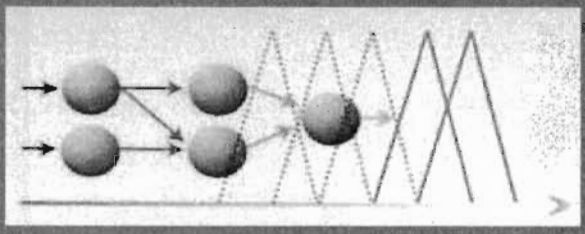
$$\mu_{A_{ij}}(x_j)=\begin{cases}\dfrac{x_j-a_{ij}}{b_{ij}-a_{ij}}, & \text{if } a_{ij}<x_j<b_{ij}\\ 1, & \text{if } b_{ij}\le x_j<c_{ij}\\ \dfrac{d_{ij}-x_j}{d_{ij}-c_{ij}}, & \text{if } c_{ij}\le x_j<d_{ij}\\ 0, & \text{otherwise}\end{cases}$$



IF (x_1 is A_{i1}) AND (x_2 is A_{i2}) AND ... AND (x_n is A_{in}) THEN (y is B_i)

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ABSTRACTS

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Fuzzy Signature Sets in Robot Control

Áron Ballagi[1] and László T. Kóczy[2,3]

[1]Department of Automation,
Széchenyi István University,
H-9026, Győr, Egyetem tér 1., Hungary
Email: ballagi@sze.hu
[2]Department of Telecommunications and Media Informatics,
Budapest University of Technology and Economics,
H-1117, Budapest, Magyar tudósok krt. 2., Hungary
Email: koczy@tmit.bme.hu
[3]Inst. of Mechanical, Electrical Engineering and Information Technology,
Széchenyi István University,
H-9026, Győr, Egyetem tér 1., Hungary

ABSTRACT

In control of autonomous mobile robots are many complex, well structured problems, where a hierarchical structure within the data is present. This means, that one or several components of the structure are determined at a higher level by a sub-tree of other components. The concept of fuzzy signatures was introduced to help model these kinds of problems. Fuzzy signatures which structure data into vectors of fuzzy values, each of which can be a further vector, handle complex structured data [2, 3, 4, 5]. This will widen the application of fuzzy theory to many areas where objects are complex and sometimes interdependent features are to be classified and similarities / dissimilarities evaluated. Often, human experts can and must make decisions based on comparisons of cases with different numbers of data components, with even some components missing. Fuzzy signature is created with this objective in mind. This tree structure is a generalization of fuzzy sets and vector valued fuzzy sets in a way modeling the human approach to complex problems. However, when dealing with a very large data set, it is possible that they hide hierarchical structure that appears in the sub-variable structures. In this way, the data components can be represented in tree form. By examining the problem, an arbitrary structure belonging to the data set can be determined. Due to the fact that some components might be missing from a data element, the actual tree structures of the data may slightly differ. So that these data can be evaluated and compared, aggregation operators are given for each node in the arbitrary structure for the purpose of modifying the structure. To model problems with this type of dataset, fuzzy

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signature based rules can be constructed. Inferring a conclusion from such a model is a key issue [1].

In this paper the formerly introduced idea of Mamdani-type inference in fuzzy signature based rule bases will be used for selecting records from an available data base which maximally match the requirements specified in a pattern. Finally a possible cooperative robot application on a realistic example with missing data components will be shown. The basic idea of this example has come from the partly unpublished research projects at LIFE [6]. The paper presents a cooperation system where a group of autonomous intelligent mobile robots is supposed to solve transportation problems according to the exact instruction given to the Robot Foreman (RF). The other robots have no direct communication links with RF and all others, but can solve the task by intention guessing from the actual movements and positions of other robots, even though they might not be unambiguous [7, 8, 9].

Research towards extending this fuzzy communication method to more complex robot cooperation is going on currently.

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Short Bio: Áron Ballagi

Áron Ballagi's degrees earned: University of Miskolc: M.Sc. in Mechanical Engineering, Branch of Machine-tool Constructor and Information Technology (1994), M.Sc. in Metallurgical Engineering, Branch of Automation (1996), B.Sc. in Economy Management (1997). Visiting positions: long-term and short-term visits and scholarships as Ph.D. student at the following Universities: Heriot-Watt University, Edinburgh, Scotland; Technical University of Kosice, Kosice, Slovakia; University of Duisburg, Duisburg, Germany; Czech Technical University, Prague, Czech Republic; Technical University of Vienna, Vienna, Austria; Brno University of Technology, Brno, Czech Republic. Research interests: computational intelligence, fuzzy control, fuzzy signatures, fuzzy communication, autonomous robotics. Membership in scientific societies: John von Neumann Computer Society Robotics Section, Hungarian Fuzzy Association.

Short Bio: Prof. László T. Kóczy

Prof. Kóczy's degrees earned: Technical University of Budapest: M. Sc. Electrical Engineering (1975); M. Phil. Control Eng. (1976); Ph.D. (1977), Dr. habil. 1998, (a postdoctoral degree in Hungary the prerequisite of full professorship), Doctor of the Hungarian Academy of Science, (1998, the highest

earnable postdoctoral degree in Hungary)Visiting positions: Various long-term and short-term visiting professorships since 1990 till current. Lecturing, Ph.D. supervision and research projects (Australian National University; Murdoch University (Perth, Australia), University of New South Wales (Sydney, Australia); J. Kepler Universität Linz (Austria); University of Trento (Italy); Tokyo Institute of Technology (Yokohama, Japan; Chair Professor in 1993/94); Pohang Institute of Science and Technology (Korea).

Summer University lecturing: Helsinki University of Economics, University of Helsinki (Finland), University of Minas Gerais (Belo Horizonte, Brazil), Dalian Maritime University (China). Research interests: Telecommunication systems, Intelligent models and systems, Very large and complex systems and networks. Professional Societies: International Fuzzy Systems Association: President 2001-current; President Elect, 1999-2001; Vice President, 1995-99.IEEE: Senior Member, 1999-; NNS Regional Activities Chair 2001-2002; Chapters Chair 2002-.EURO WG on Fuzzy Sets (currently EUSFLAT): Founding Member, 1975-. Hungarian Fuzzy Society: Founding President, 1990-1999. Fuzzy Initiative Nordrheinwestfalen Advisory Board member, 1992-. ANZIIS Advisory Board member, 1994-. Hongkong University Grants Committee member, 1994- .