Towards the Analysis of Nonlinear Dynamics in Human Movement and Face Emotions

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December 3, 2017

Movement variability is an inherent feature within and between persons and understanding and measurement of movement variability has been well established in the previous three decades mainly in areas such as biomechanics, sport science and much recently in human-robot interaction. With that in mind, we hypothesise that the subtle variations of face emotions can be described and quantified in a similar fashion as with the methodologies of movement variability. Such methodologies are based on nonlinear dynamics, particularly the state space reconstruction theorem where the dynamics of an unknown system can be reconstructed using one dimensional time series. For this work, we explain how the state reconstruction theorem works and present preliminary results of the use of the state reconstruction to understand the relationship of variability between arm movements, head pose estimation and face emotion. Particularly, we focus our work on the variability of time series in the face landmarks of 18 participants to create a multidimensional representation in the state space reconstruction. These preliminary results of the state space reconstruction in the context of face emotions lead us to conclude that not only the variability of upper body movement can be analysed and quantified but also the subtle variability of face emotion transitions across time (e.g. excitement to neutral to boredom, etc) can be understood and measured using nonlinear dynamics.