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, 2018a]. Also, considering that methodologies for movement variability to quantify variability in facial expressions and my preliminary experiments of the analysis of variations for facial expressions using nonlinear dynamics [Xochicale and Baber, 2018b]. I am interested in quantifying the complexity of facial expression that one person or multiple persons can present in scenarios of human-robot interaction and in researching the subtle variations of facial expressions that are related to different mental states (e.g. anxiety, disinterest, relief) [Back and Jordan, 2014]. Hence, such statements have led me to ask two questions in the context of human-robot interaction: (i) does the quantification of the variation for facial expressions using nonlinear dynamics can tell us something about 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 in my Ph.D. thesis where investigated nonlinear dynamics to quantify movement variability [Xochicale, 2018], I am proposing to apply Recurrence Quantification Analysis (RQA) for this work. 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, the use Shannon Entropy can be applied to measure 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.

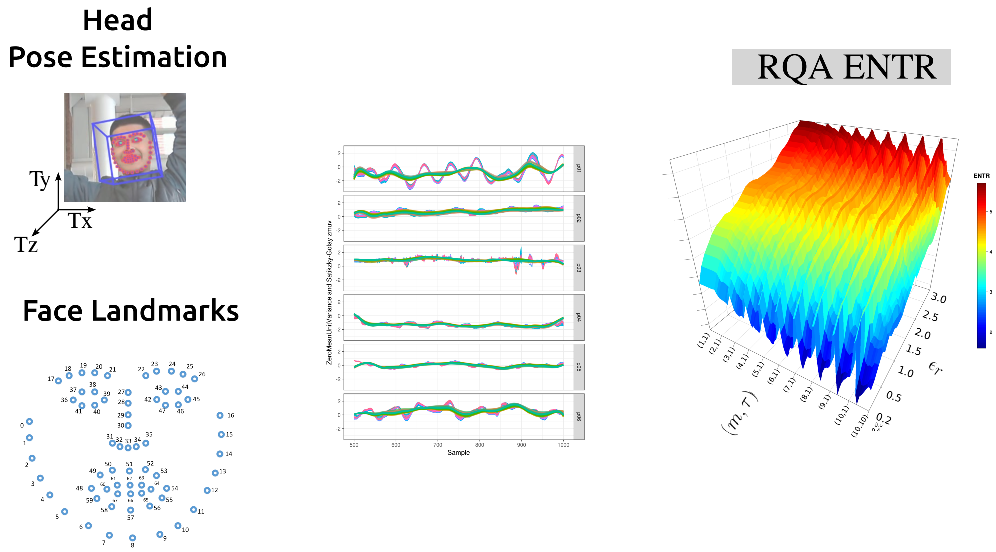

Figure 1: **Quantifying variations of face variations using nonlinear dynamics.** (A) Head pose estimation and face landmarks with OpenFace [Baltrusaitis et al., 2018], (B) time series from landmarks, and (C) 3D surface of RQAEntr for one time series.

References

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