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Special Session on “Incremental Learning for Prediction and Control under Nonstationarity (Evolving, Intelligent, and Learning-based Systems)”

Organised by

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Call for Papers

Description:

Many real-world systems operate under nonstationary conditions, where statistical properties evolve over time due to environmental and system changes, aging, operational variability, or disturbances. Traditional machine learning and control approaches, which rely on static models, offline multi-epoch training, or fixed-structure adaptive schemes, often fail to maintain performance when confronted with continuously evolving data. Incremental learning of model structures and parameters provides a framework to address these challenges by allowing predictors, classifiers, and intelligent feedback controllers to evolve sequentially with a higher degree of autonomy and flexibility. These methods allow models to track drifts and emerging patterns, operate in real time without requiring retraining from scratch or access to historical data, and mitigate catastrophic forgetting while maintaining robustness and interpretability.

This session aims to bring together researchers working on incremental and continual machine learning methods for time series prediction, evolving system identification, and structurally adaptive models and controllers for nonstationary systems observed from data streams. The session welcomes theoretical advances, algorithmic developments, and practical applications of incremental learning in streaming environments, intelligent and evolving systems, and dynamical systems. Particular emphasis is given to methods capable of adapting model structures, parameters, and knowledge representations over time, including granular, fuzzy, neural, modular, and hybrid approaches. The goal is to foster interaction between the machine learning and control communities and to promote new methodologies that allow reliable prediction, monitoring, and control in continuously evolving environments.

Topics of interest include (but are not limited to):

Methods and Algorithms

- Incremental and online learning for time series and dynamical systems
- Learning under nonstationarity and concept drift
- Adaptive system identification and modeling
- Evolving intelligent systems: granular, fuzzy, and neural systems
- Incremental neural networks with modular or granular architectures
- Online regression, prediction, and control
- Data-driven modeling of physical systems
- Incremental and evolving clustering
- Ensemble learning in nonstationary environments
- Feature selection and dimensionality reduction in data streams
- Interpretability of incremental and evolving models




Theory and Analysis

- Learning and control under uncertainty
- Online optimization and adaptive estimation
- Stability, robustness, and convergence of incremental learning and adaptive control

Prediction and Control Applications

- Adaptive prediction of nonstationary time series
- Robotics and autonomous systems
- Fault detection and condition monitoring
- Biomedical signal processing and assistive systems
- Learning-based and adaptive control of dynamical systems

Short CV of Each Organizer

<p>Daniel Leite is a researcher at the Department of Computer Science, Paderborn University, Germany. He has held faculty and research positions in Brazil, Slovenia, Chile, and Germany, working in granular computing, machine learning, fuzzy systems, neural networks, and control theory. He received the Ph.D. degree in Electrical Engineering from the University of Campinas (UNICAMP), Brazil, in 2012. Leite is a recipient of the NAFIPS Early Career Award (2017) and Ph.D. Thesis Awards from the IEEE Computational Intelligence Society (2017), NAFIPS (2015), and the Brazilian Computer Society (2014). He received outstanding student paper recognitions at FUZZ-IEEE and IJCNN conferences. He served for seven years as an Associate Editor of the journal <i>Evolving Systems</i> and is Associate Editor of the <i>Springer Journal of Control, Automation and Electrical Systems</i>. His interests include incremental and continual learning, multimodal data streams, and human-centered AI applied to medicine, robotics, engineering, and brain-computer interfaces.</p>	
<p>Igor Škrjanc received B.S., M.S. and Ph.D. degrees in electrical engineering, in 1988, 1991 and 1996, respectively, at the Faculty of Electrical and Computer Engineering, University of Ljubljana, Slovenia. He is currently a Full Professor with the same faculty and Head of Laboratory for Autonomous and Mobile Systems. He is lecturing the basic control theory at graduate and advanced intelligent control at postgraduate study. His main research areas are adaptive, predictive, neuro-fuzzy and fuzzy adaptive control systems. His current research interests include also the field of autonomous mobile systems in sense of localization, direct visual control and trajectory tracking control. He is Humboldt research fellow, research fellow of JSPS and Chair of Excellence at University Carlos III of Madrid and the fellow of the Slovenian Academy of Engineering. He also serves as an Associated Editor for <i>IEEE Transaction on Neural Networks and Learning System</i>, <i>IEEE Transaction on Fuzzy Systems</i>, the <i>Evolving Systems</i> journal and <i>International journal of artificial intelligence</i>.</p>	
<p>Jérôme Mendes received his Ph.D. in Electrical and Computer Engineering from the University of Coimbra (UC) in 2014. He is currently Senior Researcher at the UC. Jérôme has been involved as a team member with enterprise partners in several R&D projects, focusing his research on developing computational intelligence-based solutions, mainly for smart industry, with an emphasis on intelligent control (adaptive, auto-tuning, predictive, data-driven, evolving, and interpretable); intelligent identification (prediction of unknown and time-varying systems, automatic identification design with evolving and interpretable capability), decision systems and intelligent failure detection. Jérôme has been IFAC Industry Committee Member, member of the Board of Directors of the Portuguese Association of Automatic Control (APCA), Associated Editor of scientific reports (nature) and <i>Evolving Systems</i> (Springer) journals.</p>	
<p>Fernando Gomide has a BSEE degree from Polytechnic Institute of the Pontifical Catholic University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil 1975; MSc degree from the University of Campinas, School of Electrical and Computer Engineering, Campinas, São Paulo, Brazil 1979; and PhD degree in Systems Engineering from Case Western Reserve University, Cleveland, Ohio, USA 1983. Currently he is professor of electrical and computer engineering, School of Electrical and Computer Engineering, University of Campinas, São Paulo, Brazil. He is IEEE Fellow Class 2016, K. S. Fu Awardee North American Fuzzy Information Society 2011, IFSA Fellow Class 2009, and Fellow 1A Brazilian National Council for Scientific and Technological Development 2000. His areas of interest include modeling, optimization, and control; decision-making, artificial intelligence, machine learning, fuzzy systems, and applications. He serves the editorial board of <i>Fuzzy Optimization and Decision Making</i>, <i>Journal of Advanced Computational Intelligence</i>, <i>Evolving Systems</i>, and the <i>International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems</i>.</p>	