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

Miguel P Xochicale
map479@bham.ac.uk
Department of Electronic Engineering
School of Engineering
University of Birmingham, UK

May 21, 2018

Movement variability is an inherent feature within and between persons. Such movement variability can be seen in many activities where human body movement is involved. For instance, walking patters in the morning are generally energetic, however after a working day such walking patterns might slightly change due tiredness where no measurements have been made or in the case of accessing the quality of movement when one person has an injury in a body extremity there is little understanding about how well a person is recovering to his/her original movements.

With that in mind, we hypothesise that not only the subtle variations of face emotions but also simple body movements can be described and quantified in using nonlinear dynamics. Nonlinear dynamics is an area of mathematics that helps to understand phenomena where many changing variables are involved such as modelling weather forecast, modelling neural activity or, in our case, understanding and measuring movement variability. For this work, we therefore explain how the state space reconstruction theorem works (where dynamics of an unknown system can be reconstructed using one dimensional time series) and present preliminary results of the use of the state reconstruction to understand the relationship between the variability of arm movements, head pose estimation and the emotion of six participants in the context of human-robot interactions. The 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 using the state space reconstruction theorem but also the subtle variability of face emotion transitions across time (e.g. from excitement to neutral to boredom, etc) can be understood and measured using nonlinear dynamics. We also present some areas of applications of our results such rehabilitation, neuroscience, sport science, education, artificial intelligence to mention but a few.