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DEPARTAMENTUL DE ȘTIINȚE SOCIALE

Candidați înscriși:

1. Dzițac Ioan, profesor poz. 8 (CV: PDF (1,8 MO) ; Lista de lucrări: PDF (524,3 KO) ; Fișa de verificare: PDF (428,7 KO))

III. DATE PRIVIND ÎNDEPLINIREA STANDARDELOR SPECIFICE

A. Cerințele Universității Agora din municipiul Oradea pentru postul de profesor universitar:

1) Diploma de doctor: Doctor în informatică (Criteriu îndeplinit).
2) Îndeplinirea standardelor minimale naționale în vigoare la data declanșării concursului, necesare și obligatorii, pentru abilitare/ profesor universitar, pe domeniul postului de concurs (matematică):

Abilitare/Profesor universitar

	I	I_{recent}	C
Puctaje/ cerințe minimale necesare și obligatorii	5	2,5	12
Punctaje realizate de candidat	8,252	6,573	58

Criteriul este îndeplinit.

PRELEGERE
Aplicații ale matematicii fuzzy în metodele de luare a deciziilor

Candidat: Ioan Dziţac

1. Contribuții personale în folosul comunității științifice: IJCCC, ICCCC, Conferințe internaționale invitate
2. Rezumat
3. Literatura în domeniu
4. Contribuții personale în domeniu
5. Paradigme specifice
6. Concluzii

INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL (IJCCC), With Emphasis on the Integration of Three Technologies (C & C & C), ISSN 1841-9836.

IJCCC was founded in 2006, at Agora University, by Ioan DZITAC (A. Editor-in-Chief), Florin Gheorghe FILIP (Editor-in-Chief), and Misu-Jan MANOLESCU (Managing Editor):

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June 4, 2008

Dr. Ioan Dzitac
CCC Publications
Piata Tineretului 8, Oradea, Jud
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Dear Dr. Ioan Dzitac,

I am pleased to inform you that ***International Journal of Computers Communications & Control*** has been selected for coverage in Thomson Reuters products and custom information services. Beginning with V. 2 (1) 2007, this publication will be indexed and abstracted in the following:

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International Journal of Computers Communications & Control

ISSN: 1841-9836

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ROMANIA

Titles
ISO: Int. J. Comput. Commun. Control
JCR Abbrev: INT J COMPUT COMMUN

Categories
AUTOMATION & CONTROL SYSTEMS - SCIE;
COMPUTER SCIENCE, INFORMATION SYSTEMS - SCIE;

Key Indicators

Year	Total Cites Graph	Journal Impact Factor Graph	Impact Factor Without Journal Self Cites Graph	5 Year Impact Factor Graph	Immediacy Index Graph	Citable Items Graph	Cited Half-Life Graph	Citing Half-Life Graph	Eigenfacto Score Graph	Article Influence Score Graph	% Articles in Citable Items Graph	Normalizec Eigenfacto Graph	Average JIF Percentile Graph
2015	391	0.627	0.537	0.635	0.297	74	4.2	8.2	0.00078	0.131	100.00	0.08883	19.711
2014	391	0.746	0.615	0.739	0.178	73	4.2	7.9	0.00106	0.185	100.00	0.11861	25.561
2013	305	0.694	0.585	0.622	0.165	85	3.7	7.8	0.00083	0.126	100.00	0.09197	26.070
2012	175	0.441	0.289	0.436	0.060	84	4.0	7.8	0.00057	0.093	100.00	Not A…	17.800
2011	144	0.438	0.335	Not A…	0.095	63	3.2	8.4	0.00059	Not A…	100.00	Not A…	20.591
2010	174	0.650	0.380	Not A…	0.079	89	2.6	7.0	0.00045	Not A…	100.00	Not A…	31.055
2009	95	0.373	0.272	Not A…	0.205	39	Not A…	7.2	0.00011	Not A…	100.00	Not A…	11.715

JCR Impact Factor

JCR Year	AUTOMATION & CONTROL SYSTEMS			COMPUTER SCIENCE, INFORMATION SYSTEMS		
	Rank	Quartile	JIF Percentile	Rank	Quartile	JIF Percentile
2015	48/59	Q4	19.492	116/144	Q4	19.792
2014	47/58	Q4	19.828	96/139	Q3	31.295
2013	46/59	Q4	22.881	96/135	Q3	29.259
2012	49/59	Q4	17.797	109/132	Q4	17.803
2011	46/58	Q4	21.552	109/135	Q4	19.630
2010	38/60	Q3	37.500	97/128	Q4	24.609
2009	50/59	Q4	16.102	108/116	Q4	7.328

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2015	268/393-Q3
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2013	255/378-Q3
2012	296/372-Q4

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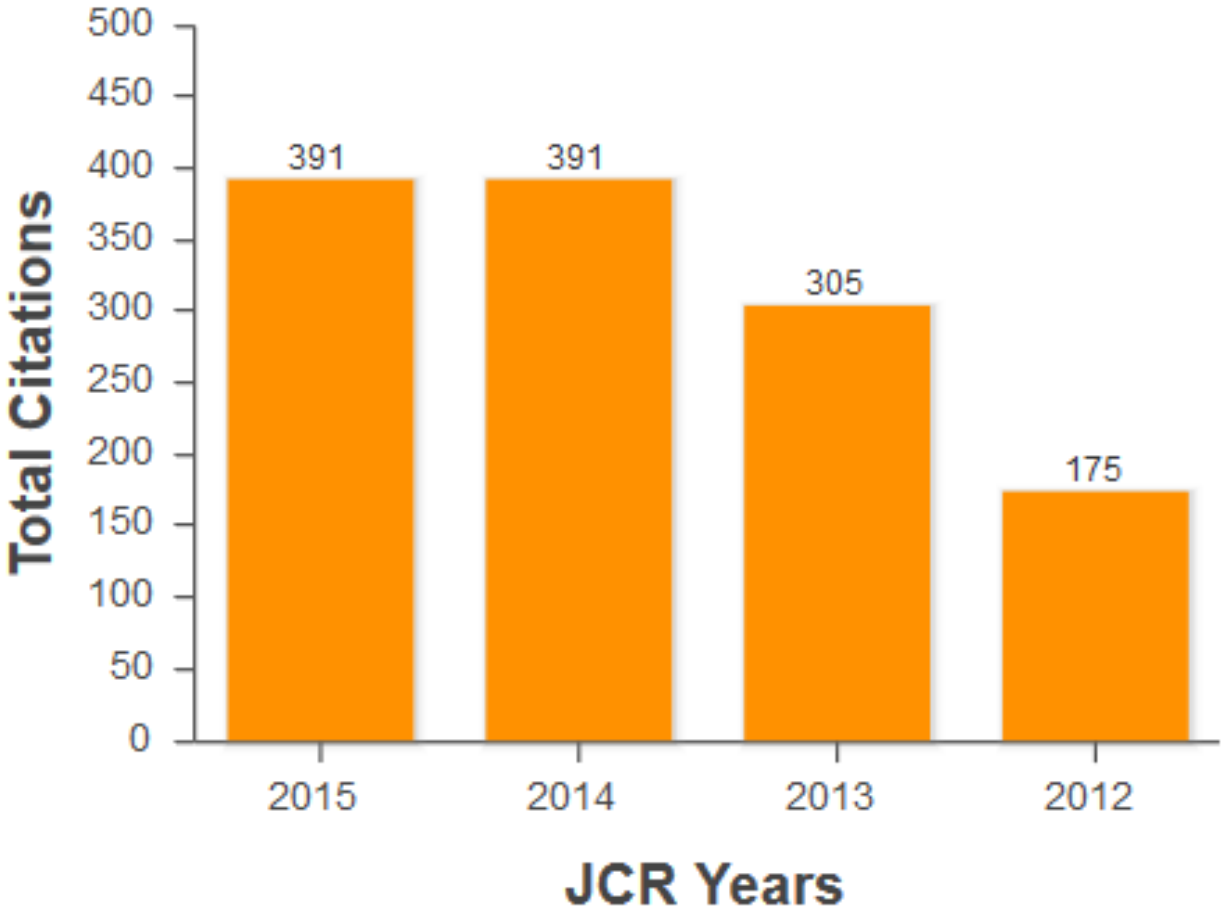

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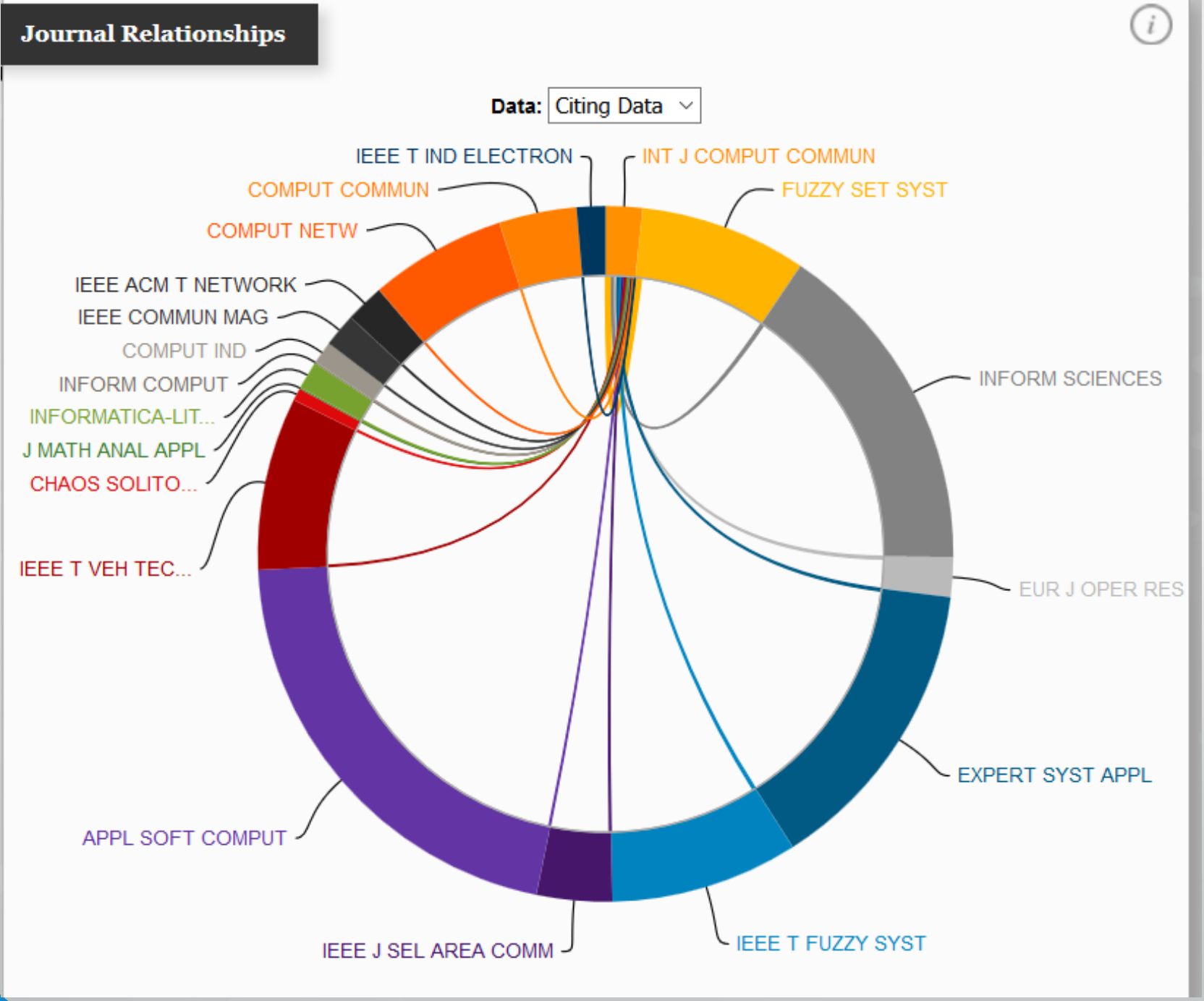
	Impact	Cited Journal	All Yrs	2015	2014	2013	2012	2011
1		ALL Journals	1,582	15	79	111	103	
2		ALL OTHERS (775)	775	5	31	49	59	
3		**NON-TRADITIONAL**	54	0	0	0	0	
4	2.098	FUZZY SET SYST	48	0	0	1	2	
5	0.627	INT J COMPUT COMMUN	46	6	7	7	8	
6		LECT NOTES COMPUT ...	38	0	2	1	1	
7	3.364	INFORM SCIENCES	22	1	3	6	1	
8	2.679	EUR J OPER RES	21	0	1	0	0	
9	2.981	EXPERT SYST APPL	19	0	0	2	4	
10	6.701	IEEE T FUZZY SYST	19	1	0	1	0	
11	3.672	IEEE J SEL AREA COMM	11	0	1	0	0	
12	2.857	APPL SOFT COMPUT	9	0	3	4	0	
13	2.243	IEEE T VEH TECHNOL	9	0	2	2	0	
14	1.611	CHAOS SOLITON FRACT	8	0	0	0	0	
15	1.386	INFORMATICA-LITHUAN	8	0	6	0	0	
16	1.014	J MATH ANAL APPL	8	0	0	0	0	
17	1.685	COMPUT IND	7	0	0	0	0	

Journal Relationships



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International Journal of Computers, Communications and Control

Contact:

Editor in Chief: Professor Florin Gheorghe Filip

ISSN:

1841- 9844

Website:

http://univagora.ro/jour/index.php/ijccc

Publisher:

Agora University of Oradea

Frequency: Bimonthly

Subject: Computer Science

From the same publisher

International Journal of Computers, Communications and Control


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Co-Sponsored by IEEE Region 8 - Europe, Middle East, Africa

and by Research & Development Center of Agora University

2016 6th International Conference on Computers Communications and Control (ICCCC)

Date 10-14 May 2016

Record 1 of 43

Title: The Wonderful Adventures of the Mathematician in Logic-Land: From Lukasiewicz-Moisil Logic to Computers

Author(s): Moisil, II (Moisil, Ioana I.)

Edited by: Dzitac I; Filip FG; Manolescu MJ

Source: 2016 6TH INTERNATIONAL CONFERENCE ON COMPUTERS COMMUNICATIONS AND CONTROL (ICCCC) **Pages:** 1-9 **Published:** 2016

Times Cited in Web of Science Core Collection: 0

Total Times Cited: 0

Usage Count (Last 180 days): 0

Usage Count (Since 2013): 0

Cited Reference Count: 22

Abstract: Informatics restores not only the union of pure and applied mathematics, of concrete technique and abstract mathematics, but also the union of natural sciences with man and society. It re-establishes abstract and formal concepts, and brings peace between art and science, not only in the scientist's spirit, where they always are at peace, but also in their philosophy.

Accession Number: WOS:000391251000001

Language: English

Document Type: Proceedings Paper

Conference Title: 6th International Conference on Computers Communications and Control (ICCCC)

Conference Date: MAY 10-14, 2016

Conference Location: Oradea, ROMANIA

Conference Sponsors: IEEE, IEEE Reg 8, Agora Univ

Author Keywords: Gr.C.Moisil; multi-valued logic; Lukasiewicz-Moisil algebras; switching circuits; Romanian School of Computing

Addresses: [Moisil, Ioana I.] Univ Lucian Blaga, Sibiu, Romania.

Reprint Address: Moisil, II (reprint author), Univ Lucian Blaga, Sibiu, Romania.

E-mail Addresses: im25sibiu@gmail.com

Publisher: IEEE

Publisher Address: 345 E 47TH ST, NEW YORK, NY 10017 USA

Web of Science Categories: Automation & Control Systems; Engineering, Electrical & Electronic

Research Areas: Automation & Control Systems; Engineering

IDS Number: BG7EQ

ISBN: 978-1-5090-1735-5

Source Item Page Count: 9

Organizer and Chair of a Special Session la ITQM 2013:

- **Special Session 03:** Soft Computing and Quantitative Management

May 16-18, 2013 , World Dushulake Hotel , Suzhou, China

Organizer and Chair of Special Session 07:

Soft Computing Methods in Quantitative Management and Decision Making

Organizer and Chair of Special Session 01:

Soft Computing Methods in Quantitative Management and Decision Making

From Kelvin to Zadeh: Hard Computing vs. Soft Computing

University of Chinese Academy of Sciences, Beijing, China, 2013

信息技术与管理科学前沿系列讲座
International Seminar on Information Technology and Management Science

主办单位：中国科学院虚拟经济与数据科学研究中心、中国科学院大学管理学院、
中国科学院自然与社会交叉科学研究中心

时　间：2013年5月14日下午2:30--5:30

地　点：中国科学院大学中关村教学楼S106

Speaker 1: Professor Florin Gheorghe Filip
Title: Green Manufacturing and Computer Aided Decision Making

Bio-Sketch: Academician Florin Gheorghe Filip is an engineer and a PhD in automatic. He has been Vice-President of the and now is the chairman of the Department of Science and Technology Information Romanian Academy. He has been the director of the Romanian Academy Library and a member of the Romanian Academy since 1999.

Speaker 2: Professor Fuad Aleskerov
Title: Three Quantitative Management Problems In Public Procurement And Decision Procedures For Their Analysis And Solving

Bio-Sketch: Fuad Aleskerov is the head of the Department of Mathematicsf or Economics and International Laboratory of Decision Analysis and Choice at National Research University Higher School of Economics and Russia Academy of Sciences.

Speaker 3: Professor Luiz Flavio Autran Monteiro Gomes
Title: Behavioral Multi-Criteria Decision Analysis

Bio-Sketch: Luiz Flavio Autran Monteiro Gomes is a Professor of Management Science in Ibmec University. He is a member of the National Academy of Engineering, Brazil since 1991.

Speaker 4: Professor Ioan Dzitac
Title: From Kelvin to Zadeh: Hard Computing versus Soft Computing

Bio-Sketch: Ioan Dzitac is a professor of informatics (Artificial Intelligence and Distributed Systems) at Aurel Vlaicu University of Arad and Rector of Agora University of Oradea, Romania.

Speaker 5: Professor Minghe Sun
Title: A Multi-Class Support Vector Machine: Theory and Model

Bio-Sketch: Minghe Sun is a professor at the University of Texas at San Antonio. His research interests are in mathematical programming and related areas.

聘　书

No: HP-2013-03

LETTER OF APPOINTMENT

School of Management, University of Chinese Academy of Sciences

Does hereby appoint

Professor Ioan Dzitac

Adjunct Professor of the School of Management, University of Chinese Academy of Sciences

For the period from May 2013 to May 2016

School of Management
University of Chinese Academy of Sciences
May 14, 2013

School of Business Administration, Southwestern University of Finance and Economics, Chengdu, China

- Invited lecture: "From Hard Computing to Soft Computing" (May 19, 2013)

"Soft Computing and Hard Computing"

PhD School, Kalasalingam University, India, 2014

„Fuzzy Logic and Artificial Intelligence"

International Conference on Oriental Thinking and Fuzzy Logic

ICOTFL2015, Dalian, China, 2015

"From Fuzzy Logic to Soft Computing: New Paradigms in Artificial Intelligence":

7th International Workshop, Data Analysis Methods for Software Systems, Druskininkai, Lithuania, Hotel „Europa Royale", December 3 – 5, 2015

Asan, Korea

ITQM

16-18 Aug. 2016

Information Technology and Quantitative Management

Tutorial Lectures

Tutorial Speakers:

- Ioan Dzitac, Professor, Aurel Vlaicu University of Arad & Rector of Agora University of Oradea, Romania

University "Aurel Vlaicu" from Arad

UNIVERSITATEA AGORA
IN HOC SIGNO VINCES

Record 1 of 50

Title: Profit Maximizing from Energy Consumption with the Choquet-Based Cluster Analysis

Author(s): Machado, MAS (Soares Machado, Maria Augusta); Giesta, HCP (Preston Giesta, Haroldo Carlos); Gomes, LFAM (Autran Monteiro Gomes, Luiz Flavio); Caldeira, AM (Caldeira, Andre Machado); Santos, DJ (Santos, Danilo Jusan)

Edited by: Lee H; Shi Y; Lee J; Cordova F; Dzitac I; Kou G; Li J

Source: PROMOTING BUSINESS ANALYTICS AND QUANTITATIVE MANAGEMENT OF TECHNOLOGY: 4TH INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY AND QUANTITATIVE MANAGEMENT (ITQM 2016) **Book Series:** Procedia Computer Science **Volume:** 91 **Pages:** 9-18 **DOI:** 10.1016/j.procs.2016.07.036 **Published:** 2016

Times Cited in Web of Science Core Collection: 0

Total Times Cited: 0

Usage Count (Last 180 days): 1

Usage Count (Since 2013): 1

Cited Reference Count: 7

Abstract: New rules and laws for the electricity sector in Brazil aim to produce severe reductions to the cost of electricity in order to reduce the so-called 'Brazil Cost'. Taking into account those new rules and laws all electricity companies have an obligation to improve their processes. Among them the following actions are contemplated: intelligent use of resources; expansion of synergies; increase of the efficiency of internal procedures and processes; massive introduction of technological innovations; reduction of the amount of compensation paid in lawsuits; reduction of technical losses or losses by theft in the case of distribution of the generated energy. If the companies do not make plans and act quickly they will be bound to cause their shareholders very high losses of capital, leading to an expressive decrease of interest to invest in the sector. The absence of those plans and subsequent actions can also lead to investments in generation and distribution being returned to the state, which contributes to an increasing degree of state interference in the economy. In this paper the ordered groups of reading power consumption of clients that maximize the profits of a power plant are determined. The groups were determined by cluster analysis and their reading consumption groups ordered by making use of the Choquet integral. (C) 2016 The Authors. Published by Elsevier B.V.

Accession Number: WOS:000387683300001

Language: English

Document Type: Proceedings Paper

Conference Title: 4th International Conference on Information Technology and Quantitative Management (ITQM) - Promoting Business Analytics and Quantitative Management of Technology

Conference Date: AUG 16-18, 2016

Conference Location: Asan, SOUTH KOREA

Conference Sponsors: Hoseo Univ, Acad Informat Technol & Quantitat Management, Korea Adv Inst Sci & Technol, Chinese Acad Sci, Res Ctr Fictitious Economy & Data Sci, Chinese Acad Sci, Key Lab Big Data Mining & Knowledge Management, Univ Chinese Acad Sci, Sch Econ & Management, Chinese Acad Sci, Inst Policy & Management, Univ Nebraska, Beijing Taiji Huabao Tech Co Ltd, Chinese Acad Management

Author Keywords: Power Plant Industry; Cluster Analysis; Choquet Integral

Addresses: [Soares Machado, Maria Augusta; Preston Giesta, Haroldo Carlos; Autran Monteiro Gomes, Luiz Flavio; Santos, Danilo Jusan] IBMEC, Ave Presidente Wilson 118,2th Floor, BR-20030020 Rio De Janeiro, RJ, Brazil.

PRELEGERE
Aplicații ale matematicii fuzzy în metodele de luare a deciziilor

Candidat: Ioan Dziţac

1. Contribuții personale în folosul comunității științifice: IJCCC, ICCCC, Conferințe internaționale invitate
2. Rezumat
3. Literatura în domeniu
4. Contribuții personale în domeniu
5. Paradigme specifice
6. Concluzii

Abstract (1-4):

Hard Computing (traditional computing paradigm, usually for well posed problems)
Soft Computing (usually for ill posed problems)

1) Influence of *fuzzy logic* in *soft computing paradigms* and *decision making methods* is presented in many research works.

2) Humans have a remarkable capability to reason and make decisions in an environment of *imprecision, uncertainty* and *partiality of knowledge, truth and class membership.*

3) It is this capability that is needed to achieve *human-level machine intelligence*. Achievement of human-level machine intelligence is beyond the reach of existing Artificial Intelligence (AI) techniques and more of these are based on fuzzy sets theory and fuzzy logic.

4) In many real-world situations, the problems of decision making are subjected to some *constraints*, objectives and consequences that *are not accurately known.*

Abstract (5-7):

5) After **Bellman** and **Zadeh** introduced for the first time fuzzy sets within MCDM, many researchers have been preoccupied by decision making in fuzzy environments.

6) The fusion between *Multiple-Criteria Decision-Making* **(MCDM)** and fuzzy set theory has led to a new decision theory, known today as *Fuzzy Multi-Criteria Decision Making* **(FMCDM),** where we have decision-maker models that can deal with incomplete and uncertain knowledge and information.

7) The most important thing is that, when we want to assess, judge or decide we usually use a natural language in which the words do not have a clear, definite meaning. As a result, we need *fuzzy numbers* to express *linguistic variables*, to describe *the subjective judgment* of a decision maker in a *quantitative manner*.

Abstract (8-9):

8) Fuzzy numbers (FN) most often used are triangular FN, trapezoidal FN and Gaussian FN. We highlight that the concept of linguistic variable introduced by **Zadeh** in 1975 allows computation with words instead of numbers and thus linguistic terms defined by fuzzy sets are intensely used in problems of decision theory for modeling uncertain information.

9) After **Atanassov** introduced the concept of *intuitionistic fuzzy sets*, where each element is characterized by a membership function, as in fuzzy sets, as well as by a non-membership function, the interest in the study of the problems of decision making theory with the help of intuitionistic fuzzy sets has increased.

Keywords: Fuzzy logic, artificial intelligence, soft computing, natural language computation, MCDM, FMCDM, TOPSIS, fuzzy TOPSIS.

PRELEGERE
Aplicații ale matematicii fuzzy în metodele de luare a deciziilor

Candidat: Ioan Dziţac

1. Contribuții personale în folosul comunității științifice: IJCCC, ICCCC, Conferințe internaționale invitate
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6. Concluzii

Lotfi A. Zadeh

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Professor Emeritus, EECS, UC Berkeley

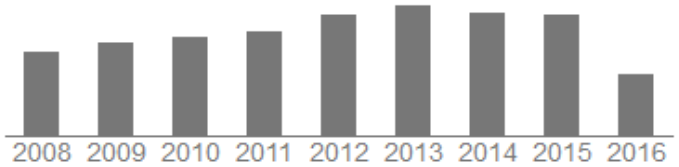
Fuzzy Logic, Soft Computing, Artificial Intelligence, Human-Level Machine Intelligence

Verified email at eecs.berkeley.edu - Homepage

Google Scholar

Title 1–20	Cited by	Year
Fuzzy Sets L Zadeh Information and Control 8, 338-353	63786	1965
Outline of a new approach to the analysis of complex systems and decision processes LA Zadeh IEEE Transactions on systems, Man, and Cybernetics, 28-44	28199 *	1973
The concept of a linguistic variable and its application to approximate reasoning—I LA Zadeh Information sciences 8 (3), 199-249	~~11614~~	1975
Decision-making in a fuzzy environment RE Bellman, LA Zadeh Management science 17 (4), B-141-B-164	7458	1970
The concept of a linguistic variable and its application to approximate reasoning—II LA Zadeh	3193	1975

Citation indices	All	Since 2011
Citations	162534	62406
h-index	101	68
i10-index	282	170



INFORMATION AND CONTROL 8, 338–353 (1965)

Fuzzy Sets*

L. A. ZADEH

Department of Electrical Engineering and Electronics Research Laboratory, University of California, Berkeley, California

A fuzzy set is a class of objects with a continuum of grades of membership. Such a set is characterized by a membership (characteristic) function which assigns to each object a grade of membership ranging between zero and one. The notions of inclusion, union, intersection, complement, relation, convexity, etc., are extended to such sets, and various properties of these notions in the context of fuzzy sets are established. In particular, a separation theorem for convex fuzzy sets is proved without requiring that the fuzzy sets be disjoint.

Definition 1 (Zadeh, 1965): Let X be a nonempty set. A fuzzy set A drawn from X is defined as $A = \{(x, \mu_A(x)) : x \in X\}$, where $\mu_A(x)$: $X \longrightarrow [0, 1]$ is the membership function of the fuzzy set A. Fuzzy set is a collection of objects with graded membership i.e. having degrees of membership.

Aprecieri și recomandări pe care le-am primit din partea unor personalități din țară și străinătate

Prof. Lotfi A. Zadeh (părintele mulțimilor și logicii fuzzy), Director, Berkeley Initiative in Soft Computing (BISC), University of California, Berkeley, 2008:

"From: Lotfi A. Zadeh [zadeh@eecs.berkeley.edu]
Sent: Thursday, May 07, 2009 9:51 AM
To: Ioan Dzitac
Subject: Congratulations/Dzitac
Dear Professor Dzitac:
I received copies of the Proceedings and the Journal. I was highly impressed in all respects. You and your colleagues have done an outstanding job. I was very pleased with the inclusion of my powerpoint presentation in the Appendix of the Proceedings.
Please accept my compliments and congratulations.
I should like to take this opportunity to thank you again for the very warm welcome which you extended to me. Participation in your Conference was a very stimulating as well as pleasant experience.
With my warm regards. Sincerely,
Lotfi Zadeh

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SOCIALIST REPUBLIC
INSTITUTE FOR MATHEMATICS

UNIVERSITY OF BUCHAREST
COMPUTING CENTER

Gr.C.MOISIL

LUKASIEWICZIAN ALGEBRAS

- October 1968 -

Acknowledgement

During professor L.Zadeh's visit to Bucharest, in the autumn 1967, I became acquainted with his works about "fuzzy sets" and I started tu study the theory of these "fuzzy sets" as a set theory in a logic with a totally ordered set of logical values.

The prezent work exposes the logic of propositions with a totally ordered set of logical values. The models of this logic of propositions uses an algebraic technic very closed to that given by us in the study of models for propositional logic with a finite number of logic values.

Krassimir Atanassov

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Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences
Mathematical Modelling, Artificial Intelligence, Intuitionistic Fuzzy Sets, Generalized Nets, Number Theory
Verified email at bas.bg

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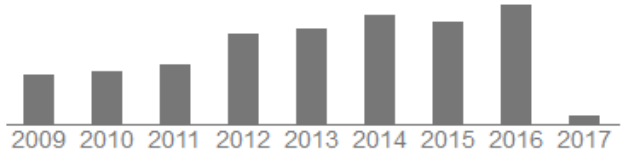
Title 1–20	Cited by	Year
Intuitionistic fuzzy sets KT Atanassov Fuzzy sets and Systems 20 (1), 87-96	8626 *	1986
More on intuitionistic fuzzy sets KT Atanassov	937	1989

Citation indices	All	Since 2012
Citations	14688	8742
h-index	31	27
i10-index	87	52



Intuitionistic fuzzy sets

From Ifigenia, the wiki for intuitionistic fuzzy sets and generalized nets (You can help improve this article immediately)

Intuitionistic fuzzy sets are sets whose elements have degrees of membership and non-membership. Intuitionistic fuzzy sets have been introduced by Krassimir Atanassov (1983) as an extension of Lotfi Zadeh's notion of fuzzy set, which itself extends the classical notion of a set.

- In classical set theory, the membership of elements in a set is assessed in binary terms according to a bivalent condition — an element either belongs or does not belong to the set.
- As an extension, fuzzy set theory permits the gradual assessment of the membership of elements in a set; this is described with the aid of a membership function valued in the real unit interval [0, 1].
- The theory of intuitionistic fuzzy sets further extends both concepts by allowing the assessment of the elements by two functions: μ for membership and ν for non-membership, which belong to the real unit interval [0, 1] and whose sum belongs to the same interval, as well.

Intuitionistic fuzzy sets generalize fuzzy sets, since the indicator functions of fuzzy sets are special cases of the membership and non-membership functions μ and ν of intuitionistic fuzzy sets, in the case when the strict equality exists: $\nu = 1 - \mu$, i.e. the non-membership function fully complements the membership function to 1, not leaving room for any uncertainty.

ELSEVIER

Fuzzy Sets and Systems

Volume 20, Issue 1, August 1986, Pages 87-96

Intuitionistic fuzzy sets

Krassimir T. Atanassov

doi:10.1016/S0165-0114(86)80034-3

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A definition of the concept ‘intuitionistic fuzzy set’ (IFS) is given, the latter being a generalization of the concept ‘fuzzy set’ and an example is described. Various properties are proved, which are connected to the operations and relations over sets, and with modal and topological operators, defined over the set of IFS's.

Keywords

Intuitionistic fuzzy set; Fuzzy Set; Modal operator (necessity, possibility); Topological operator (interior, closure)

Florentin Smarandache

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Title 1–20	Cited by	Year
Only problems, not solutions! F Smarandache Infinite Study	828	1991
A Unifying Field in Logics: Neutrosophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability: Neutrsophic Logic. Neutrosophy, Neutrosophic Set, Neutrosophic Probability F Smarandache Infinite Study		
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Single valued neutrosophic sets H Wang, F Smarandache, Y Zhang, R Sunderraman Review of the Air Force Academy, 10		

Citation indices	All	Since 2012
Citations	9491	6196
h-index	42	35
i10-index	200	151

Neutrosophic Set – A Generalization of the Intuitionistic Fuzzy Set

Florentin Smarandache, University of New Mexico,
Gallup, NM 87301, USA, E-mail: smarand@unm.edu

Abstract: In this paper one generalizes the intuitionistic fuzzy set (IFS), paraconsistent set, and intuitionistic set to the neutrosophic set (NS). Many examples are presented. Distinctions between NS and IFS are underlined.

Keywords and Phrases: Intuitionistic Fuzzy Set, Paraconsistent Set, Intuitionistic Set, Neutrosophic Set, Non-standard Analysis, Philosophy.
MSC 2000: 03B99, 03E99.

1. Introduction:

One first presents the evolution of sets from fuzzy set to neutrosophic set. Then one introduces the neutrosophic components T, I, F which represent the membership, indeterminacy, and non-membership values respectively, where $]^-0, 1^+[$ is the non-standard unit interval, and thus one defines the neutrosophic set. One gives examples from mathematics, physics, philosophy, and applications of the neutrosophic set. Afterwards, one introduces the neutrosophic set operations (complement, intersection, union, difference, Cartesian product, inclusion, and n-ary relationship), some generalizations and comments on them, and finally the distinctions between the neutrosophic set and the intuitionistic fuzzy set.

In many real-world situations, the problems of decision making are subjected to some constraints, objectives and consequences that are not accurately known. After Bellman and Zadeh

Bellman RE, Zadeh LA. Decision-making in a fuzzy environment. *Management Science* 1970; **17(4)**: 141–164.

introduced for the first time fuzzy sets within MCDM, many researchers have been preoccupied by decision making in fuzzy environments. The fusion between MCDM and fuzzy set theory has led to a new decision theory, known today as fuzzy multi-criteria decision making (FMCDM), where we have decision-maker models that can deal with incomplete and uncertain knowledge and information. The most important thing is that, when we want to assess, judge or decide we usually use a natural language in which the words do not have a clear, definite meaning.

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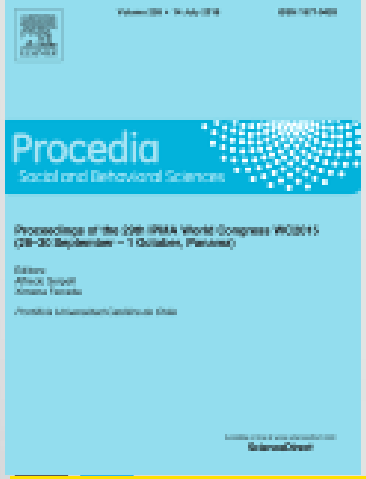
DECISION-MAKING IN A FUZZY ENVIRONMENT*†

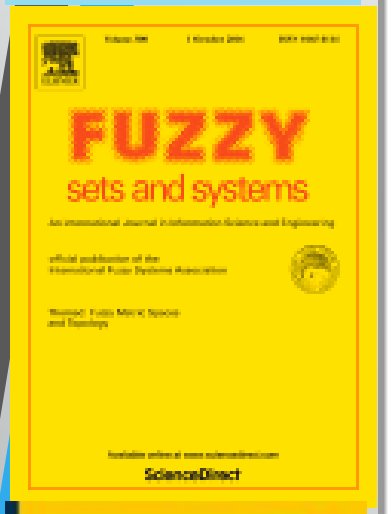
R. E. BELLMAN‡ AND L. A. ZADEH§

By decision-making in a fuzzy environment is meant a decision process in which the goals and/or the constraints, but not necessarily the system under control, are fuzzy in nature. This means that the goals and/or the constraints constitute classes of alternatives whose boundaries are not sharply defined.

An example of a fuzzy constraint is: "The cost of A should not be *substantially* higher than α," where α is a specified constant. Similarly, an example of a fuzzy goal is: "x should be in the *vicinity* of x_0," where x_0 is a constant. The italicized words are the sources of fuzziness in these examples.

Fuzzy goals and fuzzy constraints can be defined precisely as fuzzy sets in the space of alternatives. A fuzzy decision, then, may be viewed as an intersection of the given goals and constraints. A maximizing decision is defined as a point in the space of alternatives at which the membership function of a fuzzy decision attains its maximum value.





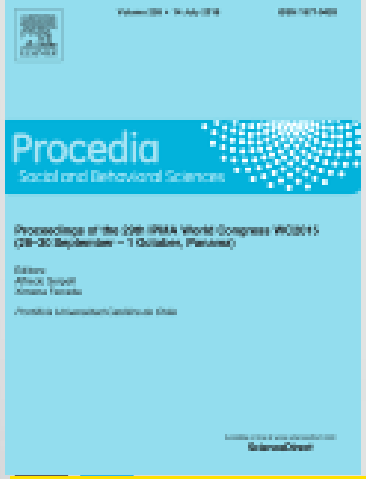
There are very good monographs and surveys papers on FMCDM.

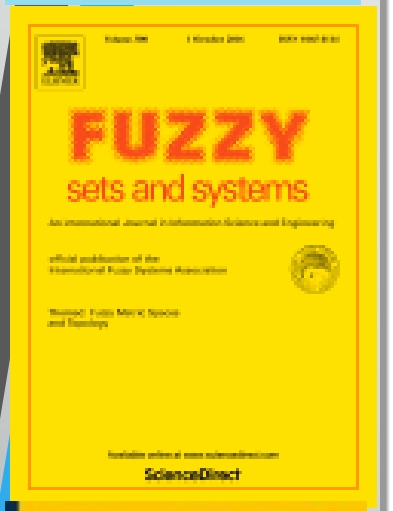
- Abdullah L. Fuzzy multi criteria decision making and its applications: A brief review of category. *Procedia - Social and Behavioral Sciences* 2013; **97**: 131–136.
- Carlsson C, Fullér R. Fuzzy multiple criteria decision making: Recent developments. *Fuzzy Sets and Systems* 1996; **78(2)**: 139–153.
- Chen SJ, Hwang CL. *Fuzzy Multiple Attribute Decision-Making, Methods and Applications*. Lecture Notes in Economics and Mathematical Systems, vol. 375, Springer-Verlag Berlin Heidelberg; 1992.

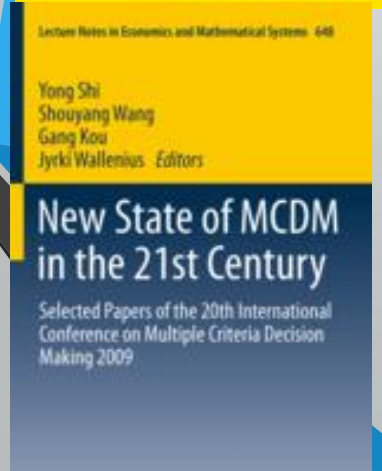
As a result, we need fuzzy numbers to express linguistic variables, to describe the subjective judgement of a decision maker in a quantitative manner. Fuzzy numbers (FN) most often used are triangular FN, trapezoidal FN and Gaussian FN.
We highlight that the concept of linguistic variable introduced by Zadeh in 1975

Zadeh LA. The concept of a linguistiv variable and its application to approximate reasoning - I. *Information Sciences* 1970; **8**: 199–249.

allows computation with words instead of numbers and thus linguistic terms defined by fuzzy sets are intensely used in problems of decision theory for modeling uncertain information.







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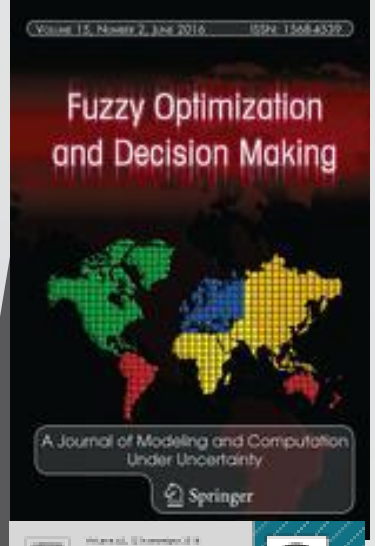

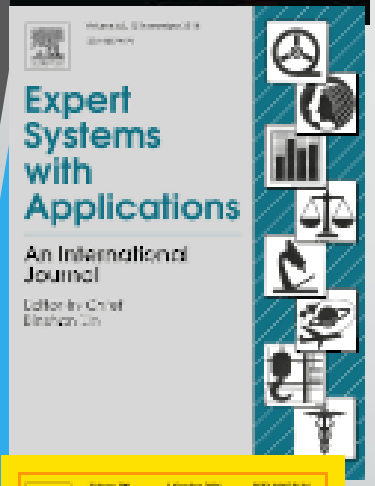

- Herrera F, Alonso S, Chiclana F, Herrera-Viedma E. Computing with word in decision making: Fundation, trens and prospects. *Fuzzy Optimization and Decision Making* 2009; **8(4)**: 337–364.
- Mardani A, Jusoh A, Zavadskas EK. Fuzzy multiple criteria decision-making techniques and applications - Two decades review from 1994 to 2014. *Expert Systems with Applications* 2015; **42**: 4126–4148.
- Ribeiro RA. Fuzzy multiple attribute decision making: A review and new preference elicitation techniques. *Fuzzy Sets and Systems* 1996; **78(2)**: 155–181.

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i10-index	233	180

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Multi-criteria evaluation of green suppliers using an extended WASPAS method with interval type-2 fuzzy sets MK Ghorabaee, EK Zavadskas, M Amiri, A Esmaeili Journal of Cleaner Production 137, 213-229		2016
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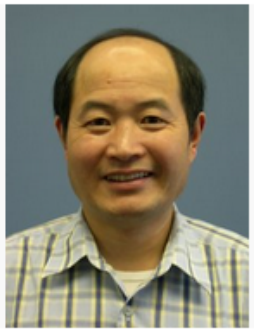
Multicriteria group decision making with ELECTRE III method based on interval-valued intuitionistic fuzzy information SS Hashemi, SHR Hajiagha, EK Zavadskas, HA Mahdiraji Applied Mathematical Modelling 40 (2), 1554-1564	4	2016



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h-index	46	40

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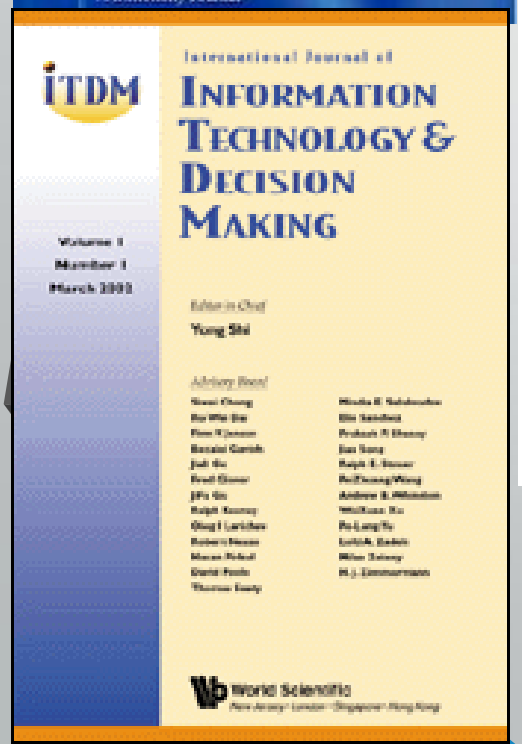
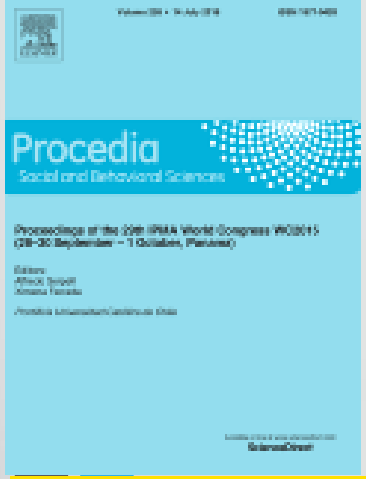
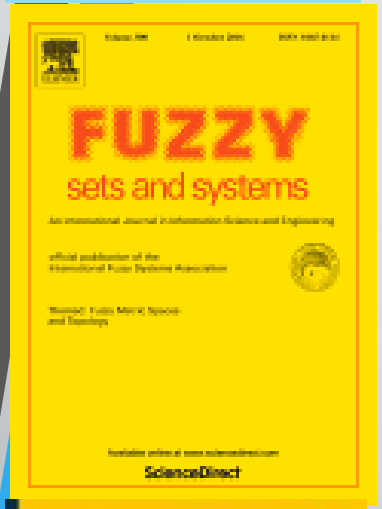
A fuzzy programming approach for solving a multiple criteria and multiple constraint level linear programming problem YH Liu, Y Shi Fuzzy Sets and Systems 65 (1), 117-124	35	1994
Duality in fuzzy multi-criteria and multi-constraint level linear programming: a parametric approach Y Zhong, Y Shi Fuzzy Sets and Systems 132 (3), 335-346	25	2002



Recently, some new methods have been explored

- Ashraf S, Rehman A, Kerre EE. Group decision making with incomplete interval-valued fuzzy preference relations based on the minimum operator. *International Journal of Computers, Communications & Control* 2015; **10(6)**: 789–802.
- Xia M, Xu Z. A novel method for fuzzy multi-criteria decision making. *International Journal of Information Technology & Decision Making* 2014; **13(2)**: 497–519.
- Zeng S, Chen J, Li X. A hybrid method for pythagorean fuzzy multiple-criteria decision making. *International Journal of Information Technology & Decision Making* 2016; **15(2)**: 403–422.





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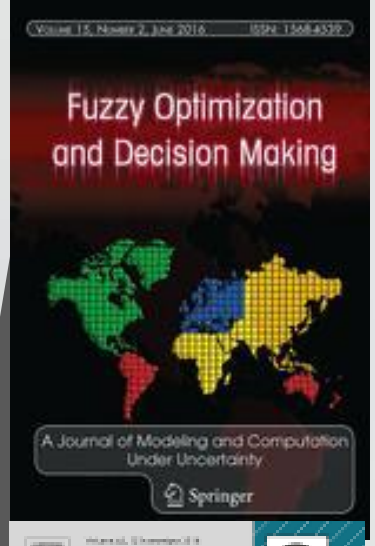

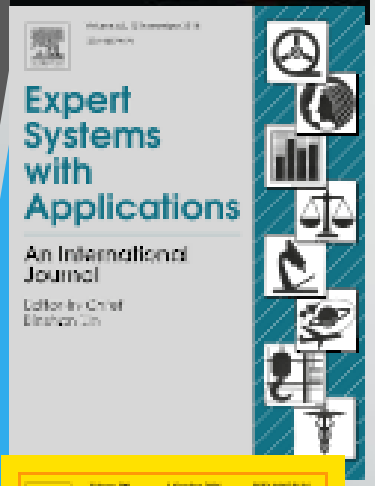

- Herrera F, Alonso S, Chiclana F, Herrera-Viedma E. Computing with word in decision making: Fundation, trens and prospects. *Fuzzy Optimization and Decision Making* 2009; **8(4)**: 337–364.
- Mardani A, Jusoh A, Zavadskas EK. Fuzzy multiple criteria decision-making techniques and applications - Two decades review from 1994 to 2014. *Expert Systems with Applications* 2015; **42**: 4126–4148.
- Ribeiro RA. Fuzzy multiple attribute decision making: A review and new preference elicitation techniques. *Fuzzy Sets and Systems* 1996; **78(2)**: 155–181.

In fuzzy MCDM, in order to assign the importance degree to the criteria, it can be used an empirical method described in

Yang T, Hung C. Multiple-attribute decision making methods for plant layout design problem. *Robotics and Computer-Integrated Manufacturing* 2007; **23**: 126–137.

where an equivalence between the importance of an attribute and a triangular FN is presented.

Table : Triangular FNs for the importance of criteria

Rank	Attribute grade	Triangular FN
Very low	1	(0.00, 0.10, 0.30)
Low	2	(0.10, 0.30, 0.50)
Medium	3	(0.30, 0.50, 0.75)
High	4	(0.50, 0.75, 0.90)
Very high	5	(0.75, 0.90, 1.00)

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Criteria Interactions in Multiple Criteria Decision Aiding: A Choquet Formulation for the TODIM Method ☆

Luiz Flavio Autran Monteiro Gomes [a], Maria Augusta Soares Machado [a], Francisco Ferreira da Costa [b], Luis Alberto Duncan Rangel [c]

Keywords

Prospect theory; Real estate; Fuzzification; Additive value function

Note. The *TODIM method* (an acronym in Portuguese of Interactive and Multicriteria Decision Making), conceived in its current form at the beginning of the nineties, is a discrete multicriteria *method* based on Prospect Theory (Kahneman and Tversky, 1979).

Luis Magdalena

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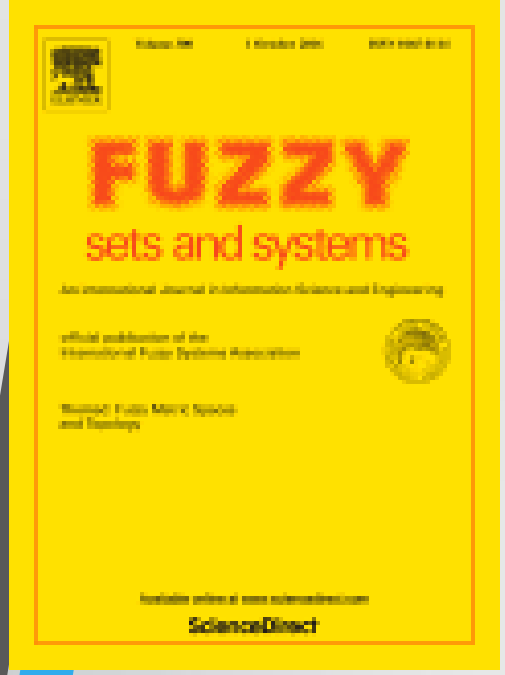
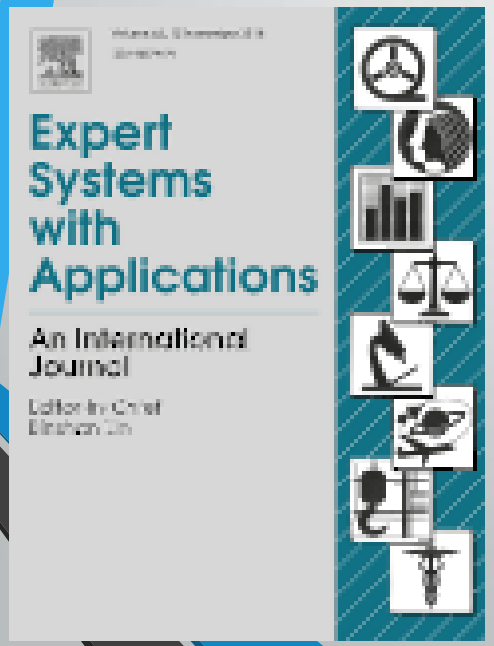
Genetic fuzzy systems: evolutionary tuning and learning of fuzzy knowledge bases LM O. Cordón, F. Herrera, F. Hoffmann World Scientific Pub Co Inc	1136 *	2001
Ten years of genetic fuzzy systems: current framework and new trends O Cordón, F Gomide, F Herrera, F Hoffmann, L Magdalena Fuzzy Sets and Systems 141 (1), 5-31	866	2004
Ten years of genetic fuzzy systems: current framework and new trends O Cordón, F Herrera, F Gomide, F Hoffmann, L Magdalena IFSA World Congress and 20th NAFIPS International Conference, 2001. Joint ...	~~866~~	2001
Interpretability issues in fuzzy modeling Springer	368	2013
Accuracy improvements in linguistic fuzzy modeling	319 *	2013

The *Technique for Order of Preference by Similarity to Ideal Solution* (**TOPSIS**) is a multi-criteria decision analysis method, which was originally developed by Hwang and Yoon in 1981 with further developments by Yoon in 1987, and Hwang, Lai and Liu in 1993.

A fuzzy TOPSIS approach for selecting plant location is firstly proposed by Chu in 2002, in paper

Chu TC. Selecting plant location via a fuzzy TOPSIS approach. *The International Journal of Advanced Manufacturing Technology* 2002; **20(11)**: 859–864.





In 2008, Chen and Tsao

Chen TY, Tsao CY. The interval-valued fuzzy TOPSIS method and experimental analysis. *Fuzzy Sets and Systems* 2008; **159(11)**: 1410–1428.

extended TOPSIS method based on interval-valued fuzzy sets.

In 2010, Chen and Lee

Chen SM, Lee LW. Fuzzy multiple attributes group decision-making based on the interval type-2 TOPSIS method. *Expert Systems with Applications* 2010; **37(4)**: 2790–2798.

presented a fuzzy TOPSIS technique based on interval type-2 fuzzy sets.

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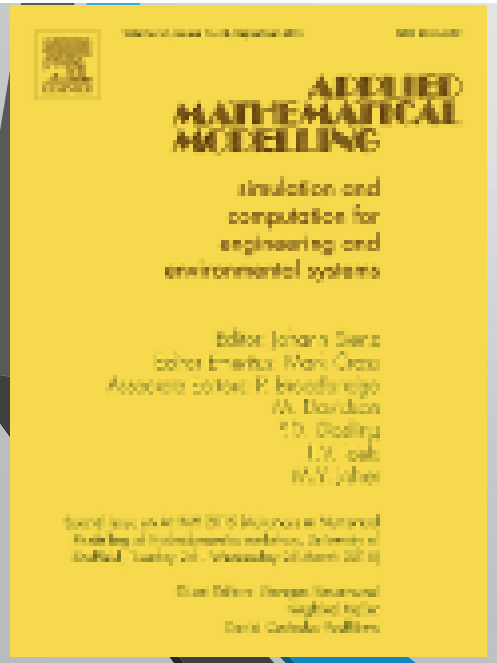
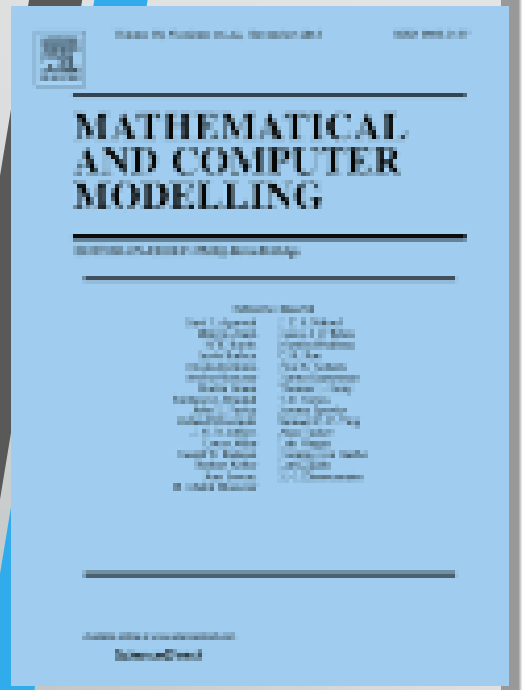


In 2010, Li developed in paper

Li DF. TOPSIS-based nonlinear-programming methodology for multiattribute decision making with interval-valued intuitionistic fuzzy sets. *IEEE Transactions on Fuzzy Systems* 2010; **18(2)**: 299–311.

a methodology that is based on TOPSIS to solve MCDM problems with both ratings of alternatives w.r.t. criteria and weights of criteria are expressed in interval-valued intuitionistic fuzzy sets.
In 2011, another TOPSIS method to solve MCDM problems in interval-valued intuitionistic fuzzy environment is proposed in paper

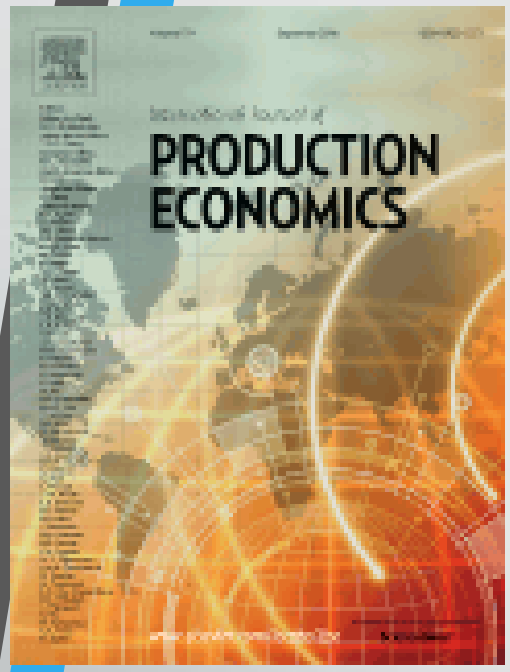
Park JH, Park IY, Kwun YC, Tan X. Extension of the TOPSIS method for decision making problems under interval-valued intuitionistic fuzzy environment. *Applied Mathematical Modelling* 2011; **35**: 2544–2556.



In paper

Awasthi A, Chauhan SS, Goyal SK. A multi-criteria decision making approach for location planning for urban distribution centers under uncertainty. *Mathematical and Computer Modelling* 2011; **53**: 98–109.

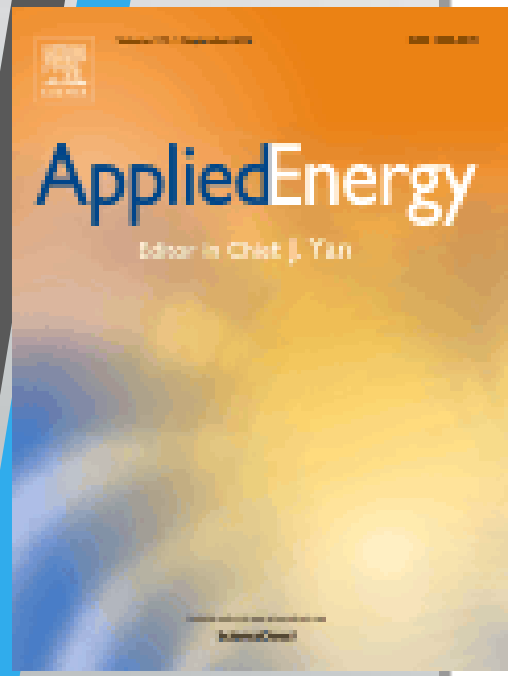
fuzzy TOPSIS method is also used . A logistic company is interested in implementing a new urban distribution center and there are three alternatives (A_1, A_2, A_3). Firstly a committee of three decision-makers is formed. The criteria are: accessibility (C1), security (C2), connectivity to multimodal transport (C3), costs (C4), environmental impact (C5), proximity to customers (C6), proximity to suppliers (C7), resource availability (C8), conformance to sustainable freight regulations (C9), possibility of expansion (C10), quality of service (C11).



In paper

Chen CT, Lin CT, Huang SF. A fuzzy approach for supplier evaluation and selection in supply chain management. *International Journal of Production Economics* 2006; **102**: 289–301.

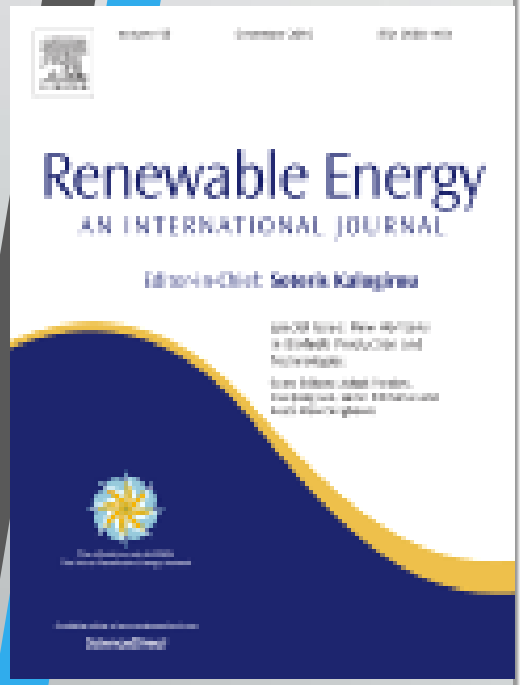
a fuzzy TOPSIS approach based on trapezoidal FNs is used to solve the supplier-selection problem. Five benefit criteria are considered: profitability of supplier, relationship closeness, technological capability, conformance quality, conflict resolution.



In paper

Cavallaro F. Fuzzy TOPSIS approach for assessing thermal-energy storage in concentrated solar power (CSP) systems. *Applied Energy* 2010; **87**: 496–503.

a fuzzy TOPSIS methodology is used to compare different heat transfer fluids. An important step, in problem formulation, is choosing the criteria. Ten criteria are selected both technical-economic and environmental. Three of them are qualitative and expressed in linguistic terms: state of knowledge of innovative technology, environmental risk and safety freezing point.



A fuzzy TOPSIS method is applied in paper

Şengul U, Eren M, Shiraz SE, Gezder V, Şengul AB. Fuzzy TOPSIS method for ranking renewable energy supply systems in Turkey. *Renewable Energy* 2015; **75**: 617–625.

for ranking renewable energy supply systems in Turkey. There are five criteria with positive impact: value of CO_2 emission (environmental), job creation (social), efficiency, installed capacity, amount of energy produced (technical) and four criteria with negative impact: investment cost, operation and maintenance cost, payback period (economic), land use (environmental).

PRELEGERE
Aplicații ale matematicii fuzzy în metodele de luare a deciziilor

Candidat: Ioan Dziţac

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Fuzzy and neural controllers for a pneumatic actuator T Vesselenyi, S Dzitac, I Dzitac, MJ Manolescu International Journal of Computers Communications & Control 2 (4), 375-387	36	2007
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How to write a good paper in Computer Science and how will it be Measured by ISI Web of Knowledge R Andonie, I Dzitac International Journal of Computers Communications & Control 5 (4), 432-446	20	2010

Co-authors Edit...

Simona Dzitac

Misu-Jan Manolescu

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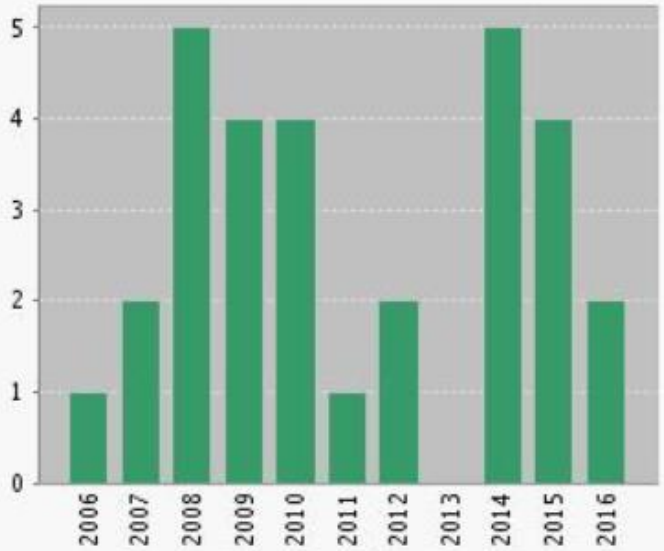

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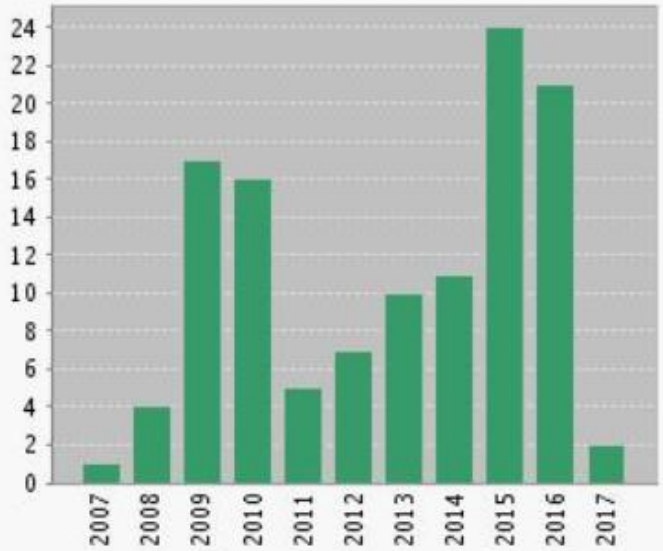

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Artificial Intelligence plus Distributed Systems = Agents

By: Dzitac, I (Dzitac, Ioan)[1] ; Barbat, BE (Barbat, Boldur E.)[2]

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Abstract

The connection with Wirth's book goes beyond the title, albeit confining the area to modern Artificial Intelligence (AT). Whereas thirty years ago, to devise effective programs, it became necessary to enhance the classical algorithmic framework with approaches applied to limited and focused subdomains, in the context of broad-band technology and semantic web, applications - running in open, heterogeneous, dynamic and uncertain environments-current paradigms are not enough, because of the shift from programs to processes. Beside the structure as position paper, to give more weight to some basic assertions, results of recent research are abridged and commented upon in line with new paradigms. Among the conclusions: a) Non-deterministic software is unavoidable; its development entails not just new design principles but new computing paradigms. b) Agent-oriented systems, to be effectual, should merge conventional

Citation Network

ON THE RATIO OF FUZZY NUMBERS - EXACT MEMBERSHIP FUNCTION COMPUTATION AND APPLICATIONS TO DECISION MAKING

By: Stanojevic, B (Stanojevic, Bogdana)[1] ; Dzitac, I (Dzitac, Ioan)[

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TECHNOLOGICAL AND ECONOMIC DEVELOPMENT OF ECONOI

Volume: 21 **Issue:** 5 **Pages:** 815-832 **Special Issue:** SI

DOI: 10.3846/20294913.2015.1093563

Published: SEP 3 2015

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ropose a new approach to solving the full fu
certain problems in which the goals may be
In order to evaluate the membership functio
y numbers obtained as sums of products of
rs, compute the exact membership function
ular fuzzy number. We analyse the effect of t
solving a special example - a decision-maki

Author Keywords: full fuzzy program; triangular fuzzy number; fuzzy

C61

KeyWords Plus: AGGREGATION OPERATORS; INTERVAL; EXTEN

Year	Total Cites Graph	Journal Impact Factor Graph	Impact Factor Without Journal Self Cites Graph	5 Year Impact Factor Graph	Immediacy Index Graph	Citable Items Graph	Cited Half-Life Graph	Citing Half-Life Graph	Eigenfacto Score Graph	Article Influence Score Graph	% Articles in Citable Items Graph	Normalize Eigenfacto Graph	A P
2015	598	1.952	1.704	2.057	0.283	46	3.9	6.8	0.00139	0.402	93.48	0.15788	
2014	448	1.563	1.223	1.700	0.175	40	3.5	7.1	0.00117	0.324	92.50	0.13063	
2013	503	2.818	2.116	2.216	0.123	65	3.2	6.4	0.00124	0.365	98.46	0.13687	
2012	458	3.224	2.576	1.972	0.237	38	2.6	6.0	0.00131	0.355	92.11	Not A...	
2011	468	3.235	2.400	Not A...	0.795	39	2.5	6.5	0.00092	Not A...	100.00	Not A...	
2010	582	5.605	4.259	Not A...	1.130	46	2.1	5.3	0.00102	Not A...	100.00	Not A...	

Source Data

Rank

Cited Journal Data

Citing Journal Data

JCR Impact Factor

JCR Year	ECONOMICS		
	Rank	Quartile	JIF Percentile
2015	55/345	Q1	84.203
2014	68/333	Q1	79.730
2013	25/333	Q1	92.643

The Fuzzification of Classical Structures: A General View

By: Dzitac, I (Dzitac, I.)[1,2]

View ResearcherID and ORCID

INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL

Volume: 10 **Issue:** 6 **Pages:** 772-788 **Special Issue:** SI

Published: DEC 2015

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Abstract

The aim of this survey article, dedicated to the 50th anniversary of Zadeh's pioneering paper "Fuzzy Sets" (1965), is to offer a unitary view to some important spaces in fuzzy mathematics: fuzzy real line, fuzzy topological spaces, fuzzy metric spaces, fuzzy topological vector spaces, fuzzy normed linear spaces. We believe that this paper will be a support for future research in this field.

Keywords

Author Keywords: Fuzzy real line; fuzzy topological spaces; fuzzy metric spaces; fuzzy topological vector spaces; fuzzy normed linear spaces; fuzzy F-space

KeyWords Plus: TOPOLOGICAL VECTOR-SPACES; NORMED LINEAR-SPACES; FUZZY METRIC-SPACES; MULTIVALUED MAPPINGS; BOUNDED OPERATORS; TYCHONOFF THEOREM; SETS

Decision Support Model for Production Disturbance Estimation

By: Felea, I (Felea, Ioan)[1] ; Dzitac, S (Dzitac, Simona)[1] ; Vesselenyi, T (Vesselenyi, Tiberiu)[1] ; Dzitac, I (Dzitac, Ioan)[2,

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INTERNATIONAL JOURNAL OF INFORMATION TECHNOLOGY & DECISION MAKING

Volume: 13 **Issue:** 3 **Pages:** 623-647

DOI: 10.1142/S0219622014500576

Published: MAY 2014

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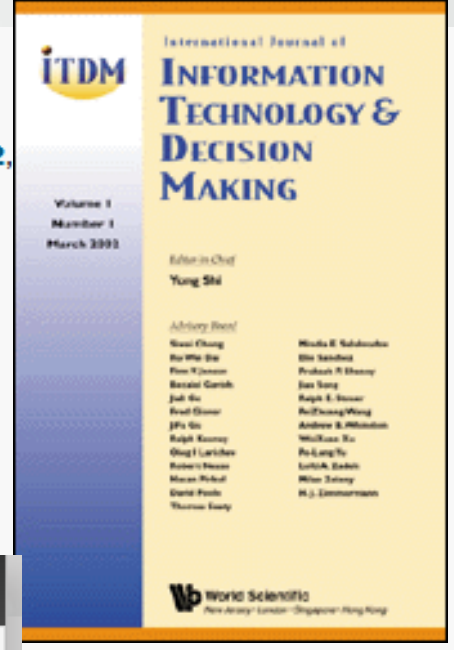

Key Indicators

Year	Total Cites Graph	Journal Impact Factor Graph	Impact Factor Without Journal Self Cites Graph	5 Year Impact Factor Graph	Immediacy Index Graph	Citable Items Graph	Cited Half-Life Graph	Citing Half-Life Graph	Eigenfacto Score Graph	Article Influence Score Graph	% Articles in Citable Items Graph	Normalize Eigenfacto Graph	Average JIF Percentile Graph
2015	627	1.183	1.076	1.502	0.111	45	4.9	9.7	0.00135	0.359	100.00	0.15396	44.493
2014	669	1.406	1.148	1.753	0.434	53	4.8	9.2	0.00161	0.432	100.00	0.18043	57.720
2013	568	1.890	1.310	1.688	0.039	51	4.4	7.9	0.00134	0.359	100.00	0.14752	78.592
2010	534	3.139	0.810	2.191	0.356	45	3.0	7.9	0.00078	0.198	97.78	Not A...	94.913
2009	322	1.312	0.450	1.379	0.133	30	3.6	8.4	0.00076	0.180	100.00	Not A...	56.738
2008	234	0.953	0.418	Not A...	0.125	40	3.7	7.8	0.00030	Not A...	100.00	Not A...	40.361
2007	145	0.718	0.388	Not A...	0	40	3.4	7.7	0.00056	Not A...	97.50	Not A...	42.780
2006	101	0.818	0.428	Not A...	0.022	46	2.6	8.5	Not A...	Not A...	100.00	Not A...	50.434

stochastic uid models
S. Objective functions of
quality of products or the
sturbances which
e indicators.
regards production time
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nce of machine

Some Properties and Applications of Fuzzy Quasi-Pseudo-Metric Spaces

By: Nadaban, S (Nadaban, Sorin)[1] ; Dzitac, I (Dzitac, Ioan)[1,2]

View ResearcherID and ORCID

INFORMATICA

Volume: 27 **Issue:** 1 **Pages:** 141-159

Published: 2016

View Journal Information

Abstract

In this paper we establish some properties c… zy
quasi-metric, which can be applied both in t…
increasing information. We also obtain deco…
pseudo metrics. We develop a topological fo…
space can be considered. Also, we built a fe…
important role on denotational semantics, ar…

Keywords

Author Keywords: fuzzy quasi-pseudo-me…

2012	281	1.117	0.636	1.054	0.086	35	4.1	7.9	0.00096	0.296	100.00	Not A…	66.097
2011	284	1.627	0.853	1.074	0.500	36	3.1	7.5	0.00092	0.263	100.00	Not A…	85.503
2010	312	1.786	0.814	1.186	0.488	41	3.4	7.3	0.00068	0.188	100.00	Not A…	82.359
2009	272	1.040	0.560	0.854	0.382	34	4.1	7.2	0.00054	0.135	100.00	Not A…	53.381
2008	254	0.734	0.544	0.914	0.361	36	4.4	8.4	0.00033	0.076	100.00	Not A…	36.537
2007	96	0.329	0.202	0.405	0.026	39	Not A…	7.0	0.00052	0.118	100.00	Not A…	13.246
2006	72	0.221	0.077	Not A…	0.025	40	Not A…	7.6	Not A…	Not A…	100.00	Not A…	3.937
2005	83	0.456	0.303	Not A…	0.103	39	Not A…	7.6	Not A…	Not A…	100.00	Not A…	28.800
2004	43	0.260	0.068	Not A…	0.026	38	Not A…	7.3	Not A…	Not A…	100.00	Not A…	11.206

Source Data

Rank

Cited Journal Data

Citing Journal Data

Box Plot

Journal Relationships

JCR Impact Factor

JCR Year	COMPUTER SCIENCE, INFORMATION SYSTEMS			MATHEMATICS, APPLIED		
	Rank	Quartile	JIF Percentile	Rank	Quartile	JIF Percentile
2015	60/144	Q2	58.681	47/254	Q1	81.693
2014	86/139	Q3	38.489	115/257	Q2	55.447
2013	80/135	Q3	41.111	98/251	Q2	61.155
2012	55/132	Q2	58.712	66/247	Q2	73.482
2011	30/135	Q1	78.148	18/245	Q1	92.857
2010	34/128	Q2	73.828	22/236	Q1	90.890
2009	68/116	Q3	41.810	72/204	Q2	64.951
2008	71/99	Q3	28.788	98/175	Q3	44.286
2007	79/92	Q4	14.674	146/165	Q4	11.818
2006	85/87	Q4	2.874	143/150	Q4	5.000
2005	64/83	Q4	23.494	100/151	Q3	34.106
2004	68/78	Q4	13.462	148/162	Q4	8.951

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Volume 91, 2016, Pages 823–831

Promoting Business Analytics and Quantitative Management of Technology: 4th International Conference on Information Technology and Quantitative Management (ITQM 2016)

Open Access

Fuzzy TOPSIS: A General View ☆

Sorin Nădăban[a], Simona Dzitac[b, c], Ioan Dzitac[a, c]

Show more

http://dx.doi.org/10.1016/j.procs.2016.07.088

Abstract

The aim of this survey paper is to offer a general view of the developments of fuzzy TOPSIS methods. We begin with a literature review an we explore different fuzzy models that have been applied to the decision making field. Finally, we present some

Special Types of Fuzzy Relations

By: Nadaban, S (Nadaban, S.)[1] ; Dzitac, I (Dzitac, I.)[1,2]

Edited by: Shi, Y; Lepskiy, A; Aleskerov, F

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2ND INTERNATIONAL CONFERENCE ON INFORMATION TECHNOLOGY AND QUANTITATIVE MANAGEMENT, I

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Conference: 2nd International Conference on Information Technology and Quantitative Management (ITQM)

Location: Natl Res Univ, Higher Sch Econ, Moscow, RUSSIA

Date: JUN 03-05, 2014

Sponsor(s): Int Acad Informat Technol & Quantitat Management; Yandex LLC; Chinese Acad Sci, Res Ctr Fictitious Econ & Data Sci; Univ Nebraska Omaha; Global Act Inc; CurrexSole

Abstract

The aim of this paper is to present, in an unitary way, some special types of fuzzy relations: affine fuzzy relations, linear fuzzy relations, convex fuzzy relations, M-convex fuzzy relations. All these fuzzy relations are characterized and we established the inclusions between these classes of fuzzy relations. (C) 2014 Published by Elsevier B.V. Open access under CC BY-NC-ND license.

Keywords

Author Keywords: fuzzy relations; fuzzy multifunctions; fuzzy multivalued mappings; convex fuzzy processes; affine fuzzy relations; linear fuzzy relations; convex fuzzy relations

Identification of ERD using Fuzzy Inference Systems for Brain-Computer Interface

By: Dzitac, I (Dzitac, I.)[1] ; Vesselenyi, T (Vesselenyi, T.)[2] ; Tarca, RC (Tarca, R. C.)[2]

View ResearcherID and ORCID

INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL

Volume: 6 **Issue:** 3 **Pages:** 403-417 **Special Issue:** SI

Published: SEP 2011

View Journal Information

Abstract

A Brain-Computer Interface uses measurements of scalp electric potential (electroencephalography - EEG) reflecting brain activity, to communicate with external devices. Recent developments in electronics and computer sciences have enabled applications that may help users with disabilities and also to develop new types of Human Machine Interfaces. By producing modifications in their brain potential activity, the users can perform control of different devices. In order to perform actions, this EEG signals must be processed with proper algorithms. Our approach is based on a fuzzy inference system used to produce sharp control states from noisy EEG data.

Keywords

Author Keywords: Event Related Desynchronization (ERD); Brain-Computer Interface (BCI); electroencephalography (EEG); fuzzy inference system

KeyWords Plus: FEATURE-EXTRACTION; CLASSIFYING EEG; MOVEMENTS; TASKS; QUANTIFICATION; PERFORMANCE; SIGNALS; LOGIC

Preliminary Issues on Brain-Machine Contextual Communication Structure Development

By: Vesselenyi, T (Vesselenyi, T.)[1]; Dzitac, I (Dzitac, I.); Dzitac, S (Dzitac, S.)[1]; Hora, C (Hora, C.)[1]; Porumb, C (Porumb, C.)[1]

Book Group Author(s): IEEE

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SOFA 2009: 3RD INTERNATIONAL WORKSHOP ON SOFT COMPUTING APPLICATIONS, PROCEEDINGS

Pages: 35-40

Published: 2009

Conference

Conference: 3rd International Workshop on Soft Computing Applications

Location: Szeged, HUNGARY

Date: JUL 29-AUG 01, 2009

Sponsor(s): IEEE Computat Intelligence soc; IEEE Hungary Sect; EUROFUSE; Hungarian Fuzzy Assoc; BMT Resources; Grupul Scolar Transporturi Auto, Henri Coanda Arad

Abstract

The increasing sophistication of computer programs and communication systems requires the development of more efficient and interactive human-computer interfaces. One solution to this problem could be the brain - machine interfaces. The aim of this paper is to explore the possibilities of using context dependent interpretations of EEG signals, in addition to signal processing techniques.

ICCCC 2008 & EWNLC 2008 celebrates Bardeen's Centenary and welcomes Professor Zadeh

By: Dzitac, I (Dzitac, Ioan)

View ResearcherID and ORCID

INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL
Volume: 3 **Pages:** 16-25 **Supplement:** S
Published: 2008
View Journal Information

Abstract

This edition of International Conference on Computers, Communications and Control, ICCCC 2008 [1], together with the satellite-event Exploratory Workshop on Natural Language Computation, EWNLC 2008 [2]: "From Natural Language to Soft Computing: New Paradigms in Artificial Intelligence", celebrates the Centenary of John Bardeen (19081991) [3-24], the co-inventor of the transistor, a very important element in the development of the computers and the communications.

ICCCC 2008 and EWNLC 2008 are honored to have a special guest as keynote speaker in the person of a famous scientist, Dr. Lotfi A. Zadeh [25-32], professor at Berkeley University of California. His Fuzzy Set Theory (1965), Fuzzy Logic Theory (1973) and the next contributions on Soft Computing (1990), Human-Machine Perception (2000) and Natural Language Computation are of a capital importance in the actual mathematics, computer science and technological applications (from the home intelligent e-devices to guiding-computers for missiles).

Other thirteen international scientists are present at this event as plenary ICCCC 2008 keynote speakers and as invited EWNLC 2008 speakers: Vasile Baltac (National School of Political Studies and Public Administration, Bucharest, Romania), Boldur Barbat (Lucian Blaga University, Sibiu, Romania), Pierre Borne (Ecole Centrale de Lille, France), Ioan Buciu (University of Oradea, Romania), Florin Gheorghe Filip (Romanian Academy, Bucharest Romania), Janos Fodor (Budapest Tech, Hungary), Gaston Lefranc (Pontifical Catholic University of Valparaiso, Chile), Stephan Olariu (Old Dominion University, United States of America), Gheorghe Paun (Institute of Mathematics of Romanian Academy, Bucharest, Romania and University of Seville, Spain), Dragan Radojevic (Mihailo Pupin Institute, Beograd, Serbia), Athanasios D. Styliadis (ATEI, Thessaloniki, Greece), Horia-Nicolai Teodorescu (Gheorghe Asachi Technical University of Iasi, Romania), Dan Tufis (Research Institute for Artificial Intelligence of the Romanian Academy, Romania).

On a fuzzy linguistic approach to solving multiple criteria fractional programming problem

By: Pop, B (Pop, Bogdana)[1] ; Dzitac, I (Dzitac, Ioan)[2]

View ResearcherID and ORCID

INTERNATIONAL JOURNAL OF COMPUTERS COMMUNICATIONS & CONTROL

Volume: 1 **Pages:** 381-385 **Supplement:** S

Published: 2006

View Journal Information

Abstract

Mathematical model of multiple objective linear fractional programming problem is analyzed with respect to linguistic variables based solving methods. Two propositions are formulated related to choosing possibilities of aggregation coefficients for fractional criteria' membership functions. Computational results are developed in order to highlight theoretical remarks related to membership functions' for efficiency needed properties.

Keywords

Author Keywords: fuzzy optimization; linguistic variable; mufti-objective programming; linear fractional programming

PRELEGERE

Aplicații ale matematicii fuzzy în metodele de luare a deciziilor

Candidat: Ioan Dziţac

1. Contribuții personale în folosul comunității științifice: IJCCC, ICCCC, Conferințe internaționale invitate
2. Rezumat
3. Literatura în domeniu
4. Contribuții personale în domeniu
5. Paradigme specifice
6. Concluzii

Artificial Intelligence and Soft Computing

- In the near future *Artificial Intelligence* (AI) will surpass human intelligence in more and more domains.
- Indeed, based on *soft computing*, fuzzy control, bio-inspired computing, computational theory of perceptions and computation in natural language, Artificial Intelligent computers can write their own programs as they encounter situations and try different ways to achieve a goal.

Decisions in well/ill posed problems

- Artificial Intelligent machines (*net-centric automobiles, intelligent aircraft, intelligent home utilities, intelligent learn labs, entertainment devices, military defense arms, health applications*), will be a commonplace.
- Humans have a remarkable *capability to reason and make decisions* in an environment of imprecision, uncertainty and partiality of knowledge, truth and class membership.
- It is this capability that is needed to achieve *human-level machine intelligence*. Achievement of human-level machine intelligence is beyond the reach of existing AI techniques and more of these are *based on fuzzy sets theory and fuzzy logic*.

FUZZY SETS (Genesis)

Lotfi A. Zadeh said: *"In July of 1964, I was attending a conference in New York and was staying at the home of my parents. They were away. I had a dinner engagement but it had to be canceled. I was alone in the apartment. My thoughts turned to the unsharpness of class boundaries. It was at that point that the simple concept of a fuzzy set occurred to me. It did not take me long to put my thoughts together and write a paper on the subject. This was the genesis of fuzzy set theory.*

I knew that the word "fuzzy" would make the theory controversial. Knowing how the real world functions, I submitted my paper to Information and Control because I was a member of the Editorial Board. There was just one review-which was very lukewarm. I believe that my paper would have been rejected if I were not on the Editorial Board. Today (20 Dec. 2010), with over 26,000 Google Scholar citations (cca. 60,000 on 1 Dec. 2015), "Fuzzy Sets" is by far the highest cited paper in Information and Control. "

Zadeh, L.A. (2011); My Life and Work - A Retrospective View, Special Issue on Fuzzy Set Theory and Applications, Dedicated to the 90th Birthday of prof. Lotfi A. Zadeh, *Aplied and Computational Mathematics, 10(1):4-9, 2011.*

Intuitionistic Fuzzy Sets

Definition 2 (Atanassov, 1999): Let X be a nonempty set. An intuitionistic fuzzy set A in X is an object having the form $A = \{\langle x, \mu_A(x), \nu_A(x)\rangle : x \in X\}$, where the functions $\mu_A(x), \nu_A(x): X \longrightarrow [0,1]$ define respectively, the degree of membership and degree of non-membership of the element $x \in X$ to the set A, which is a subset of X, and for every element $x \in X, 0 \leq \mu_A(x) + \nu_A(x) \leq 1$. Furthermore, we have $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ called the intuitionistic fuzzy set index or hesitation margin of x in A. $\pi_A(x)$ is the degree of indeterminacy of $x \in X$ to the IFS A and $\pi_A(x) \in [0,1]$ i.e., $\pi_A(x): X \longrightarrow [0,1]$ and $0 \leq \pi_A \leq 1$ for every $x \in X$. $\pi_A(x)$ expresses the lack of knowledge of whether x belongs to IFS A or not.

For example, let A be an intuitionistic fuzzy set with $\mu_A(x) = 0.5$ and $\nu_A(x) = 0.3 \Rightarrow \pi_A(x) = 1 - (0.5 + 0.3) = 0.2$. It can be interpreted as "the degree that the object x belongs to IFS A is 0.5, the degree that the object x does not belong to IFS A is 0.3 and the degree of hesitancy is 0.2".

As a result, we need fuzzy numbers to express linguistic variables, to describe the subjective judgement of a decision maker in a quantitative manner. Fuzzy numbers (FN) most often used are triangular FN, trapezoidal FN and Gaussian FN.
We highlight that the concept of linguistic variable introduced by Zadeh in 1975

Zadeh LA. The concept of a linguistiv variable and its application to approximate reasoning - I. *Information Sciences* 1970; **8**: 199–249.

allows computation with words instead of numbers and thus linguistic terms defined by fuzzy sets are intensely used in problems of decision theory for modeling uncertain information.

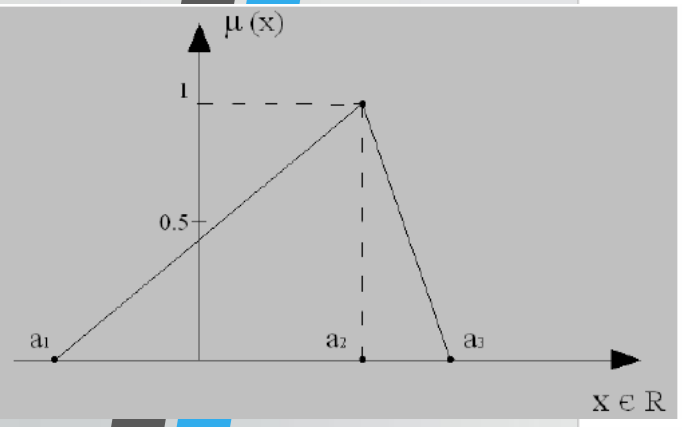
Definition

A fuzzy number (FN) is a fuzzy set in $\mathbb{R}$*, namely a mapping* $x : \mathbb{R} \to [0, 1]$*, with the following properties:*

1. x *is convex, i.e.* $x(t) \geq \min\{x(s), x(r)\}$*, for* $s \leq t \leq r$*;*
2. x *is normal, i.e.* $(\exists) t_0 \in \mathbb{R} \ : \ x(t_0) = 1$*;*
3. x *is upper semicontinuous, i.e.*

$$(\forall) t \in \mathbb{R}, (\forall) \alpha \in (0, 1] \ : \ x(t) < \alpha, (\exists) \delta > 0$$

$$\text{such that } |s - t| < \delta \Rightarrow x(s) < \alpha \ .$$



Ioan Dziţac, *Inteligenţă artificială*, 2008

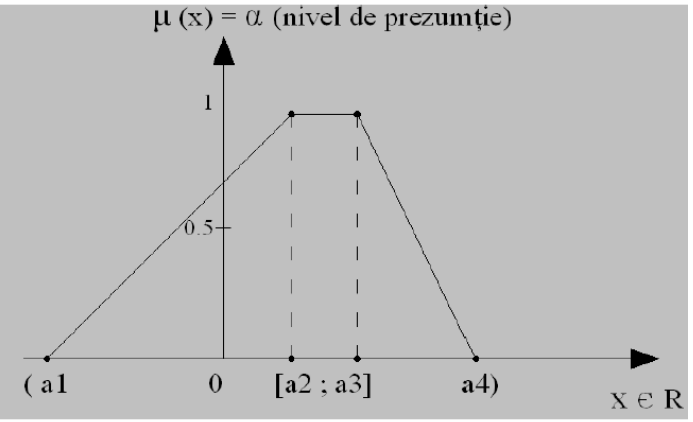


Figura 2.1.5. Număr fuzzy trapezoidal (*P*)

Remark

Among the various types of FNs, triangular FNs and trapezoidal FNs are the most popular. A triangular FN is defined by its membership function

$$x(t) = \begin{cases} 0 & \text{if} \quad t < a \\ \frac{t-a}{b-a} & \text{if} \quad a \leq t < b \\ \frac{c-t}{c-b} & \text{if} \quad b \leq t < c \\ 0 & \text{if} \quad t > c \end{cases}$$

, where $a \leq b \leq c$ *, and it is denoted* $\tilde{x} = (a, b, c)$.

A trapezoidal FN is defined by its membership function

$$x(t) = \begin{cases} 0 & \text{if} \quad t < a \\ \frac{t-a}{b-a} & \text{if} \quad a \leq t \leq b \\ 1 & \text{if} \quad b < t < c \\ \frac{d-t}{d-c} & \text{if} \quad c \leq t \leq d \\ 0 & \text{if} \quad t > d \end{cases}$$

, where $a \leq b \leq c \leq d$ *, and it*

can be expressed as $\tilde{x} = (a, b, c, d)$

Similarly, alternatives can be evaluated by linguistic terms which can be represented by triangular FNs

Chen CT. Extension of the TOPSIS for group decision-making under fuzzy environment. *Fuzzy Sets and Systems* 2000; **114**: 1–9.

Table : Linguistic terms for alternatives ratings

Linguistic terms for alternatives ratings	Triangular FN
Very good	(9,10,10)
Good	(7,9,10)
Medium	(3,5,7)
Poor	(1,3,5)
Very poor	(1,1,3)

Table : Fuzzy preference scale

Linguistic value	Triangular FN ($\tilde{a}_{ij}$)
Absolutely important	(7,9,9)
Very strongly extreme important	(6,8,9)
Very strongly important	(5,7,9)
Strongly important	(4,6,8)
Moderately strong important	(3,5,7)
Moderate important	(2,4,6)
Weakly important	(1,3,5)
Equally moderate important	(1,2,4)
Equally important	(1,1,3)

It is often difficult for decision makers to assign a precise value to an alternative for the criteria considered. In this situation the fuzzy MCDM problem can be expressed by the decision matrix

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{11} & \tilde{x}_{12} & \cdots & \tilde{x}_{1n} \\ \tilde{x}_{21} & \tilde{x}_{22} & \cdots & \tilde{x}_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ \tilde{x}_{m1} & \tilde{x}_{m2} & \cdots & \tilde{x}_{mn} \end{bmatrix}, \tag{3}$$

where $\tilde{x}_{ij}$ are fuzzy value (triangular FN, trapezoidal FN, IFS, IVIFS, trapezoidal hesitant fuzzy element etc.)

FUZZY LOGIC

The term *"fuzzy logic"* emerged in the development of the theory of fuzzy sets by Lotfi Zadeh (1965). A fuzzy subset *A* of a (crisp) set *X* is characterized by assigning to each element *x* of *X* the *degree of membership* of *x* in *A* (e.g., *X* is a group of people, *A* the fuzzy set of *old* people in *X*).

Now if *X* is a set of propositions *degree of truth* then its elements may be assigned their, which may be "absolutely true," "absolutely false" or some *intermediate truth degree*: a proposition may be more true than another proposition. This is obvious in the case of *vague (imprecise)* propositions like "this person is old" (beautiful, rich, etc.).

Two main directions in fuzzy logic have to be distinguished (cf. Zadeh 1994).

1. ***Fuzzy logic in the broad sense*** (older, better known, heavily applied but not asking deep logical questions) serves mainly as apparatus for fuzzy control, analysis of vagueness in natural language and several other application domains. It is one of the techniques of *soft-computing*, i.e. computational methods tolerant to suboptimality and impreciseness (vagueness) and giving quick, simple and *sufficiently good* solutions.

   The monographs Novak 1989, Zimmermann 1991, Klir-Yuan 1996, Nguyen 1999 can serve as recommended sources of information.

2. Fuzzy logic in the narrow sense is symbolic logic with a comparative notion of truth developed fully in the spirit of classical logic (syntax, semantics, axiomatization, truth-preserving deduction, completeness, etc.; both propositional and predicate logic). It is a branch of *many-valued logic* based on the paradigm of *inference under vagueness*.
This fuzzy logic is a relatively young discipline, both serving as a foundation for the fuzzy logic in a broad sense and of independent logical interest, since it turns out that strictly logical investigation of this kind of logical calculi can go rather far.

A basic monograph is Hajek 1998, further recommended monographs are Turunen 1999, Novak *et al*. 2000; also recent monographs dealing with many-valued logic (not specifically oriented to fuzziness), namely Gottwald 2001, Cignoli *et al*. 2000a; are highly relevant.

SOFT COMPUTING

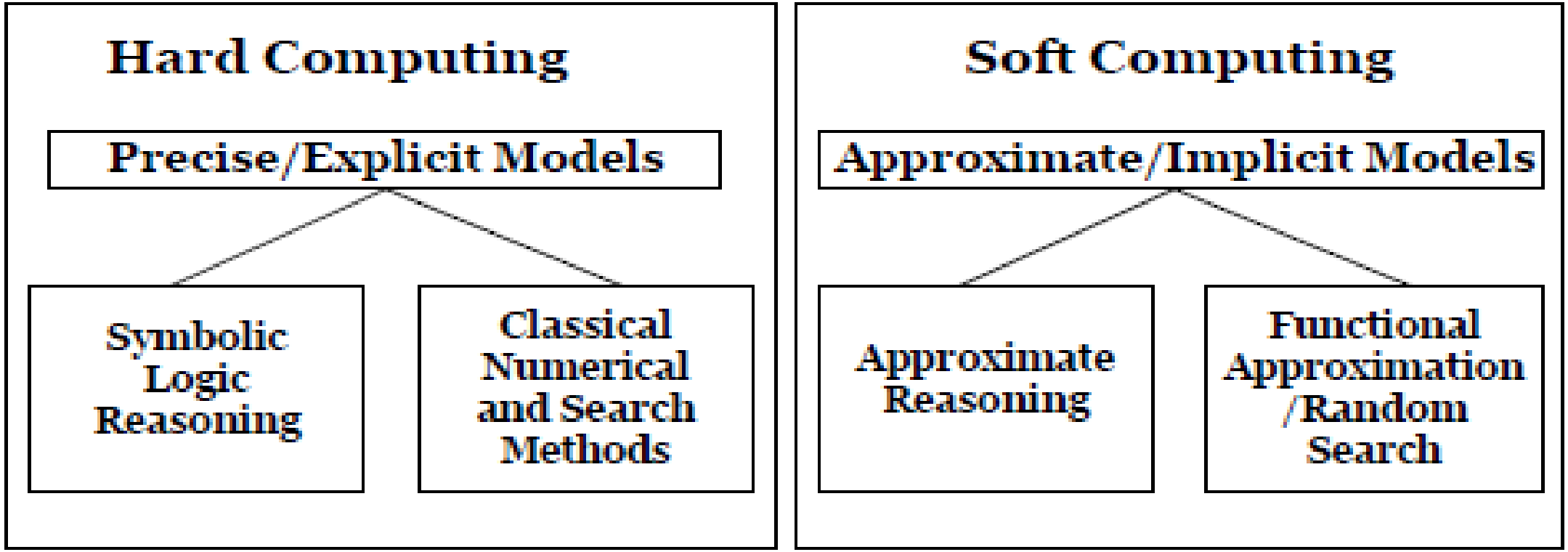
Soft computing differs from *conventional (hard)* computing in that, unlike *hard computing*, it is tolerant of *imprecision*, *uncertainty*, *partial truth*, and *approximation*. In effect, the role *model for soft computing* is the *human mind.*

The guiding principle of soft computing is: Exploit the tolerance for imprecision, uncertainty, partial truth, and approximation to achieve tractability, robustness and low solution cost.

- The basic ideas underlying soft computing in its current incarnation have links to many earlier influences, among them Zadeh's 1965 paper on fuzzy sets;
- The 1973 paper on the analysis of complex systems and decision processes; and the 1979 report (1981 paper) on possibility theory and soft data analysis.
- The inclusion of *neural computing* and *genetic computing* in soft computing came at a later point.

The principal constituents of Soft Computing (SC) are:

1. Fuzzy Logic (FL),
2. Neural Computing (NC),
3. Evolutionary Computation (EC)
4. Machine Learning (ML) and
5. Probabilistic Reasoning (PR),
6. with the latter subsuming *belief networks*, *chaos theory* and parts of *learning theory*.



[Magdalena, 2010]

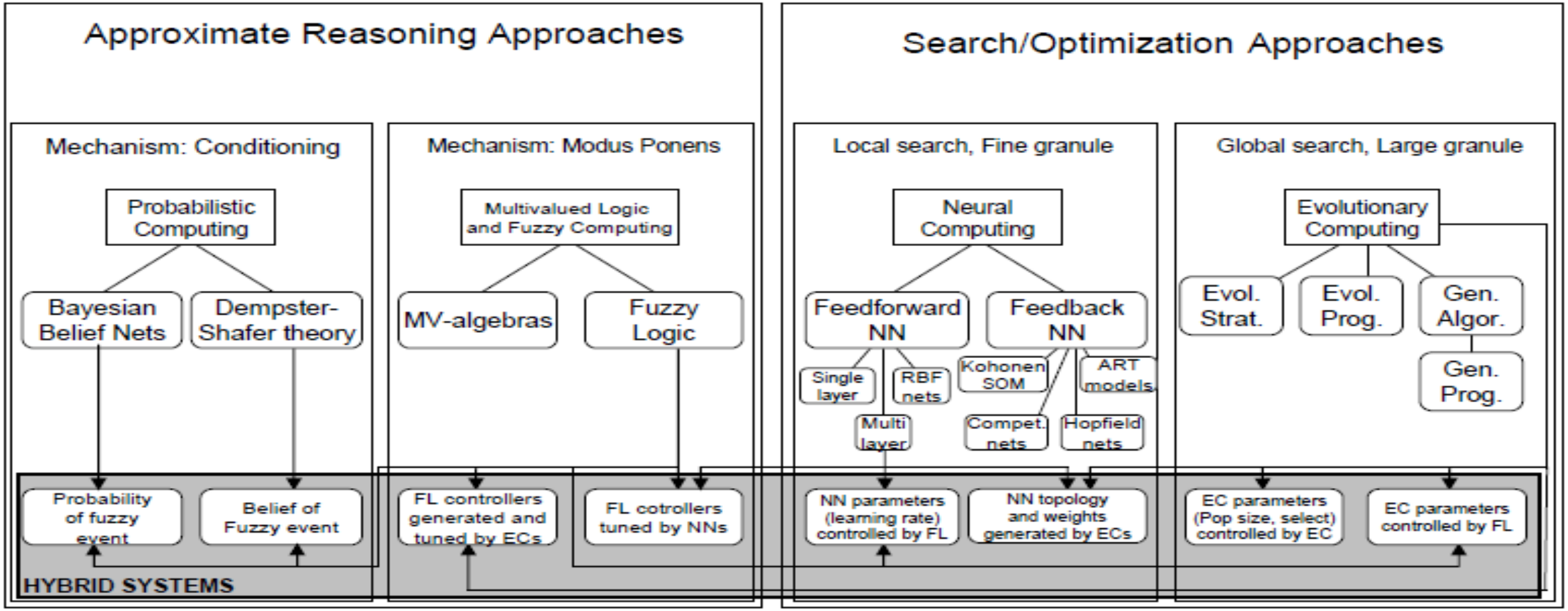


Fig. 1. Hybridization in Soft Computing according to Bonissone et al.[3].

[Magdalena, 2010]

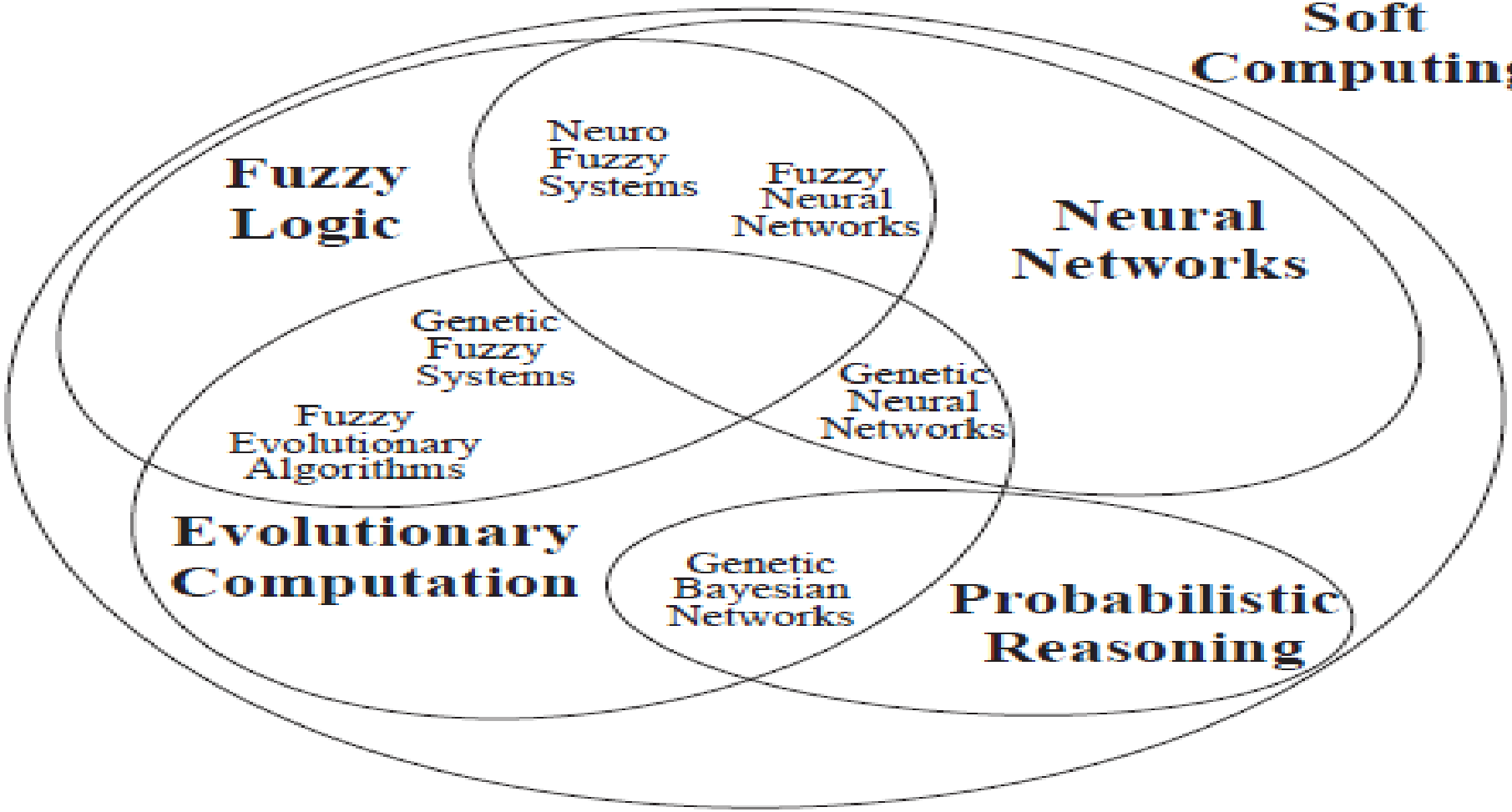


Fig. 2. A graphical view of Hybridization according to Cordón et al.[4].

Table 2: "Zadeh-Word-Oriented" paradigm vs. "Kelvin-Number-Oriented" paradigm

"Kelvin-Number-Oriented"	**"Zadeh-Word-Oriented"**
Deterministic environment (closed, static, known)	*Nondeterministic* environment (open, dynamic, uncertain)
Well-defined *problem* (quantity, precision, certainty)	Fuzzy-defined *Situation* (quality, imprecision, uncertainty)
Solving accurately problems (imperative, firm, reliable)	*Managing* "Just In Time" situations (descriptive, flexible, robust)
Optimal, lasting, *solution* (algorithmic, apodictic, general)	Suboptimal, temporary, *answer* (non-algorithmic, revisable, local)
Technocentric design Software entity: *PROGRAM* (*object devised as tool*)	*Anthropocentric* design Software entity: *AGENT* (*process devised as interactant*)
Client-Server paradigm (object-oriented, sequential)	*"Computing as Interaction"* paradigm (agent-oriented, parallel)

[Dzitac & Barbat, 2008]

PRELEGERE
Aplicații ale matematicii fuzzy în metodele de luare a deciziilor

Candidat: Ioan Dziţac

1. Contribuții personale în folosul comunității științifice: IJCCC, ICCCC, Conferințe internaționale invitate
2. Rezumat
3. Literatura în domeniu
4. Contribuții personale în domeniu
5. Paradigme specifice
6. Concluzii

CONCLUSIONS

A Frontier in Human Reasoning: Mental Rubicon*

HARD COMPUTING (HC)

1H. **well-posed problems**

2H. **HC**, i.e., conventional computing, requires a precisely stated analytical model and often a lot of computation time.

SOFT COMPUTING(SC)

1S. **ill-posed problems**

2S. **SC** differs from HC, it is tolerant of imprecision, uncertainty, partial truth, and approximation. In effect, the role model for soft computing is the human mind.

*__Rubicon__ = the name of a shallow river in northeastern Italy, just south of Ravenna, and the name historically given to a river that was famously crossed by Julius Caesar in 49 B.C.

HC

3H. based on binary logic, crisp systems, numerical analysis and crisp software

4H. precision and categoricity

5H. requires exact input data

6H. is strictly sequential

7H. produces precise answers

SC

3S. based on fuzzy logic, neural nets and probabilistic reasoning

4S. approximation and dispositionality

5S. can deal with ambiguous and noisy data

6S. allows parallel computations

7S. can yield approximate answers

- Some scientists, especially philosophers and mathematicians, had attempted to formalize the process of *logical deduction.* Their work culminated in the invention of the programmable digital computer, a machine based on the abstract essence of mathematical reasoning. This machine and the ideas behind it inspired a handful of scientists to begin seriously discussing the possibility of building an *artificial brain.*
- The success of the research in *fuzzy logic* undertaken has been demonstrated in a variety of areas such as*: artificial intelligence*, computer science, quantum particle physics, control engineering, robotics and many others.

- Multi-Criteria Decision Making (MCDM) appear and are intensely applied in many domains, such as *Economics*, *Social Sciences*, *Medical Sciences* etc. Sometimes, MCDM problems are mentioned as Multiple-Criteria Decision Analysis (MCDA) or Multi-Attribute Decision-Making (MADM).
- In spite of their diversity, the MCDM have as common characteristic multiple objectives and multiple criteria which usually are in conflict with each other. The decision makers have to select, assess or rank these alternatives according to the weights of the criteria.
- In the last decades the MCDM techniques have become an important branch of operations research.

• As a generalization of the concept of the classic set, fuzzy set, *intuitionistic fuzzy* set etc., Smarandache firstly proposed the concept of *neutrosophic set*. Recently, neutrosophic sets have been applied in MCDM.

[1] Smarandache F. , *A unifying field in logics. Neutrosophy: Neutrosophic probability, set and logic. American Research Press Rehoboth*, 1999.
[2] Antucheviciene J, Hajiagha SHR, Hashemi SS. Extension of weighted aggregated sum product assessment with interval valued intuitionistic fuzzy numbers (WASPAS-IVIF). *Applied Soft Computing 2014; 24: 1013–1021.*
[3] Zavadskas EK, Bausys R, Lazauskas M. Sustainable Assessment of Alternative Sites for the Construction of a Waste Incineration Plant by Applying WASPAS Method with Single-Valued Neutrosophic Set. *Sustainability 2015; 7: 15923–15936.*

Torra and Narakawa [5] and Torra [4] introduced the concept of *hesitant fuzzy set*, which undergoes a much more flexible approach for decision makers when they provide their decisions. Therefore, hesitant fuzzy sets have become useful in MCDM problems [6, 7].

[4] Torra V. Hesitant fuzzy sets. *International Journal of Intelligent Systems 2010; 25(6): 529–539.*

[5] Torra V, Narukawa Y. On hesitant fuzzy sets and decision. *In Proceeding of the 18th IEEE International Conference on Fuzzy Systems,* Jeju Island, Korea, 2009; 1378–1382.

[6] Qin J, Liu X, Pedrycz W. Frank aggregation operators and their application to hesitant fuzzy multiple attribute decision making. *Applied Soft Computing 2016; 41: 428–452.*

[7] Rodrıguez RM, Martınez L, Herrera F. Hesitant fuzzy linguistic term sets for decision making. *IEEE Transaction on Fuzzy System 2012;* 20(1): 109–119.

Vă mulțumesc pentru atenție!

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