

Evolving Fuzzy Models of Mechatronics Applications

Radu-Emil Precup

*Department of Automation and Applied Informatics
Politehnica University of Timisoara
Timisoara, Romania
radu.precup@upt.ro*

PLENARY TALK

Abstract—Evolving fuzzy models are characterized by the continuous online rule base learning. The structure and parameters of these fuzzy models in their Takagi–Sugeno or Takagi–Sugeno–Kang (TSK) forms are obtained by several online identification algorithms. The online identification algorithms continuously evolve the parameters of the fuzzy models, which are built online by adding new or removing old local models; this process is referred to as the adding mechanism.

According to the classification proposed by Dovžan, Logar and Škrjanc in 2015, three categories of online identification algorithms are considered, (1), (2) and (3), and they have specific features described as follows. (1) Adaptive algorithms start with the initial TS fuzzy model structure given by other algorithms or by user experience; the number of space partitions/clusters does not change over time, and these algorithms adapt just the parameters of the membership functions and the local models. (2) Incremental algorithms implement only adding mechanisms. (3) Evolving algorithms, which besides the adding mechanism they also implement removing and a part of them merging and splitting mechanisms as well.

The presentation is organized to highlight a part of the recent results obtained by the Process Control group of the Politehnica University of Timisoara, Romania, related to the application of incremental online identification algorithms that belong to the category (2) mentioned above. A convenient implementation of these algorithms is given in two versions that depend on how the estimation of parameters in TS fuzzy model rule consequents is performed. The identification algorithms produce sets of TS fuzzy models of some representative mechatronics applications in the laboratories of the Process Control group, where the experimental validation is guaranteed in order to next enable the development of model-based fuzzy control system structures: pendulum-crane systems, twin rotor aerodynamic systems, magnetic levitation systems, and anti-lock braking systems.

Keywords—*evolving fuzzy models, online identification algorithms, mechatronics applications*

SHORT BIO

Radu-Emil Precup (M'03–SM'07) received the Dipl.Ing. (with honors) degree in automation and computers from the “Traian Vuia” Polytechnic Institute of Timisoara, Timisoara, Romania, the Dipl. degree in mathematics from the West University of Timisoara, Timisoara, and the Ph.D. degree in automatic systems from the Politehnica University of Timisoara (UPT), Timisoara, Romania, in 1987, 1993, and 1996, respectively.

He is currently with UPT, Timisoara, Romania, where he became a Professor with the Department of Automation and Applied Informatics in 2000. He is also an Adjunct Professor within the School of Engineering, Edith Cowan University, Joondalup, WA, Australia, and an Honorary Professor with the Óbuda University, Budapest, Hungary. He is the author or coauthor of more than 300 papers. His current research interests include intelligent control systems and data-driven control.

Prof. Precup is a corresponding member of The Romanian Academy, a member of several Technical Committees (TCs) including IEEE ones, the IFAC TC on Computational Intelligence in Control and the TC12 on Artificial Intelligence of IFIP. He was the recipient of the Elsevier Scopus Award for Excellence in Global Contribution (2017), the “Grigore Moisil” Prize from the Romanian Academy, two times, in 2005 and 2016, for his contribution on fuzzy control and the optimization of fuzzy systems, and best paper awards (2004–2015).

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