Editorial

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Biographical notes: Sundarapandian Vaidyanathan is a Professor and Dean from the R&D Centre, Vel Tech University, Chennai, India. He received his DSc in Electrical and Systems Engineering from the Washington University, St. Louis, USA in 1996. He has published over 470 Scopus-indexed research papers. His current research focuses on control systems, chaos theory, chaotic and hyperchaotic systems, sliding mode control, neuro-fuzzy control, computational science, circuits and memristors. He is the Editor-in-Chief of *International Journal of Nonlinear Dynamics and Control* (*IJNDC*) published by Inderscience Publishers, Olney, UK. He is also an Associate Editor of *International Journal of Automation and Control* (*IJAAC*) published by Inderscience, Olney, UK. He has delivered plenary lectures on control systems and chaos theory in many international conferences around the world. He has also conducted several workshops on modern control systems and chaos theory using MATLAB and SCILAB.

Ahmad Taher Azar has received his MSc in 2006 and PhD in 2009 from the College of Engineering, Cairo University, Egypt. He is a Research Associate Professor at the College of Engineering, Prince Sultan University, Riyadh, Kingdom of Saudi Arabia. He is also an Associate Professor at the Faculty of Computers and Artificial Intelligence, Benha University, Egypt. He is the Editor in Chief of *International Journal of System Dynamics Applications* (*IJSDA*) published by IGI Global, USA. Also, he is the Editor in Chief of *International Journal of Intelligent Engineering Informatics* (*IJIEI*), Inderscience Publishers, Olney, UK. He worked as an Associate Editor of *IEEE Trans. Neural Networks and Learning Systems* from 2013 to 2017. He is currently an Associate Editor of *ISA Transactions*, Elsevier and *IEEE Systems Journal*. He worked in the areas of control theory and applications, process control, chaos control and synchronisation, nonlinear control, robust control, computational intelligence.

Sliding mode control (SMC) is a nonlinear control method. The SMC method alters the dynamics of a given dynamical system (linear or nonlinear) by applying a discontinuous control signal that forces the system to 'slide' along a cross-section (manifold) of the system's normal behaviour.

For over 50 years, the SMC has been extensively studied and widely used in many scientific and industrial applications due to its simplicity and robustness against parameter variations and disturbances. Important types of SMC are classical SMC, integral SMC, second-order SMC and higher order SMC. The new SMC approaches show promising dynamical properties such as finite time convergence and chattering alleviation. SMC has applications in several branches of science and engineering like control systems, electrical engineering, mechanical engineering, robotics, network engineering, etc.

This special issue aims at presenting the latest developments, trends, research solutions and applications of SMC with engineering applications. In this special issue, we are delighted to select five research articles reporting on recent engineering applications of SMC.

It is hoped that this special issue will provide a useful reference for informing recently developed techniques in SMC. The contents of the selected five articles are described briefly as follows:

The paper titled 'A memristor-based system with hidden hyperchaotic attractors, its circuit design, synchronisation via integral sliding mode control and an application to voice encryption' by Sundarapandian Vaidyanathan, Ahmad Taher Azar, Akif Akgul, Chang-Hua Lien, Sezgin Kacar and Unal Cavusoglu describes the finding of a new memristor-based 4D dynamical system with hyperchaos and hidden attractors. The proposed 4D memristor-based system exhibits both line equilibrium and no-equilibrium for different choice of parameters. An experimental emulation of the memristor-based system is carried out by an electronic circuit. An adaptive integral sliding mode (ISM) controller is designed for globally synchronising a pair of memristor-based hyperchaotic systems with unknown parameters. As another application, the memristive system with hyperchaos is applied for voice encryption, which has potential applications in cryptosystems, computing and secure communication.

The paper titled 'Adaptive terminal sliding mode control of high-order nonlinear systems' by Pooyan Alinaghi Hosseinabadi and Ali Soltani Sharif Abadi aims to design a finite time adaptive control input for a high-order nonlinear system in presence of a variety of mismatched uncertainties and external disturbances. Adaptive terminal sliding mode control (ATSMC) method is used to design robust controller in a finite time. Also, adaptive concept is employed in ATSMC to estimate the upper bound of mismatched uncertainties and external disturbances and their estimations are used in control input. The finite time stability proof is performed by defining a proper candidate Lyapunov function. Numerical simulation results are carried out in Simulink/MATLAB to reveal the correctness of proposed design in this research. Finally, the performance criterion, integral of the square value (ISV), is defined to provide a numerical comparison between the proposed adaptive controller and non-adaptive controller.

The paper titled 'Chaos control of a four-dimensional fundamental power system using pole placement-based proportional integral sliding mode control' by Manish Kumar and Piyush Pratap Singh investigates the problem of chaos control for a four-dimensional fundamental power system (FDFPS) model. Pole placement-based proportional integral sliding mode control (PISMC) is designed to control the chaos present in the system.

PISMC law is derived by placing the poles at appropriate location to control the chaotic behaviour in FDFPSs. The sufficient condition is derived for the asymptotic stability of the sliding manifold using Lyapunov stability theory. The proposed controller reduces the chattering, simplifies the design of power system stabiliser. Further the proposed pole placement-based PISMC is compared with conventional SMC approach. MATLAB is used for simulation. Simulation results show the effectiveness of proposed PISMC scheme.

The paper titled 'Hybrid Petri network super twisting sliding mode control of wind turbine for maximum power point tracking' by Aghiles Ardjal, Rachid Mansouri and Maamar Bettayeb deals with a hybrid sliding mode control and super-twisting algorithm (HSMC-STA) second-order SMC with Petri network applied to reach the maximum power point tracking (MPPT) of a variable speed wind energy conversion system. The design of a hybrid controller based on switching Petri network sliding mode control (PNSMC) is proposed, wherein a Petri network is used to supervise and switch between the classical SMC law and the super twisting control law. The new hybrid controller is tested in a Simulink/Matlab environment. Simulation results of the proposed control scheme present good dynamic and steady-state performance compared to the classical SMC and high order sliding mode with respect to the reduction of the chattering phenomenon and transient response.

The paper titled 'Super-twisting algorithm-based integral sliding mode control with composite nonlinear feedback control for magnetic levitation system' by Avadh Pati and Richa Negi aims to discuss the issues of actuator saturation and external disturbance in the magnetic levitation (maglev) system. The proposed technique is composed of composite nonlinear feedback (CNF) and super-twisting algorithm (STA)-based ISM control to tackle the problem of actuator saturation and external disturbances simultaneously. The CNF scheme comprises of linear feedback law which provides stability and fast response whereas the nonlinear feedback law takes care of input saturation and reduces the overshoot. The STA-based ISM controller is designed for disturbance rejection. An STA-based approach is applied on ISM scheme to eliminate the chattering effect and make it continuous in nature for its direct implementation to the physical maglev system. The designed scheme is successfully tested on real-time feedback instruments model of the maglev system.

The guest editors would like to thank all the authors for submitting their manuscripts in this special issue. We would want to acknowledge the reviewers for their contributions in reviewing the papers and providing constructive and useful comments to the authors. Finally, the guest editors would like to specially thank the Editor-in-Chief of *International Journal of Automation and Control* (*IJAAC*), Dr. Ling Wang (Tsinghua University, China) for his great help and support in organising and coordinating the publication of this special issue.