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Model Guided Deep Learning Approach Towards Prediction of Physical System Behavior

Background

Cyber-physical control systems, or mechanisms controlled/monitored by computer algorithms and processes, are utilized in various important infrastructures such as medical systems and autonomous vehicles. Crucial to the functioning of these systems are algorithms and processes that enable the system to anticipate outcomes and make decisions accordingly and continuously.

Currently, cyber-physical control systems often employ a physical system model as a predictive element to help with decision-making. However, these models tend to have shortcomings with accuracy. Therefore, it is necessary to develop a technique that is more fluid and adaptive in its learning to enable improved accuracy in cyber-physical control systems.

Invention Description

Researchers at Arizona State University have developed a model-guided deep learning algorithm for the prediction of physical system behavior in cyber-physical control systems. The deep learning network employs a deep neural network, which has many hidden layers, enabling it to learn underlying non-linear activity quicker and form predictions with more precision and accuracy. In addition, the network is guided by a predictive physiological model to increase efficiency in what the network learns.

Given an initially suboptimal mathematical prediction model in use in a cyber-physical control system, this new algorithm iteratively improves the model through a data-driven training approach. This enables this new model to continuously adapt and improve its accuracy, significantly lowering its prediction errors.

Potential Applications

- Blood glucose monitoring
- Health monitoring systems
- Automated vehicles
- Electronics for deep learning/artificial intelligence

Benefits and Advantages

- Accuracy: Algorithm employs guided deep neural network as learning mechanism for increased accuracy – around 100 times that of previous models

- Versatility: Deep learning algorithm is potentially effective with various applications of cyber-physical systems