Mathware & Soft Computing

The magazine of the European Society for Fuzzy Logic and Technology

Dialogue between Mirko Navara and Vilem Novak
by Mirko Navara and Vilem Novak

EUSFLAT congratulates
by Martin Stepnicka

25th Anniversary of IJUFKS
by Bernadette Bouchon-Meunier

News and calls

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EUSFLAT
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Message from the Editor-in-Chief (June 2019)

HUMBERTO BUSTINCE

As usual, at the same time the summer arrives, we put in your hands the new issue of the Mathware&Soft Computing online magazine. This issue is just a few weeks in advance of our next EUSFLAT conference, which, do not forget, will be held in Prague next September.

In this issue, promoted by our president, Martin, we start a new section, in order to give publicity to the different awards and recognitions that the members of our community receive. So, please, let us know any prize that you consider that must be included so that we can congratulate ourselves for our successes!

This year the International Journal of Uncertainty, Fuzziness and Knowledge-based Systems is celebrating its 25 anniversary. All of us know this journal is a reference for our community, and have made a great work disseminating the research work in fuzzy theory and applications along the years. For this reason, we have considered it should appear here, in the pages of our magazine, so that all the readers can join saying Congratulations.

Of course, as in every issue, two great figures of the fuzzy community share with us their works, their opinions, their points of view...In this issue, these two giants of our community are Mirko Navara and Vilem Novak, and I can only say thanks to them for a great, interesting talk that I know all of us will enjoy reading.

And clearly, we also include news, informations and conference summaries. Because Mathware&Soft Computing is always trying to provide any relevant information it can for the fuzzy community. And recall that, the more you collaborate sending us your contributions, the better and more complete this magazine will be. So, please, do not hesitate to contact for anything of interest you may consider because we are willing to include it in our pages!

And now I think it is time to leave you with the contents of this issue. I hope you enjoy these pages as a good start for the summer which is just starting!.

Humberto Bustince
Editor-in-chief

Message from the President (June 2019)

MARTIN ŠTĚPNIČKA

Dear EUSFLAT members,

beautiful summer is here and we are entering an amazing period of the year. A period full of joy, free time without lecture duties, leisure time with families, and exciting conference trips. When reading these lines, highly probably you are already attending the IFSA/NAFIPS in Lafayette, or even moving to New Orleans to continue with FUZZ-IEEE Conference. This American trip to attend two of the major events in our community in the world âĂŞ both of them being EUSFLAT endorsed events âĂŞ offers an attractive start to the conference season this year and I look forward to meeting as many of you as possible there.

After coming back and spending the holidays, we will have the opportunity to take part on our domestic event âĂŞ the EUSFLAT 2019 Conference in Prague. We tried to introduce several new (or renewed) points related to this event and based on the first numbers, it seems that the direction setup by these decisions is viable. In particular, trying to offer a wide variety of contributions and allowing people to participate without writing long conference full papers, if they are not sufficiently appreciated by distinct university or state publication systems more and more focusing only on journals, we offered participants to submit only abstracts and to save time and efforts. Finally, we have obtained 223 submissions in total out of which 66 abstracts constituted an essential part. This fully convinced us that offering both options is a meaningful option for future though some details will need to be clarified and polished. Also the fact that the registration fee for non-members includes the EUSFLAT membership for the current and the upcoming year turned out to bring the expected benefits. Now, it is the time to work hard on preparing the event locally in such a quality that you all will enjoy the event as much as possible.

Regarding the innovations that EUSFLAT Society is preparing for you, it is important to inform you about new systems. The old website is running significantly more than 10 years and the same holds for the private area, i.e., the membership management system. Both parts are extremely old and incompatible with latest versions of technologies running on current servers. And both parts are very important for you. Right at these days, we are close to finish both systems and place them on a commercial and safe hosting, that will allow to run new the web and the system with new functionalities and to be maintained or updated from anywhere in the world. What you will see in the first phase is surely not the final phase, we expect to continue in developing new functionalities of the system in the future. Here, it is my duty and mainly my pleasure to express my gratitude to Petr Hurtík, Marek Malina, and Marek Vajgl from the University of Ostrava for their developer jobs, and to our Board members Daniel Sánchez and Susana Montes for their amazing cooperation and never-ending support.

I hope that the increasing quality and innovation of services provided to the Society members will be the best motivation for staying with us and for attracting new and new members to enter. We will gladly welcome new friends.

Looking forward to meeting you in Prague.

Ostrava, Czech Republic, June 7, 2019

Martin Štěpnička
President of EUSFLAT

INTERVIEW

Dialogue between Mirko Navara and Vilem Novak

The two people participating in this interview have much in common. Both studied engineering before they decided to do (only) mathematics. They both wrote textbooks on fuzzy sets in Czech. And, as you see, they share a lot of common opinions on this topic and its importance, although, despite their extensive lists of coauthors, they have no common paper.

MIRKO NAVARA: How did you "convert" to mathematics after engineering studies?

VILEM NOVAK: I was not really "converting" because I studied system engineering and we had a lot of mathematics there. Moreover, in the fourth year, I decided to focus even more on mathematics, and I began to study myself (in our times, the university study always lasted five years, i.e., we had no bachelors). I even continued self-study of mathematics during my military service whenever I had free time. I was interested mainly in the probability theory, but I also learned very much from the book by Kolmogorov and Fomin: Foundations of the Theory of Functions and Functional Analysis and other ones. In 1982 I began to study Ph.D. in Faculty of Mathematics and Physics at Charles University in Prague, and I finished it (successfully) in 1988.

M.N.: I "converted" twice, there and back. I was always keen on mathematics, so it was a surprise for my schoolmates that I went to the Faculty of Electrical Engineering, instead of the expected Faculty of Mathematics and Physics. My older sister graduated at the latter and had problems to find a job. Thus, she emigrated to the USA. That was one reason for my choice; the second was the preference of my father to apply mathematics in some engineering discipline, and electrical engineering was another of my hobbies.

However, soon after beginning my university studies, I was attracted to pure mathematics by Pavel Pták. After finishing the master degree in engineering, I returned fully to mathematics. One of the advantages was that this could be done at the level comparable to the world, while engineering suffered from a lack of up-to-date equipment, both hardware and software.

The book by Kolmogorov and Fomin mentioned above was also crucial for me, together with the Sikorski's Boolean Algebras.

M.N.: What attracted you to fuzzy sets?

V.N.: After finishing the compulsory military service, I started to regularly visit the scientific library and read everything that seemed interesting to me. During that time, I unexpectedly found one paper on fuzzy sets. Their idea attracted me. Therefore, I continued to search still other and other papers on this topic. Very influential for me was the paper by B. R. Gaines: Foundations of fuzzy reasoning. In 1977 my friend Jiří Ivánek showed me Ph.D. thesis of Jan Pavelka, who developed the first well established mathematical theory of fuzzy logic. His thesis has a very high mathematical level, and he obtained brilliant results. The thesis was published in 1979 in Zeitschrift für Mathematische Logik und Grundlagen der Mathematik and in fact it was the starting point for me to

study mathematical logic and to develop the fuzzy version of the predicate logic based on the results of Pavelka.

V.N.: Do you remember the first moment when you met fuzzy sets? Which paper was it? What was your first thought at this concept?

M.N.: Under the supervision of Pavel Pták, we studied "quantum structures", i.e., mathematical models of events admitting effects studied in quantum theory. We continue until now. This led us to specialized conferences, among them Winter Schools on Measure Theory, organized in Slovakia in 1988âĂŞand 1990. These collected experts both in quantum structures and fuzzy logic. (Later on, they continued by the series of conferences Fuzzy Sets Theory and Applications, FSTA, see also below, which are organized biennially till now.) Thus we met with some "strange people" speaking about fuzzy sets. Among them, Radko Mesiar could not be neglected because of his enormous enthusiasm. For some time, we ignored this community, having a similarly critical opinion as many others. As a part of my duties, I reviewed some works dealing with "soft fuzzy algebras", an approach initiated by Krzystof Piasecki. With Pavel Pták, we realized that we would do it differently and we could solve some open problems. This attracted us to the topic, and at the next conference, we contributed to the session on fuzzy sets. Later on, this approach appeared as a "dead branch"; we concluded that many results were enabled by the fact that this model was "classical up to a set of measure zero"; thus not much attractive anymore, although even now people are studying it.

Then we found a more exciting and promising approach to measure theory on systems of fuzzy sets. Dan Butnariu and Erich Peter Klement in the book Triangular Norm-Based Measures and Games with Fuzzy Coalitions. I consider it one of the significant contributions showing that mathematics of fuzzy sets can be a piece of deep scientific work.

One cannot omit the book Metamathematics of Fuzzy Logic by Petr Hájek.

For my professional development, the fellowships with Erich Peter Klement in Linz were crucial and very inspiring.

V.N.: A small remark: do you know that it was me who typeset the book by Butnariu and Klement in LaTeX before Peter learned to do it himself? This is a very good book, but it stands aside my interests.

V.N.: What attracted you most on the idea of fuzzy sets?

M.N.: As I said, I was not keen on fuzzy sets from the very beginning. However, I found them interesting from both mathematical and practical points of view. The main reason for their success is, in my opinion, that fuzzy systems may serve as a man-machine interface. They offer a language understandable by both people and computers. Earlier, machines were successfully applied to exact arithmetical computations and logical tasks. This was an important achievement replacing a lot of human work. However, people do not always aim at high precision. What is essential in many tasks is a complex system of vague rules used in everyday life, e.g., in cooking, driving, evaluating. An exact formulation of all inputs and their relations to outputs is not feasible, but also not necessary for a useful solution. Fuzzy sets offer a tool which allows to formulate the principles and make them understandable for computers, too. This idea is not so ingenious, but it works quite well in practice. Thus fuzzy sets should be considered an alternative to the exact algorithmic approach. (Although the final result is an algorithm in both cases.)

M.N.: Who influenced your career most?

V.N.: These were two people: Petr Vopěnka and Petr Hájek. You know that P. Vopěnka was the world-renowned specialist in set theory who deeply criticized some principles of classical sets, especially the concept of actual infinity. He, with his group, began to develop a new set theory - they called it The Alternative Set Theory. I remember moments when, during my study of his first book Mathematics in the Alternative Set Theory, I was very deeply astonished by his ideas almost on every page. To be frank, since then I cannot but see results of classical mathematics via the prism of AST.

Petr Hájek is another person who influenced me and raised my interest in mathematical logic. We became friends and had many discussions. It is interesting that he, except for Pavelka's work, was very reluctant towards fuzzy sets and fuzzy logic. It took me a long time to persuade him that fuzzy logic provides a mathematical model of the vagueness phenomenon and that it is different from probability. I remember his shining eyes when, during one of such discussions (it

was in 1992), he suddenly caught this idea. Then he began to study fuzzy logic more deeply, and his interest was crowned by his excellent book Metamathematics of Fuzzy Logic.

M.N.: From which sources you studied fuzzy logic at the beginning before you wrote the first Czech book on this topic?

V.N.: As I already said, I read many papers that I was able to find in the scientific library. Do not forget that it was the era of communistic power, and we had limited admission to western literature. But I was lucky because, in Ostrava library, there were journals such as Information & Control, Information Sciences, Journal of Cybernetics, and other ones. The second source was the mentioned Pavelka's thesis.

V.N.: You are known as the specialist in t-norm theory. What result of it do you consider as the most interesting? Did you know some of its non-trivial applications?

M.N.: The above-mentioned measure theory on systems of fuzzy sets by Dan Butnariu and Erich Peter Klement has almost all aspects of excellent scientific work. Already Zadeh proposed that a measure of a fuzzy set could be defined as an integral of the membership function. However, this idea lacks a lot of specifications to make it meaningful. First of all, the domain of a measure must be clarified (T-tribes as a generalization of Boolean σ-algebras). The integral already requires some classical measure - where does it come from? And how to define a measure axiomatically? All these questions were answered; satisfactorily and highly non-trivially. The final answer was that the measures are really integrals of membership functions, but now as a consequence of well-motivated axioms. As a by-product, it was found that only some t-norms (the Frank ones) fulfill this purpose. The only missing feature is a real application; as a theoretician, I do not miss it much.

I am also deeply impressed by the life-long contribution of Daniele Mundici on MV-algebras. I was happy to belong to his cooperators.

V.N.: What open problems do you see in your area of research?

M.N.: I consider it unsatisfactory that all attempts to compute with imprecise quantities require more computer time than exact computations. My long-term dream is to change it.

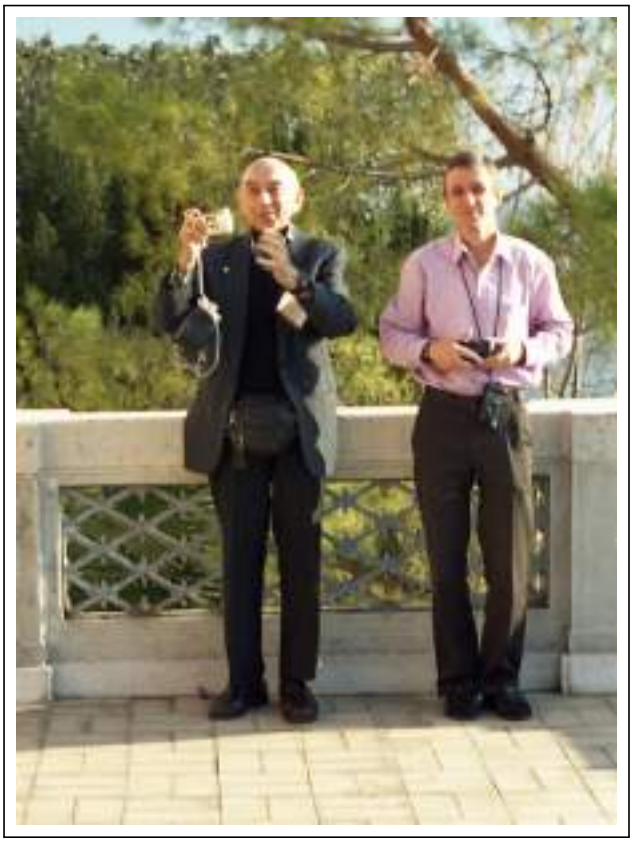
M.N.: How much are you satisfied with the development of fuzzy logic and systems? Does it fulfill your initial expectations?

V.N.: Well, I am not really happy with some of the directions. It seems to me that people forgot the primary goal of the fuzzy sets and fuzzy logic - to provide a mathematical model of the vagueness phenomenon and to develop models of various systems and processes in which this phenomenon manifests itself. Instead, we see still new and new "kinds" of sets, operations with them, etc. The results are mostly technical, without clear motivation and justification and, in fact, not at all interesting. I argue that the idea of fuzzy sets is brilliant because it introduces degrees to be able to approach the vagueness phenomenon tangibly. And the concept of degree is very natural for the human mind. Moreover, it is important to realize that we consider a mathematical model and nothing else because we still do not understand well, what vagueness in fact is and why do we face it. The theorists in mathematical fuzzy logic demonstrated that this model is excellent and works well in all known situations when the vagueness is encountered. I am convinced that no other "kind" of a (fuzzy?) set can do the job better and so, the work on them is only a waste of time.

V.N.: Do you think that the development of the theory of fuzzy sets and fuzzy logic goes in the right direction? What would you suggest?

M.N.: As I explained, I think that fuzzy sets have a role which could hardly be replaced by something else. This is not a solution to all challenges; it is one approach to solving problems. It has a high potential in applications whose requirements are not extremely high, and there are sufficiently many such tasks. The crucial question is whether we shall

dare to apply fuzzy systems in areas requiring extreme reliability, e.g., aircraft industry or nuclear power plants. Twenty years ago, Dan Butnariu asked many experts whether they would fly with a fuzzy controlled airplane; the answers were 50:50. This situation did not change much. I do not think that the use of fuzzy technologies should be considered dangerous. Other approaches are based on "exact solutions of inexact models", and the risk cannot be avoided by precision. There are numerous examples showing that we cannot predict all possible problems and include them in the formulation of the task. Even driving a bike leads to a very complex model which can be solved only under very restrictive and non-realistic assumptions. Nevertheless, even children can cope with it successfully.



V.N.: What is your opinion on special concepts that appear in recent years - hesitant fuzzy sets, soft sets, fuzzy sets of type 2, Atanassov intuitionistic fuzzy sets or even Atanassov intuitionistic fuzzy soft sets?

M.N.: At the beginning, fuzzy sets were a field of easy problems, where new results could be achieved easily. (In contrast to, e.g., Boolean algebras, which can hardly be recommended to postgraduate students who need visible progress in the horizon of several years.) In fuzzy sets, it was easier to pretend new ideas and publish than in other topics. Since that, they are disliked by some mathematicians, ignoring that fuzzy set theory and fuzzy logic contributed by profound and exciting ideas, like other fields of study. The work by Petr Hájek or Dan Butnariu and Erich Peter Klement, mentioned above, are a few of many clear examples of advanced theories dealing with fuzzy sets.

Then attention moved to more general concepts, which

are not exhausted and allow reaching new results quickly, without much in-depth investigation. One can imagine many such opportunities, but one should carefully balance generality with usefulness. Low attention is paid to motivation. Very often the authors introduce a very general notion, and then they restrict to its very special instance, e.g., an analog of triangular membership functions. This can hardly be defended unless a profound theory or successful application is accomplished, and this is rarely the case. (As a positive sample, let us recall The Type-2 Truth Value Algebra by John Harding, Carol Walker, and Elbert Walker.) The reviewers should insist on the satisfaction of high standards in these fields, and they also need a support of the editors, who should not accept a paper when some reviewers suggest acceptation and others rejection. Otherwise, these fields of study will have a bad reputation, which would also harm the whole fuzzy set theory.

V.N.: Do you teach fuzzy sets in your university?

M.N.: I am teaching a course on fuzzy sets since 1996, now only at the postgraduate level.

V.N.: Are your students attracted by the idea of fuzzy logic and fuzzy sets? What do they (dis)like most?

M.N.: This course attracts only students who are interested in it, so the cooperation with them is smooth and inspiring for both sides. They come with different expectations and aims and, each year, I can adjust the course to their needs.

This allowed me to involve some of them in scientific work and educate several young experts who enriched the discipline by their original ideas. They are mostly engineers (some of them "converted to mathematicians", like me). Their background in mathematical theory is not so strong, but this can be compensated, as proven by Rostislav Horčík, who succeeded to contribute to in-depth mathematical and logical research. The "engineering" approach can be turned into an advantage when applied to well-chosen problems. Milan Petrík is a typical example; he dared to go in ways which pure mathematicians considered not sufficiently supported, and he did not see some difficulties. However, this brought new inspiration which, in the end, led to useful results.

M.N.: What do you expect in the future - will it be leading, or diminished by concurrent approaches?

V.N.: Well, I think that the ideas of fuzzy sets and fuzzy logic will still be part of the future theories, whatever they will be. In fact, this happens already now in technology. I remember bright nineties when there was the so-called "fuzzy boom". Companies were one-upping each other in applying fuzzy techniques in their products and, especially, in emphasizing that they were using them. Now, the boom is over, but the fuzzy techniques became part of the standard technology, and nobody is stressing that they are being used. So I think that similar situation will also be in theory and the number of papers with "fuzzy" in their title will decrease, but it will still be part of them. One of the problems is that one can quite often meet papers in which the authors use numbers from interval [0, 1], then perhaps the operations min and max and they write that they are applying fuzzy techniques. It is necessary to teach the authors that first, a corresponding algebra of truth values must be considered (this will in most cases be the standard Łukasiewicz MV-algebra) and then some techniques of fuzzy logic can be applied. Moreover, it is also necessary to show that they face a specific manifestation of the vagueness phenomenon, which they thus are modelling.

It is a question whether there is a well-established concurrent approach to the vagueness phenomenon. One of them is Supervaluation theory, but this does not seem to be a well-established mathematical theory. Moreover, it can be easily modelled using higher-order fuzzy logic. Another concurrent is the mentioned alternative set theory. Its concept of a semiset is well established. The problem is that one can hardly use it in applications and, as I wanted to show in one of my papers and the book The Alternative Mathematical Model of Linguistic Semantics, we can form fuzzy sets as a reasonable approximation of semisets. So, fuzzy sets, at least so far, seem to be unbeatable concept when vagueness phenomenon is at play.

M.N.: I also meant other topics which attract attention and offer solutions to some common problems. Recently, deep neural networks changed the situation. For several decades, neural networks represented only one possible approach, not much distinguished from others. Now they achieved fascinated success in many tasks. Thus there is no wonder that they attracted enormous attention. However, they are not based on human-like understanding, and their failures are difficult to understand and interpret. Let us revive the idea of a combination of neural networks with fuzzy rules, which admits to learn interpretable rules and keep some control on the decision processes.

Sometimes it is vice versa: People use values in the interval [0,1] and call them probabilities. (The EM-algorithm is a typical example; it uses degrees of membership to fuzzy clusters and interprets them as probabilities.) They are in fact using fuzzy sets. (At least, the topic can be correctly described in terms of fuzzy sets, but not in terms of probability, when there is no crisp ground truth determining the membership to clusters.)

M.N.: Is Ostrava the right place for your research and building a team?

V.N.: Yes, I think so. We established our institute (i.e., the Institute for Research and Applications of Fuzzy Modelling) already in 1996. We started with six people. Now we have 33 scientists, including many young ones and also people from abroad. The total number of papers published by workers of our institute is more than 1300, among them eight monographs and almost 600 papers in scientific journals. I argue that we contributed significantly to the theory and suggested many sophisticated applications; several of them are actually working.

M.N.: My question was whether you feel comfortable in this city, and the environment is favorable for your activities.

V.N.: I live in Ostrava almost the whole of my life. If you have in mind its environment, then this city is not a good place at all - or better say, it was not. The reason is that Ostrava is a big industrial center with mostly heavy industry based on mining black coal and producing iron. But in the past 20 years, the situation gets still better and better, also because many factories and all coal mines were abolished. Moreover, the town itself is now in quite a good shape; it has a nice center with many well-repaired buildings, most of them more than 100 years old. In fact, all foreign visitors that came to our institute liked Ostrava. If you climb the highest tower in Ostrava - the New City Hall tower (80m), you realize that Ostrava is a very green town with many parks. In the vicinity of Ostrava (about 40 km) are beautiful mountains Beskydy. I am bound to them since my childhood, and four years ago, my wife and I moved to them permanently. Ostrava is a vivid

city, and our institute has a good position at our university.

M.N.: How could you keep your skills in playing piano during an intensive scientific career?

V.N.: During my university study, I studied in parallel also piano in a conservatory. When I began to work in a company, I had to reduce significantly practicing piano, and since then, I was playing only occasionally. But, as you know, we continued a nice tradition in organizing concerts of participants at the international conference FSTA in Liptovský Ján. Two years ago, however, I encountered problems with my left hand, and I concluded that playing piano would be the remedy. I bought a new instrument and began to practice every day for half an hour, at least. And it helped. Now, I usually play in the evening before going to bed, and I try to return to pieces that I knew in the past. Currently, I can play a concert of about 2 hours.

M.N.: This is one of the main differences between us two, although I am not a total musical ignorant.

RECOGNITION

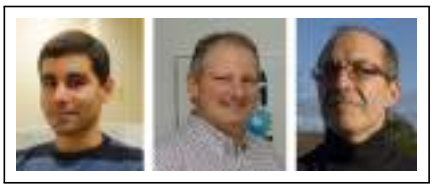
EUSFLAT Congratulates

Martin Štěpnička

EUSFLAT is an amazing society of friendly people who are truly pushing the science forward although they often do not talk about it. On the other hand, the fact, that you - our members - are friendly and modest does not mean, that you do not deserve an attention, that you do not deserve recognition. You do. Therefore, let me introduce a new Section of the Mathware & Soft Computing Magazine that will collect and publish announcements about distinct awards and recognitions related to you - our members.

In this June 2019 issue of the Magazine, we would like to congratulate to the awards received in the first half of this year:

- IFSA BEST JOURNAL PAPER 2017: On the role of linguistic descriptions of data in the building of natural language generation systems, by A. Ramos-Soto, A. Bugarin, S. Barro



- IFSA BEST JOURNAL PAPER 2019: Fuzzy Tools in Recommender Systems: A Survey, by R. Yera and L. Martínez

- IFSA 2015 Award to Didier Dubois and Henry Prade

- IFSA 2019 Award to James Bezdek and Hans J. Zimmermann

- 2019 L.A. Zadeh Award to Eyke Hüllemeier

- IFSA Fellowship awarded to Tomasa Calvo

- IFSA Fellowship awarded to Oscar Cordon

- IFSA Fellowship awarded to Irina Perfilieva

- IFSA Fellowship awarded to Gabriella Pasi

Once more, let me congratulate to all the awardees and let me apologize to all of you whose awards were not mentioned above. We will be gladly receiving information from you about your awards to publicly announce them in this new Section of the Magazine.

SCIENTIFIC REPORT

International Journal of Uncertainty, Fuzziness and Knowledge-based Systems

Bernadette Bouchon-Meunier

Special Issue in Honor of the 25th Anniversary of the International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems
Vol. 26, Suppl. 2 (December 2018)
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Cited in Science Citation Index Expanded (SciSearch), ISI Alerting Services, CompuMath Citation Indexr, Current Contentsr/ Engineering, Computing & Technology, ACM Guide to Computing Literature and Zentralblatt MATH.

CONFERENCE REPORT

The 4th International Symposium on Fuzzy Sets (ISFS 2019) - Uncertainty Modelling

The ISFS 2019 took place on May 23-24. The venue of the symposium was the University of Rzeszów which is the biggest academic institution in Podkarpackie voivodeship situated in southeastern Poland. The previous editions of the symposium were organized in the years 2014, 2015, and 2017.

The symposium was organized by Faculty of Mathematics and Natural Sciences at University of Rzeszów, Polish Mathematical Society branch in Rzeszów, and Polish Mathematical Society for Women in Mathematics, in cooperation with Slovak University of Technology in Bratislava. It was dedicated to fuzzy sets theory, its extensions and applications, including uncertainty modelling, and related topics such as aggregation functions. There was 17 presentations and many fruitful and interesting discussions on the topic of symposium. Interested participants could also listen to the concert Tales about adults organized as part of the 10th International Theater Festival of the Animated Form Maskarada. This year the scientific meeting was a part of the celebration of the Year of Mathematics in Poland. The Senate of the Republic of Poland, in recognition of the merits of Polish mathematicians for world science, commemorating the amazing development of Polish mathematics after Poland regained its independence, and underlining the role of this field of science in the development of Polish society, set the year 2019 as the Year of Mathematics.

The Organizing Committee of ISFS 2019
Urszula Bentkowska, PawełDrygaś, Katarzyna Garwol, Anna Król, Barbara Pekala, Ewa Rak

NEWS

Ph.D. Thesis defended by M. José Benítez-Caballero

University of Cádiz, Cádiz, Spain

M. José Benítez-Caballero defended her Ph.D. thesis, entitled "Characterization theorems of reducts and bireducts, with tolerance relations. Variable selection in RST and FCA", on June 04, 2019. Her advisors were Dr. J. Medina and Dr. Ramírez-Poussa.

In the last decades, the use of databases in order to collect information has increased. Therefore, it is essential to extract information from databases obtaining conclusions. Due to this fact, the development of mathematical tools in order to manage information contained in knowledge systems is a key issue.

Rough Set Theory (RST) and Formal Concept Analysis (FCA) are two powerful and useful mathematical tools, chasing these goal. These theories have been successfully applied in areas as psychology, biology, data mining or software engineering and have become powerful tools in areas ranging from Ontology Merging, to Semantic Web. This thesis is focused on two main ideas:

- to generalize the basic notions and results related to attribute selection in RST
- to study the connections between attribute reduction mechanisms in formal concept analysis and in rough set theory

On one hand, in RST, the main target of attribute selection is to obtain minimal subsets of attributes, keeping the indiscernibility between the objects of the information system. These minimal subsets of attributes are called reducts. After the definition of reduct was deeply studied, the idea of bireduct arose. In this case, the set of objects is reduced as well as the set of attributes. Usually, in order to discern objects, equivalence relations have been considered. However, indiscernibility among objects does not need to fulfill the transitivity property, tolerance relationships can be considered to compare objects. Therefore, the extensions of the basic notions of attribute selection considering tolerance relations have been introduced in this thesis. Also, the characterization theorems to build all the reducts and bireducts of information systems and decision systems, have been generalized.

On the other hand, FCA and RST are two related theories. For this reason, the advantage obtained in the study on one of these theories could have a useful and significant impact in the other theory. This fact justifies the necessity of studying the connections between the reduction mechanisms and their meanings in both theories. Therefore, the following contributions have also been presented:

- A reduction mechanism in FCA is presented considering the philosophy of RST, in a classical environment.
- Properties which affect the hierarchy and the structure of the concept lattice associated with the reduced contexts have been studied.
- This reduction mechanism has been adapted to be applied in the fuzzy environment of the multi-adjoint concept lattices.
- Interesting properties and a comparative study with other interesting fuzzy reduction methods have been presented.
- On the other hand, we reduce an information system considering the FCA philosophy.
- We present a relation between the concept-forming operators given in FCA and the classes obtained from the indiscerniblility relation considered in RST.
- We also introduce a reduction mechanism in FCA considering bireducts and its main properties are studied.

In conclusion, we have provided a generalization of the attribute selection in rough set theory when tolerance relations are considered. Also, novel reduction mechanisms have been presented and a study about the connections between the reduction mechanism in both theories have been done.

The main results included in the thesis have been already published in high impact journals and conferences related to fuzzy systems:

(1) M.J. Benítez-Caballero, J. Medina and D. Ślezak. Reducing information systems considering similarity relations. *7th European Symposium on Computational Intelligence and Mathematices (ESCIM 2015)*, pages 257-263, 2015.

(2) M.J. Benítez-Caballero, J. Medina and D. Ślezak. δ-information reducts and bireducts. *2015 Conference of the International Fuzzy Systems Association and the European Society for Fuzzy Logic and Technology (IFSA-EUSFLAT-15)*, Atlantis Press, 2015.

(3) M.J. Benítez-Caballero, J. Medina and D. Ślezak. Attribute reduction in Fuzzy Formal Concept Analysis from Rough Set Theory. *8th European Symposium on Computational Intelligence and Mathematices (ESCIM 2016)*, pages 49-54, 2016.

(4) M.J. Benítez-Caballero, J. Medina and E. Ramírez-Poussa. Attribute reduction in rough set theory and formal concept analysis. *Lecture Notes in Computer Science 10314*, Springer, Cham, pages 513-525, 2017.

(5) M.J. BENÍTEZ-CABALLERO, J. Medina and E. Ramírez-Poussa. Reducing Concept Lattices from Rough Set Theory. *Advances in Fuzzy Logic and Technology 2017*, Springer, Cham, pages 177-186, 2017.

(6) M.J. BENÍTEZ-CABALLERO, J. Medina, E. Ramírez-Poussa and D. Ślezak. Bireducts with tolerance relations. *Information Sciences, 435*, pages 26-39, 2018.

(7) M.J. BENÍTEZ-CABALLERO, J. Medina and E. Ramírez-Poussa. FCA Attribute Reduction in Information Systems. *Communications in Computer and Information Science 855*, Springer, Cham, pages 549-561, 2018.

(8) M.J. BENÍTEZ-CABALLERO, J. Medina and E. Ramírez-Poussa. Applications of Rough Set Theory reduction in Fuzzy Formal Concept Analysis. *18th International Conference Computational and Mathematical Methods in Science and Engineering (CMMSE 2018)*, 2018.

(9) M.J. BENÍTEZ-CABALLERO, J. Medina and E. Ramírez-Poussa. Bireducts in Formal Concept Analysis. *Computational Intelligence and Mathematics for tackling complex problems, Studies in Computational Intelligence*, In Press, 2018.

(10) M.J. BENÍTEZ-CABALLERO, J. Medina and E. Ramírez-Poussa. Unifying Reducts in Formal Concept Analysis and Rough Set Theory. *Trends in Mathematics and Computational Intelligence, Studies in Computational Intelligence 796*, pages 89-95, 2019.

(11) M.J. BENÍTEZ-CABALLERO, J. Medina, E. Ramírez-Poussa and D. Ślezak. A computational procedure for variable selection preserving different initial conditions. *International Journal of Computer Mathematics*, In press, 2019.

Second International Conference on Fuzzy Management Methods ICFMsquare 2019

November 11, 2019 at the University of Fribourg, Switzerland

Organizers

Committees

Conference Honorary Chair

- Andreas Meier, University of Fribourg, Switzerland.
- Lotfi Zadeh, UC Berkeley, USA

Conference Co-Chairs

- Edy Portmann, University of Bern, Switzerland.
- Michael Kaufmann, University of Applied Science Lucerne, Switzerland

Program Co-Chairs

- Luis Terán, University of Fribourg and Universidad de las Fuerzas Armadas (ESPE)

About the ICFMsquare 2019

With today's information overload, it has become increasingly difficult to analyze the huge amounts of data and to generate appropriate management decisions. Furthermore, the data are often imprecise and will include both quantitative and qualitative elements. For these reasons it is important to extend traditional decision making processes by adding intuitive reasoning, human subjectivity and imprecision.

Topics of Interest

The International Conference on Fuzzy Management Methods addresses the application of fuzzy logic to managerial decision making processes. Research papers as well as case studies are of interest in the following areas:

- Fuzzy-based Portfolio Analysis
- Reputation Management with Imprecision
- Web Analytics with Fuzzy Measures
- Fuzzy-based Business Analytics
- Inductive Fuzzy Classification
- Community Marketing with Fuzzy Methods
- Fuzzy-based Customer Equity
- Service Level Management with Vague Data
- Data Mining with Fuzziness
- Fuzzy-based Stakeholder Management
- Customer Relationship Management with Fuzzy Methods
- Fuzzy Cognitive Maps for Creativity and Knowledge Management
- Business (Process) Modelling with Words
- Sense-making with Vague (Web) Data
- and related topics

The scientific program consists of research papers, panels, and tutorials.

Committees

The members of the scientific program committee are professors of universities and research labs from Asia, Australia, USA, and Europe:

- Monica Casabayo, ESADE-URL, Spain
- Elizabeth Chang, University of New South Wales, Australia
- Shyi-Ming Chen, National Taiwan University of Science and Technology, Taipei, Taiwan

- Adrian D. Cheok, City University London, UK
- Robert Fullér, Óbuda University, Hungary
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- Rudolf Seising, University of Jena, Germany
- Enric Trillas, European Center for Soft Computing, Spain
- Ronald R. Yager, Iona College, USA
- Jin Hee Yoon, Korean Institute of Intelligent Systems, South Korea

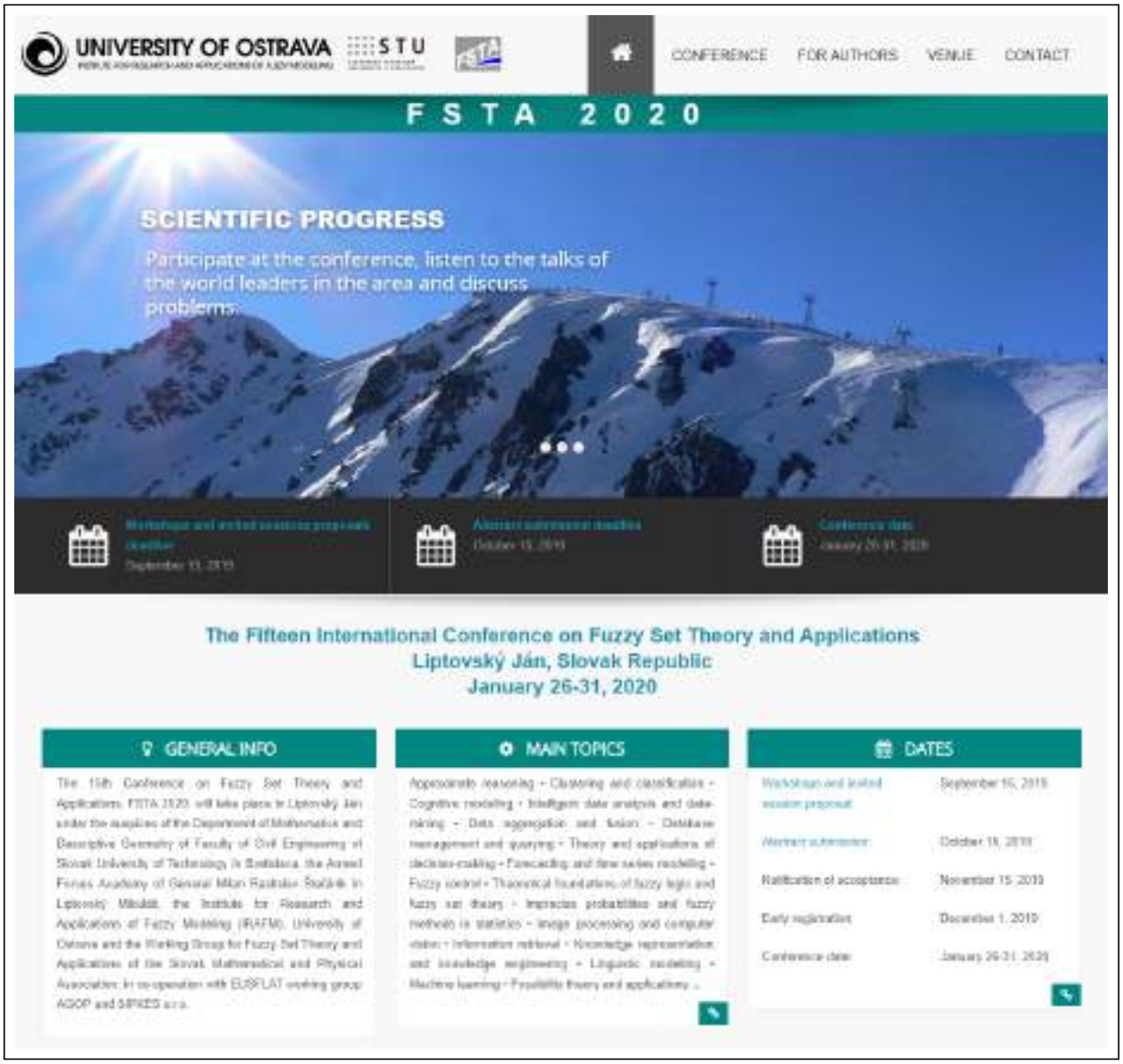
Important Dates

Scientific papers (long papers, 12 pages) or case studies (short papers, 6 pages) must be original and not used for publication elsewhere. Accepted papers will be published in the international research book series Fuzzy Management Methods by Springer and on the platform FMsquare.org. Authors are invited to submit their manuscripts by **July 15, 2019 (extended)** on FMsquare.org. Notification of acceptance will be July 30, 2019; camera-ready due August 30, 2019.

CALLS

FSTA 2020 - 15th International on Fuzzy Set Theory and Applications

Lptovský Ján (Slovak Republic) 26-31 January 2020



No words are needed. FSTA is a “must to attend”.

IEEE EAIS 2020

Conference on Evolving and Adaptive Intelligent Systems

May 27—29, 2020, Bari, Italy

IEEE

eais2020.di.uniba.it

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The 2020 IEEE Conference on Evolving and Adaptive Intelligent Systems (IEEE EAIS 2020) will be held in Bari (Italy), a beautiful mediterranean town. Bari is a modern metropolis in the south of Italy, grew up on a small limestone promontory, stretching out into the Adriatic sea. With a population of over 350,000, Bari is famous for its university and its port. A captivating place to discover, Bari is a two-faces city, with its elegant Murat district and the spellbinding area of Bari Vecchia (Old Bari). A heady mix of cultures including Arab and Roman, it is also where Saint Nicholas was laid to rest. The main monument of Bari is the Basilica of Saint Nicholas, one of the most splendid examples of Romanesque architecture.

IEEE EAIS 2020 will provide a working and friendly atmosphere and will be a leading international forum focusing on the discussion of recent advances, the exchange of recent innovations and the outline of open important future challenges in the area of Evolving and Adaptive Intelligent Systems.

Over the past decade, this area has emerged to play an important role on a broad international level in today's real-world applications, especially those ones with high complexity and dynamics change. Its embedded modelling and learning methodologies are able to cope with real-time demands, changing operation conditions, varying environmental influences, human behaviors, knowledge expansion scenarios and drifts in online data streams.

IEEE EAIS 2020 is organized by the IEEE Technical Committee on Evolving and Adaptive Intelligent Systems, SMC Society, and the IEEE Computational Intelligence Society. Authors of selected papers will be invited to submit extended versions for possible inclusion in a special issue of the Journal Evolving Systems (Springer).

Call for Papers

Papers for IEEE EAIS 2020 should be submitted electronically through the Conference website eais2020.di.uniba.it, and will be refereed by experts in the fields and ranked based on the criteria of originality, significance, quality and clarity.

Important Dates

10 Oct 2019
Special Session Proposals Deadline

10 Jan 2020
Paper Submission Deadline

19 Feb 2020
Decision Notification

20 Mar 2020
Final Paper Submission

27-29 May 2020
2020 IEEE EAIS Conference

IEEE

UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CALLS

ECAI 2020 - 24th European Conference on Artificial Intelligence

Santiago de Compostela (Spain) 8-12 June 2020

The biennial European Conference on Artificial Intelligence (ECAI) is Europe's premier venue for presenting scientific results in AI. Under the general theme "Paving the way towards Human–Centric AI", the 24th edition of ECAI will be held in Santiago de Compostela, a UNESCO's World Heritage City which is the destination of unique Routes that cross all Europe since the Middle Ages. In 2020 "the AI way" goes to . . . Santiago!

The conference dates are 10-12 June 2020, with the tutorials, workshops and other events taking place on 8-9 June. Save these dates!

ECAI provides an opportunity for researchers to present and discuss about the best AI research, developments, applications and results. ECAI2020 will feature, as usual, a full programme of technical papers, as well as many AI-related events of interest for researchers, students and all attendants who are interested on contemporary AI, including

- an extensive programme of workshops, tutorials, and invited speakers
- the Prestigious Applications of Intelligent Systems conference (PAIS)
- the Frontiers in AI track sessions
- The Lab To Market event
- Women in AI Breakfast
- EU Challenges forum
- . . . and many more!

ECAI2020 will also focus on AI students and Early Stage Researchers, who will be able to participate in several specific events designed for them, under the umbrella "Mentoring and Communication for Early Stage Researchers (MC4ESR)", including

- the Starting AI Researcher Symposium (STAIRS)
- Doctoral Consortium
- Elevator Pitch for Early Stage Researchers (EP4ESR) and Research to the Market (R2M) Contests
- Lunch with a Fellow
- Job Fair

The Conference is supported by the European Association for Artificial Intelligence (EurAI), the Spanish AI Society (AEPIA) and organized by the Intelligent Systems Group (GSI) and the Research Center on Intelligent Technologies of the University of Santiago de Compostela (CiTIUS).

ECAI 2020 CALL FOR PAPERS

The Program Committee of the 24th European Conference on Artificial Intelligence (ECAI 2020) invites the submission of papers for the technical program of the Conference. High-quality original submissions are welcome from research results and applications of all areas of AI. The following list of topics is indicative; other topics are welcome.

- Agent-based and Multi-agent Systems
- Computational Intelligence
- Computer Vision
- Constraints and Satisfiability
- Ethical, Legal, Social Issues
- Human Aspects in AI
- Knowledge Representation and Reasoning
- Machine Learning
- Natural Language Processing
- Neural Information Processing Systems
- Planning and Scheduling
- Uncertainty in AI
- Robotics and Autonomous Systems
- Safe, Explainable, and Trustworthy AI
- Semantic Technologies
- Search & Game Playing
- Multidisciplinary Topics

IMPORTANT DATES

- 13 November 2019 – ABSTRACT submission
- 19 November 2019 – PAPER submission
- 18 December 2019 – Rebuttals (for scientific papers) start

- 20 December 2019 – Rebuttals (for scientific papers) end
- 15 January 2020 – Notification of acceptance/rejection
- 28 April 2020 – Early registration deadline

FORMATTING

Two types of contributions are admitted in ECAI2020:

- Scientific papers
- Highlights

Scientific papers should report on substantial novel results in the (indicative) topics stated above.

We also invite submissions of two-pages abstracts that highlight your favorite recent technical work (published elsewhere), position, or open problems with clear and concise formulations of current challenges. The aim is to disseminate them to a wide audience, giving AI community members the opportunity to learn about unfamiliar work and foster interdisciplinarity. Highlight submissions will be reviewed by qualified members of the Program Committee. The reviewers of the papers will follow guidelines specifically tailored to their special nature.

Submitted papers must be formatted according to the camera-ready style for ECAI 2020. Long papers must not exceed eight (7+1) pages and highlights papers must not exceed two (2) pages. Overlength submissions will be rejected without review.

Originality

Submissions must be original and should not have been formally published, accepted for publication or under review. Also, submissions must not be submitted elsewhere during the ECAI 2020 reviewing phase.

Submitting and Reviewing

Submission and review of papers for ECAI 2020 will be managed via Easychair. Details will be announced soon.

All submissions will be subject to peer review by the ECAI 2020 Programme Committee. Scientific papers will be evaluated based on relevance, significance of contribution, impact, technical quality, scholarship and quality of presentation. During the rebuttal phase, the (primary) authors of submitted papers will be offered the opportunity to respond to the reviews for their papers before the final decision on acceptance or otherwise is made. Highlight submissions will be reviewed following guidelines specifically tailored to their special nature.

PROCEEDINGS AND PRESENTATION

The proceedings of the conference will be published by IOS Press and made freely available on the IOS website. The chairs of ECAI2020 are currently in negotiation with well-known journals to seed special issues of ECAI papers. The details of this arrangement will be confirmed shortly.

The authors will be responsible for producing camera-ready copies of papers in PDF format, conforming to the ECAI2020 formatting guidelines for inclusion in the published proceedings of the conference. At least one author of each accepted paper is required to attend the conference to present the contribution.

WORKSHOPS, TUTORIALS AND OTHER EVENTS

Separate calls will be issued for workshop and tutorial proposals, as well as for contributions to:

- PAIS 2020, the Prestigious Applications of Intelligent Systems conference
- STAIRS 2020, the Starting AI Researcher Symposium

Also, ECAI2020 will include several other training activities under the “Mentoring and Communication for Early Stage Researchers (MC4ESR)” umbrella. These will include:

- Doctoral Consortium (DC)
- Research to the Market Contest (R2M)
- Elevator Pitch for Early Stage Researchers Contest (EP4ESR)
- Lunch with an EurAI Fellow
- Job Fair

Finally, other AI-related events will be announced, specially addressing the role of AI in Europe (and vice-versa) with special focus on the Conference general theme. Some of them are:

- EU Challenges
- From Lab to Market (Lab2M)

In the ECAI2020 exhibits area we will feature companies and institutions offering their services, as well as demos and some of the previously described events. The Job Fair will also happen here.

CONTACT AND UPDATES

Organizing Committee Chairs:
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