

Lecture Proposal for the 2016 IEEE Summer School in Intelligent Systems

Alexander Gegov is Reader in Computational Intelligence in the School of Computing, University of Portsmouth, UK. He holds a PhD in Control Systems and a DSc in Intelligent Systems – both from the Bulgarian Academy of Sciences. He has been Humboldt Guest Researcher at the University of Duisburg-Essen, EU Guest Researcher at the University of Wuppertal and EU Visiting Researcher at the Delft University of Technology. He has also been Associate Dean Research in the Faculty of Technology, University of Portsmouth, UK.

Alexander Gegov's main research interests are in the development of computational intelligence methods and their application for modelling and simulation of complex systems. He is author of 4 research monographs published by Springer. He has published more than 10 book chapters, 40 journal articles and 60 conference papers. Alexander Gegov is Associate Editor for 'IEEE Transactions in Fuzzy Systems' and 'Intelligent and Fuzzy Systems' as well as Book Review Editor for 'Fuzzy Sets and Systems'. He has presented 3 invited lectures and 5 research tutorials at IEEE Conferences, Symposia, Congresses and Schools. He is Member of IEEE, EUSFLAT and EUROSCIENCE.

Networked Rule Based Systems: Theory and Applications

The lecture will present within 10 sections the novel area of networked rule based systems in terms of theoretical methods as well as their application in benchmark examples and case studies. Section 1 discusses complexity as a systemic feature and the ability of rule based systems to handle intelligently complexity attributes such as non-linearity, uncertainty, dimensionality and structure. Section 2 reviews several types of rule based systems in the context of systemic complexity, including systems with single, multiple and networked rule bases. Section 3 introduces formal models for networked rule based systems such as Boolean matrices, binary relations, block schemes and topological expressions. Section 4 presents basic operations on nodes in networked rule based systems, including merging and splitting in horizontal, vertical and output context. Section 5 discusses structural properties of basic operations such as associativity of merging and variability of splitting in horizontal, vertical and output context. Section 6 describes advanced operations on nodes in networked rule based systems, including node transformation for input augmentation, output permutation and feedback equivalence, as well as node identification in horizontal, vertical and output merging. Section 7 shows the application of the theoretical results from Sections 3-6 in benchmark examples of feedforward networked rule based systems with single or multiple levels and layers. Section 8 illustrates the application of the theoretical results from Sections 3-6 in benchmark examples of feedback networked rule based systems with single or multiple local

and global feedback. Section 9 evaluates networked rule based systems in the context of fuzzy logic by means of structural complexity, composition of hierarchical systems, decomposition of standard systems, model performance indicators and application for case studies. Section 10 highlights the theoretical significance, the application areas and the methodological impact of networked rule based systems.

The sections with the theoretical methods and their application in benchmark examples will benefit mainly PhD students and academic researchers in the area of intelligent systems by making them familiar with novel methods for modelling complex processes by means of networked rule based systems. The sections with the application of the theoretical methods in benchmark examples and case studies will benefit predominantly industrial participants from engineering and business by making them familiar with novel ways of using networked rule based systems for modelling complex processes.