COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

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Yu Huang

for the degree of Doctor of Philosophy (Ph.D.)

"A Unified Soft Sensing Framework for Complex Dynamical Systems"

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ABSTRACT OF DISSERTATION
Many overtly futuristic IoT applications acquire data gathered via distributed sensors that can be uniquely identified, localized, and communicated with, i.e., the support of sensor networks. Soft-sensing models are in demand to support IoT applications to achieve the maximal exploitation of transforming the information of measurements into more useful knowledge, which plays essential roles in condition monitoring, quality prediction, smooth control, and many other essential aspects of complex dynamical systems. This in turn calls for innovative soft-sensing models that account for scalability, heterogeneity, adaptivity, and robustness to unpredictable uncertainties. This dissertation develops a unified soft-sensing framework for complex dynamic systems, such as industrial processes, earth systems, etc., where novel strategies are proposed to deal with classification and regression problems, such as dynamic monitoring, quality prediction, etc. Specifically, this dissertation presents (a) a sequence-to-sequence deep learning framework based on variational auto-encoder that is complemented by pre-defined (or shallow) features in a hybrid approach to boost prediction/classification accuracy while reducing computational intensity and maintaining the performance in the presence of low-quality sensor data, such as missing values and sensor failures; (b) physics-coupled mechanisms to incorporate prior knowledge into deep learning soft-sensing models (e.g., physics-informed deep learning) for the multi-physics, multi-scale, complex, dynamic systems forecasting (e.g., long-time spatio-temporal time-series prediction); and (c) novel graph-based soft-sensing neural networks, by integrating ideas from graph representation learning, for multivariate time-series classification of noisy and highly-imbalanced sensor data, which is able to capture the inter- and intra-series dependencies jointly in the spectral domain through semi-supervised learning. Evaluations are carried out in the domains of machine condition monitoring, ocean dynamics modeling and forecasting, and smart manufacturing. Comparative studies with baseline designs validate the superiority of our proposed innovations.

BIOGRAPHICAL SKETCH

Born in Zhejiang, China
B.S., Nanjing University of Aeronautics and Astronautics, Nanjing, China, 2015
M.S., Nanjing University of Aeronautics and Astronautics, Nanjing, China, 2018
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CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

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Qualifying Examination Passed: Fall 2019

Published Papers:

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