Evolving Intelligent Systems for Process Control, Diagnostics, & Prognostics

Dimitar Filev
Research & Advanced Engineering
Ford Motor Company
2101 Village Road, Dearborn, MI 48121, Rm. 1343
E-mail: dfilev@ford.com

Outline

Emerging trend of increasing flexibility, adaptation, context awareness, and autonomy of the control and information systems is one of the driving forces behind the idea of evolving systems. While conventional adaptive techniques are suitable to represent objects with slowly changing parameters, they can hardly handle complex systems with multiple operating modes or abruptly changing characteristics since it takes a long time after every drastic change in the system to relearn model parameters.

The evolving systems paradigm is based on the concept of evolving (expanding or shrinking) model structure that is capable of adjusting to the changes in the objects that cannot solely be represented by parameter adaptation. Evolving intelligent systems develop their structure, their functionality and their internal knowledge representation through continuous learning from data and interaction with the environment. They are synergies between conventional systems, neural networks and fuzzy systems as structures for information representation and the real time methods for machine learning.

The presentation examines the theoretical and practical directions in the research and applications of evolving intelligent systems focusing on real time process control, diagnostics and prognostics.   It also discusses the advantages of blending fuzzy, control, clustering, and learning techniques in the design of embedded intelligent systems for autonomous anomaly detection and their applications to machine health monitoring, estimation and prediction of driver state and preferences.

Next, a general view and a practical perspective of some challenging engineering problems related to the industrial implementation of intelligent systems is presented with special attention given to the design of effective algorithms for real time modeling and estimation, fusion of integration of heterogeneous information & knowledge sources, and integration of legacy and advanced control & information systems.

Reference: "Evolving Intelligent Systems", P. Angelov, D. Filev, & N. Kasabov, Eds., John Wiley & Sons, New York, 2010