University of Pittsburgh | School of Computing and Information

Dissertation Defense

Doctor of Philosophy in IS

"Deep Learning for Motion Analysis"
Sara Daraei

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Time: 2:00– 4:00 PM
Place: https://pitt.co1.qualtrics.com/jfe/form/SV_7Op6E3J9IX7M6c6

Committee:

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Abstract:

Automatic analysis and interpretation of human motion from visual data has been one of the most significant computer vision challenges since 1970. In recent years, deep learning has fueled the rapid advancement of computer vision topics. In particular, human motion analysis has drawn substantial attention due to its practical importance in many applications in a variety of domain including social behavior studies, medical assistance, robotics, sport analytics, and more.

Human motion is one of the key parts of human social behavior and a rich source of information. We move our whole body involving head, shoulders, hands, trunk, legs, and limbs combined with facial expressions flavored with our individualized style to transmit social signals. A number of studies have suggested the existence of unique motion signatures of individuals by analyzing data obtained from Kinect™ devices, and Electromyography (EMG) electrodes attached to muscles. Meaning that when we move and communicate, we tend to use our characteristic style of motion. These distinct motion patterns are attributed to behavioral and anatomical differences between individuals as well as their different muscle activation strategies.

This research aims at establishing a fully-automated framework to push the envelope of understanding information hidden in human motions from visual inputs and its potential applications on a set of fundamental tasks including classification, identification, and user authentication. For this purpose, we propose a number of deep learning approaches and try to tackle the problem from a data-driven perspective and figure out to what extend we would be

able to model human motion signatures and see if it is possible to authenticate or identify people based on their movement pattern. Our results demonstrate an accuracy of 94.04% for human authentication and 92.62% for human identification among 10 subjects confirming that human motion conveys information regarding their identity and can be considered as practical biometric cues. Considering particular applications and their limitations, we further propose a generative biometric model that efficiently learns task-relevant features in data and integrate them into a probabilistic authentication setting based on limited amount of data. The proposed framework is able to authenticate the correct subject 86.11% of times.