Announcing the Final Examination of Naifan Zhuang for the degree of Doctor of Philosophy

Time & Location: April 3, 2020 at 3:30 PM in HEC 438
Title: Differential Recurrent Neural Networks for Human Activity Recognition

Human activity recognition has been an active research area in recent years. The difficulty of this problem lies in the complex dynamical motion patterns embedded through the sequential frames. The Long Short-Term Memory (LSTM) recurrent neural network is capable of processing complex sequential information since it utilizes special gating schemes for learning representations from long input sequences. Unfortunately, the conventional LSTMs do not consider the impact of spatio-temporal dynamics corresponding to the given salient motion patterns, when they gate the information that ought to be memorized through time. To address this problem, we propose a differential gating scheme for the LSTM neural network, which emphasizes the change in information gain caused by the salient motions between the successive video frames. This change in information gain is quantified by Derivative of States (DoS), and thus the proposed LSTM model is termed as differential Recurrent Neural Network (dRNN). Based on the energy profiling of DoS, we further propose to employ the State Energy Profile (SEP) to search for salient dRNN states and construct more informative representations. The dRNN model is further extended by connecting Convolutional Neural Networks (CNN) and stacked dRNNs into an end-to-end model. Lastly, the dissertation continues to discuss and compare the combined and the individual orders of DoS used within the dRNN. We propose to control the LSTM gates via individual order of DoS and stack multiple levels of LSTM cells in an increasing orders of state derivatives. To this end, we have introduced a new family of LSTMs, expanding the applications of LSTMs and advancing the performances of the state-of-the-art methods.

Major: Computer Science

Educational Career:
Bachelor's of Automatic Control, BS, 2012, Northwestern Polytechnical University
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Approved for distribution by Kien Hua, Committee Chair, on March 19, 2020.

The public is welcome to attend.