Evolving Embedded Systems and Their Vehicle Applications

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Friday, October 31, 2014
3:30 – 4:30 pm • 1500 EECS

ABSTRACT The emerging trend of increasing flexibility, adaptation, and autonomy of embedded control and information systems is the driving force behind the evolving systems paradigm. Evolving systems are systems with flexible model structure that adjust to changes which cannot be solely handled by parameter adaptation. Evolving intelligent systems develop their structure and knowledge representation through continuous learning from data and interaction with the environment. They exploit synergies between two powerful concepts – real time data granulation and machine learning - with no limitations on the types of the model structure that may include regression models, neural networks, fuzzy, and/or stochastic models. Practical applications encompass a wide range of systems with variable parameters and structure, and multiple operating modes. This presentation provides an overview of the multiple facets of evolving systems theory and describes some of their automotive applications to adaptive process control, automated calibration, anomaly detection, driver state estimation, and fuel economy optimization.

Biosketch: Dr. Dimitar P. Filev is the Executive Technical Leader - Intelligent Control & Information Systems, Ford Research & Advanced Engineering. He is conducting research in modeling and control of complex systems, intelligent control, fuzzy and neural systems, and their applications to automotive engineering. He is the recipient of the 2008 Norbert Wiener Award of the IEEE SMC Society, the 2007 IFSA Outstanding Industrial Applications Award, and the highest Ford Motor Company corporate awards – he was awarded 6 times with the Henry Ford Technology Award and with the 2010 Inaugural Dr. Haren Gandhi Research & Innovation Award for development and implementation of advanced automotive technologies, and for his long term research contributions. He has published 4 books and over 200 papers, and holds over 60 US and foreign patents. Dr. Filev is a Fellow of IEEE and IFSA. He received his PhD. degree in Electrical Engineering from the Czech Technical University in Prague in 1979.