

A Technical Talk on

# Variable Structure Systems Theory Based Training Strategies for Computationally Intelligent Systems

by:

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**Distinguished Lecturers  
Program (DLP)**

**August, 14th, 2007  
10.00 am – 11.00 am**

**Bilik Demo 1,  
Block P16,  
Fakulti Kejuruteraan Elektrik,  
Universiti Teknologi Malaysia  
Skudai, JOHOR**

**Organized by:**  
Power Electronics, Industrial Electronics and  
Industry Applications, Societies Joint Chapter of  
IEEE Malaysia Section  
**Co-organizer:**  
Faculty of Electrical Engineering, UTM

## Overview of the talk

Noise rejection, handling plant-model mismatches and alleviation of structured or unstructured uncertainties constitute the prime challenges that are frequently encountered in the practice of systems and control engineering. One way of reducing the adverse effects of the stated difficulties and obtaining a good tracking precision is to utilize the techniques of variable structure systems (VSS) theory, which offers well formulated solutions particularly to problems containing uncertainty and imprecision.

In this talk, variable structure systems theory based training strategies of computationally intelligent systems are discussed. Several approaches are developed for alleviating the above-mentioned difficulties.

The presentation starts with an introduction to VSS theory, specifically Sliding Mode Control (SMC). Various computationally intelligent architectures are then introduced and the techniques commonly used for parameter adaptation and their shortcomings are discussed. It is proposed that SMC approach can be a good candidate for alleviating the difficulties encountered in practice. The works of different research groups as reported in the literature are overviewed. One particular example considered aims to extract the conditions for establishing equivalence between sliding mode control of the plant and sliding mode learning in the controller. Another method is based on the selection of an extended Lyapunov function, by the use of which the sensitivity of the cost measure to the adjustable parameters is minimized together with an error measure. The particular importance of what has been presented is the imposition of a sliding regime on the plant under control while a similar behavior is observed at the output of the controller. Specifically, the unavailability of the desired control sequence emerges as the prime problem that is alleviated by the learning control approaches discussed.

The performances of the methods developed are assessed on the dynamic models of several nonlinear systems, whose dynamic equations are assumed to be unknown throughout the results presented. In the tests, the alleviation of the adverse effects of observation noise and varying payload conditions are studied. Finally a practical implementation presented with experimental results.

## The presenter

**Okyay Kaynak** received the B.Sc. degree with first class honors and Ph.D. degrees in electronic and electrical engineering from the University of Birmingham, UK, in 1969 and 1972 respectively.

From 1972 to 1979, he held various positions within the industry. In 1979, he joined the Department of Electrical and Electronics Engineering, Bogazici University, Istanbul, Turkey, where he is presently a Full Professor. He has served as the Chairman of the Computer Engineering and the Electrical and Electronic Engineering Departments and as the Director of Biomedical Engineering Institute at this university. Currently, he is the UNESCO Chair on Mechatronics and the Director of Mechatronics Research and Application Centre. He has hold long-term (near to or more than a year) Visiting Professor/Scholar positions at various institutions in Japan, Germany, U.S. and Singapore. His current research interests are in the fields of intelligent control and mechatronics. He has authored three books and edited five and authored or coauthored more than 200 papers that have appeared in various journals and conference proceedings.

Dr. Kaynak is a fellow of IEEE. He has served as an Associate Editor of the IEEE Transactions on Neural Networks and as the Editor-in-Chief of IEEE Transactions on Industrial Informatics. Currently he is an Associate Editor of the IEEE Transactions on Industrial Electronics, IEEE Sensors Journal and the Area Editor (Robotics and Mechatronics) of the Springer journal; Soft Computing. Additionally he is on the Editorial or Advisory Boards of a number of scholarly journals.

Dr. Kaynak is active in internationally organizations, has served on many committees of IEEE and was the president of IEEE Industrial Electronics Society during 2002-2003.

This is a **FREE** Talk but registration is required for logistics purposes. Seats are limited: first come first serve basis.  
For registration and more details please email: [nikrumzi@ieee.org](mailto:nikrumzi@ieee.org) or visit [http://ewh.ieee.org/r10/malaysia/ie\\_ia\\_pel/](http://ewh.ieee.org/r10/malaysia/ie_ia_pel/)

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Universiti Teknologi Malaysia  
Skudai, Johor

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