# Sensor-Based Modeling & Nonlinear Stochastic Dynamic Systems Approach for Health Analytics and Smart Connected Systems

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**Abstract:** Advancements in computing and sensing technologies in healthcare have yielded the largest-ever stream of data. Although our understanding of human biological processes has evolved considerably over the past few decades, unraveling the complex relationships of measured data and the underlying mechanisms poses daunting challenges due to biological processes' inherently stochastic and nonlinear attributes. To address these challenges, this research, rooted in sensor-based modeling and nonlinear stochastic dynamic systems approach, investigates a framework for personalized prognostics in smart and connected health contexts. Such framework consists of 1) Data-driven and sensor-based modeling methods to characterize the coupling dynamics of the pathological processes via investigating the nonlinear stochastic model of the pathophysiological processes driven by the collected sensor data; 2) Design of decentralized Internet of Medical Things embedded sensing systems that can effectively capture and manage the data of interest for the extraction of characteristic features in enriched domain notwithstanding the constraints from current clinical needs and 3) Predictive analytics approach to forecast acute event onsets by qualifying the transition of the system dynamics from the normal to abnormal conditions for personalized prognostic healthcare. The proposed approaches have been evaluated from in-vitro and in-vivo to human subject models.

**Bio:** Dr. Trung Le is a joint Assistant Professor at the Industrial and Manufacturing Engineering Department and Biomedical Engineering Department at North Dakota State University. He received his Ph.D. degree from Oklahoma State University. He was the Postdoctoral Research Associate of Industrial Systems Engineering Department and Research Scientist of Biomedical Engineering Department at Texas A&M University and Lecturer of Biomedical Engineering Department at International University –National University Ho Chi Minh City, Vietnam. He collaborates closely with cardiologists, sleep physicians, oncologists, health scientists, and researchers in biomedical engineering and industrial manufacturing engineering to perform his research in three complementary directions, including **1) Data-driven and Sensor-based Modeling of Complex System**; **2) Medical Device Manufacturing and Distributed IoT Embedded Systems; and 3) Diagnostic and Predictive Analytics for Personalized Healthcare**. He published his research in IEEE Transaction of Biomedical Engineering, IISE Transactions, Medical Engineering and Physics, IEEE Journal of Translational Engineering in Health and Medicine, PLOS One, Sensors, and Artificial Intelligence in Medicine. His works have led to several US and International patent applications. His works have been funded by several agencies including NSF, NIH, EPSCOR-North Dakota, British Council and Industries. He is currently the head of **S**ensing and **P**redictive **A**nalytics for **C**omputational **He**alth **S**ystem (SPACHeS) lab- www.spaches.org.