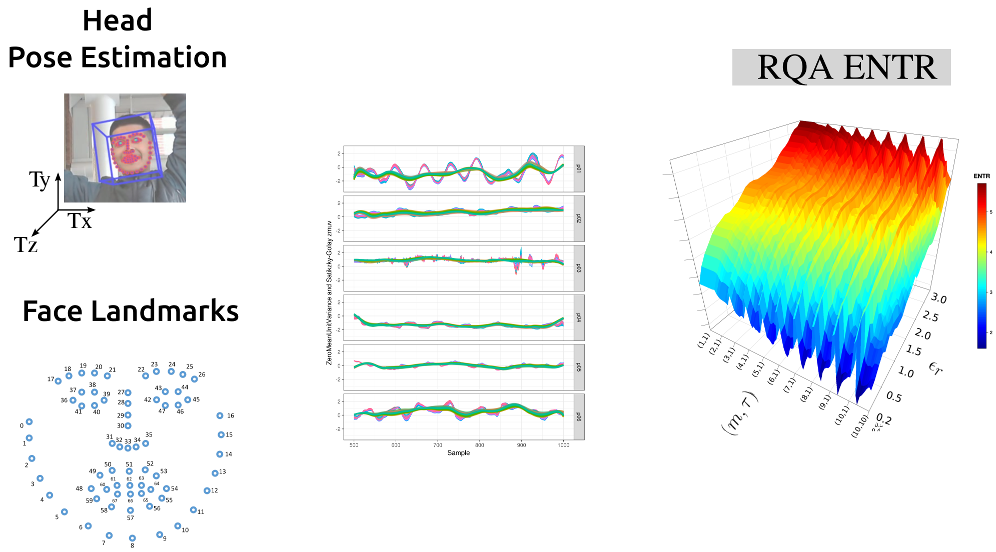

Figure 1: **Quantifying variations of face variations using nonlinear dynamics.** (A) Head pose estimation and face landmarks with OpenFace [Baltrusaitis et al., 2018], (B) time series from landmarks, and (C) 3D surface of RQAEntr for one time series.

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