

The Fifteenth International Conference on Fuzzy Set Theory and Applications



FSTA 2022

Liptovský Ján, Slovak Republic

January 30 – February 4, 2022

Programme



UNIVERSITY OF OSTRAVA
INSTITUTE FOR RESEARCH
AND APPLICATIONS
OF FUZZY MODELING



**SLOVENSKÁ TECHNICKÁ
UNIVERZITA V BRATISLAVE**

Organized by
SIPKES s.r.o.

jointly with

Institute for Research and Applications of Fuzzy Modeling,
University of Ostrava



UNIVERSITY OF OSTRAVA
INSTITUTE FOR RESEARCH
AND APPLICATIONS
OF FUZZY MODELING

Department of Mathematics and Descriptive Geometry,
Faculty of Civil Engineering,
Slovak University of Technology in Bratislava

STU
SLOVENSKÁ TECHNICKÁ
UNIVERZITA V BRATISLAVE

in co-operation with

Armed Forces Academy of General Milan Rastislav Štefánik



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**EUROPEAN SOCIETY
FOR FUZZY LOGIC
AND TECHNOLOGY**

Conference venue

About the Liptov region

Liptov is a historical and geographical region in central Slovakia with historical and cultural centres in cities Liptovský Mikuláš, Ružomberok, and Liptovský Hrádok. The whole region is surrounded by the highest mountains in Slovakia, including High Tatras, West Tatras, Low Tatras, or Great Fatra. Tourists may enjoy the richness of nature provided by two national parks, namely the Tatra National Park and the Low Tatra National Park. The beautiful nature offers a lot, mountains, caves, animals, or plants; tourists usually appreciate splendid ski resort Jasná (closely located to the conference venue) and hot springs spas (e.g. Tatralandia in Liptovský Mikuláš or Bešňová)

Venue

The venue of the conference – Alexandra Wellness Hotel – lies in the village Liptovský Ján, located 4km from the Exit 279 of the main Slovakian Highway D1 (E50).

Bus connections

If you do not intend to come by car, the organizers will assist you in getting to the hotel and getting back from the hotel to the train station in Liptovský Mikuláš by organizing buses at the following scheduled departure times:

Sunday, January 30 (Liptovský Mikuláš train station – Alexandra Wellness Hotel) departures:

14:15, 16:15, 18:15, 20:15, 22:15

Friday, February 4 (Alexandra Wellness Hotel – Liptovský Mikuláš train station) departures:

9:30, 11:30, 13:30

Apart from the free buses by the organizers, participants may use the standard buses operating every day. **Their schedule in PDF is linked on the conference web.**

Hotel services

Alexandra Wellness Hotel as the conference hotel does not provide only accommodation, catering, and conference rooms' services. It is here to make you feeling like in a paradise. It offers the following services:

- unlimited access to the swimming pool, one free access to the wellness centre per day,
- free wifi, free access to fitness centre, free table tennis,
- bowling tracks for rent (20% discount for hotel guests)
- rent of an indoor sport hall.

Enjoy your stay as much as you can.

General Information

Registration

The registration desk will be open in the conference hotel during the following hours:

- Sunday, January 30, 16:30 – 19:30,
- Monday, January 31, 8:30 – 9:00.

If your arrival does not allow to approach the registration desk in the hours given above, feel free to approach organizer, your registration will be done upon your request individually.

Lectures

Each lecture room will be equipped with a computer with Acrobat Reader and Powerpoint, a data projector, a canvas, and a laser-pointer. Each lecture has a determined time slot for 20 minutes including the discussion. We kindly ask the speakers to:

- come to the lecture room in time in order to upload the slides to the provided computer before the beginning of the session and to avoid slowing down the schedule of the session;
- to leave some time for the discussion (if the talk will not be finished in time, the chairman cannot allow the discussion);
- to avoid risking problems with Powerpoint presentations and to consider converting them to PDF.

The only official language of the conference is English.

Catering

Participants will be provided with the full board catering, namely with dinners starting from Sunday, January 30 and ending with the gala dinner on Thursday, February 3, and with lunches starting from Monday, January 31 and ending with the lunch on Friday, February 4. Accommodation automatically includes breakfasts buffet. The lectures will be separated by appropriately scheduled coffee breaks with some drinks and small refreshments.

Health

The emergency phone number call ambulance is the standard European 112. The same number can be used for calling to police or a fire department. We hope that the participant will not have any reason to use them.

Currency

Slovakia uses EUR currency. (Current exchange rate to USD is: 1.00 USD = 0.88 EUR.)

Electricity

The standard electrical voltage in Slovakia is 230 volts AC, 50Hz. The electrical sockets are identical to the standard European sockets.

Telephone

The international access code for Slovakia is +421. **Please silence your mobile phone during all conference sessions.**

Weather

The weather in Slovakian mountains in January can differ a lot and the temperatures may range from low positive degrees Celsius to rare extremes below -30°C. In general, be ready for classical winter mountain weather and you will not get surprised.

Time-zone

Slovakia uses the Central European Time (CET) that is the Greenwich Mean Time (GTM) plus 1 hour.

Social events

Excursions (13:30 – 17:30)

FSTA traditionally offers excursions to its participants. After several years when trips to sulfur springs spa dominated, the excursion trips were organized to Hotel Permon Spa (Sauna) Paradise and to Demänovská Cave of Liberty. As the main conference hotel is a wellness hotel offering rich wellness programme of a high quality, we decided to replace the first excursion goal (Hotel Permon) with a new one – Museum of Liptov Village in Pribylina. Buses will be provided and entrance fees are included. The only thing we need is that each interested participant registers by signing in on particular sheets placed on the board at the conference site.

Excursion no. 1 - Demänovská Cave of Liberty

BUS departure 13:30

Demänovská Cave of Liberty is a karst cave in Low Tatras in Slovakia. It is the most visited cave in Slovakia. Of the total length of 8126 metres, 1800 metres are open to the public. The cave is richly decorated with many stalactites, stalagmites and stalagmites. It contains large domes with the largest one called the Great Dome with height of 41m, with length of 75m and width of 35m.



Excursion no. 2 – Museum of Liptov Village in Pribylina

BUS departure 13:30

Museum of Liptov Village in Pribylina presents settlement disposition that was characteristic in the Liptov region. The houses come from several Liptov villages, mainly from the area now flooded with water of Liptovská Mara dam. The houses are actually copies of original buildings with numerous original elements. You can see folk wooden architecture and two exceptional medieval stone structures: early Gothic church of the Holy Virgin from Liptovská Mara (a village that gave its name to the dam) and Gothic-Renaissance mansion from Parížovce. You can see the way of life

in the late 19th and the early 20th centuries. Each house is labelled with description in Slovak, English, German and Polish. The staff of the Museum will gladly answer your possible questions.



Concert (Wednesday 20:30 – 21:30)

It is again a tradition specific for FSTA that Wednesday evening is reserved for the concert consisting of participants' performances. Something you cannot miss, something you have to see, something you have to listen.

Football match (Thursday 16:30 – 17:30)

When we – organizers – decided for the change of the hotel, and contracted the Alexandra Wellness Hotel that offers rich sport background including an indoor sport hall, we found it suitable for an attempt to set up a new tradition: a football match between organizers and participants. How the situation will evolve in 2022 we do not know yet. COVID-19 can indeed cause unexpected changes of our plans. But we surely want to build two teams that will fight for this glorious victory. We ask all participants to come to support both teams in building the tradition of friendly matches with joy, respect and fun. Cheerleaders are especially welcome.

Gala dinner (Thursday 19:00)

Gala dinner is traditionally the main social event of any conference. The one at FSTA provides a lot, the award ceremony, rich food buffet, but mainly, fabulous local folklore “dulcimer” band performance that lasts hours and hours and provides an amazing opportunity for dancing.

FSTA 2022 programme

SUNDAY, JANUARY 30

16:30 - 19:00	REGISTRATION	Foyer
19:00 - 20:30	DINNER	Restaurant

MONDAY, JANUARY 31

8:30 - 9:00	REGISTRATION	Foyer
9:00 - 9:10	OPENING CEREMONY	Congress

INVITED TALK Congress

9:10 - 10:10 **Speaker:** Manuel Ojeda-Aciego
Title: Galois connections between fuzzy unbalanced structures.

10:10 - 10:40 **COFFEE BREAK** Congress Foyer

Session 1 Room A

10:40 - 11:00 **Author(s):** WIECZYNSKI Jonata, DIMURO Graçaliz, LUCCA Giancarlo, BORGES Eduardo and BUSTINCE Humberto
Title: Two New Generalizations of the Choquet Integral

11:00 - 11:20 **Author(s):** BASARIK Stanislav and HALČINOVÁ Lenka
Title: Generalized Choquet integral - properties and comparison with the Choquet integral

11:20 - 11:40 **Author(s):** FERRERO-JAURRIETA Mikel, TAKÁČ Zdenko, HORANSKÁ Ľubomíra, PEREIRA DIMURO Graçaliz, FERNANDEZ Javier and BUSTINCE Humberto
Title: Spam detection improvement by using Choquet integral in recurrent models

11:40 - 12:00 **Author(s):** ASMUS Tiago, DIMURO Graçaliz P., BEDREGAL Benjamín, FERNANDEZ Javier, MESIAR Radko and BUSTINCE Humberto
Title: Fusion functions with floating domains in arbitrary closed real intervals

Session 2 Room B

10:40 - 11:00 **Author(s):** FIALA Karel and MURINOVÁ Petra
Title: Fuzzy Syllogisms Generated by Graded Cube of Opposition

11:00 - 11:20 **Author(s):** MURINOVÁ Petra and NOVÁK Vilém
Title: Distribution, Quality and Quantity Rules for Logical Syllogisms

11:20 - 11:40 **Author(s):** NOVÁK Vilém and MURINOVÁ Petra
Title: Formal Analysis of Peterson's Rules for Valid Syllogisms

11:40 - 12:00 **Author(s):** URRUTIA TORRENS Adriá and NOVÁK Vilém
Title: Modeling linguistic vague information from evaluative expressions and its sentiment

12:15 – 13:30 LUNCH Restaurant

16:10 – 16:40 COFFEE BREAK Congress Foyer

Session 3 Room A

16:40 – 17:00 **Author(s):** ASMUS Tiago, DIMURO Graçaliz P., SANZ José Antonio, FERNANDEZ Javier, MESIAR Radko and BUSTINCE Humberto
Title: *Controlling the information quality in interval-valued fusion processes*

17:00 – 17:20 **Author(s):** ŠTAJNER-PAPUGA Ivana, TEPAVČEVIĆ Andreja, CORNEJO M. Eugenia and MEDINA Jesús
Title: *A note on construction of fuzzy measures used for ranking data*

17:20 – 17:40 **Author(s):** FUMANAL-IDOCIN Javier, VIDAURRE Carmen, CORDÓN Óscar and BUSTINCE Humberto
Title: *Application of the generalized interval-valued Sugeno integral in Brain Computer Interfaces and Social Networks*

17:40 – 18:00 **Author(s):** GUTIÉRREZ Inmaculada, GÓMEZ Daniel, CASTRO Javier and ESPÍNOLA Rosa
Title: *Community detection in networks with multiple fuzzy Sugeno λ -measures*

18:00 – 18:20 **Author(s):** KRÍDLO Ondrej and OJEDA-ACIEGO Manuel
Title: *Lower Sugeno-like Integral for Multi-Adjoint FCA*

Session 4 Room B

16:40 – 17:00 **Author(s):** MOŚ Grzegorz and BACZYŃSKI Michał
Title: *On the S-power Invariance Properties and the Mixed Invariance Properties for Fuzzy Implication Functions*

17:00 – 17:20 **Author(s):** MASSANET Sebastia and VEMURI Nageswara Rao
Title: *On the characterization of interval-valued (S,N)-implications*

17:20 – 17:40 **Author(s):** MIŚ Katarzyna
Title: *On Different Compositions of Fuzzy Relations in Approximate Reasoning*

17:40 – 18:00 **Author(s):** DVOŘÁK Antonín and ŠTĚPNIČKA Martin
Title: *Is it important to have Mamdani-Assilian rules consistent and why it is not?*

18:00 – 18:20 **Author(s):** STANIMIROVIĆ Stefan, MICIĆ Ivana and JANČIĆ Zorana
Title: *Approximate Solutions to Weakly Linear Systems of Fuzzy Relation Equations*

19:00 – 20:30 DINNER Restaurant

TUESDAY, FEBRUARY 1

INVITED TALK

Congress

9:10 – 10:10 **Speaker:** Martin Holeňa
Title: *Machine Learning Alleviates the Dilemma of Black-Box Optimization*

10:10 – 10:40 **COFFEE BREAK**

Congress Foyer

Session 5

Room A

10:40 – 11:00 **Author(s):** HORANSKÁ Lubomíra and TAKÁČ Zdenko
Title: *On comonotone k -maxitive aggregation functions*

11:00 – 11:20 **Author(s):** HUDEC Miroslav, MINÁRIKOVÁ Erika and MESIAR Radko
Title: *A note on aggregation functions in classification based on ordinal sums*

11:20 – 11:40 **Author(s):** MINÁRIKOVÁ Erika and HUDEC Miroslav
Title: *Linguistic Summaries in Interpretable Classification by Ordinal Sums*

11:40 – 12:00 **Author(s):** BENTKOWSKA Urszula and MRUKOWICZ Marcin
Title: *Parameterized families of interval-valued aggregation functions in optimization problem of classifiers*

Session 6

Room B

10:40 – 11:00 **Author(s):** ZUBYUK Andrey, FADEEV Egor and SHISHKIN Artem
Title: *Bayesian Decision Making as a Theoretical Basis for a New Look at Fuzzy Logic Control*

11:00 – 11:20 **Author(s):** BALLOVÁ Dominika and RENDEKOVÁ Alena
Title: *Statistical comparison of the flora of conventional tram tracks and managed green tram tracks in Bratislava*

11:20 – 11:40 **Author(s):** HOLČAPEK Michal, NGUYEN Linh, QUOC Bui Viec and RICO Agnés
Title: *On analysis of stochastic processes by fuzzy transform*

11:40 – 12:00 **Author(s):** NAVARA Mirko and VORÁČEK Václav
Title: *Non-existence of hidden variables: Kochen--Specker constructions*

12:15 – 13:30 **LUNCH**

Restaurant

16:10 – 16:40 **COFFEE BREAK**

Congress Foyer

Session 7**Room A**

16:40 – 17:00	Author(s): BRUTENIČOVÁ Michaela, JANIŠ Vladimír and MONTES Susana Title: <i>Relational modifiers preserving convexity</i>
17:00 – 17:20	Author(s): HUIDOBRO Pedro, ALONSO Pedro, JANIŠ Vladimír and MONTES Susana Title: <i>Convexity in Betweenness Structures</i>
17:20 – 17:40	Author(s): HUTNÍK Ondrej and KLEINOVÁ Miriam Title: <i>On a class of discrete integrals of measure with respect to measure</i>
17:40 – 18:00	Author(s): DORIA Serena Title: <i>Preference orderings represented by coherent lower conditional previsions defined by Super-Additive integrals</i>
18:00 – 18:20	Author(s): MESIAR Radko and KOLESÁROVÁ Anna Title: <i>Outliers-based triangular norms</i>
18:20 – 18:40	Author(s): MESIAROVÁ-ZEMÁNKOVÁ Andrea Title: <i>On the cardinality of the branching set in the z-ordinal sum construction</i>

Session 8**Room B**

16:40 – 17:00	Author(s): HOLČAPEK Michal and QUOC Bui Viec Title: <i>Integral transforms for two-dimensional functions and their application to image processing</i>
17:00 – 17:20	Author(s): OJEDA-HERNÁNDEZ Manuel, CABRERA Inma P., CORDERO Pablo and MUÑOZ-VELASCO Emilio Title: <i>Fuzzy closure relations</i>
17:20 – 17:40	Author(s): PERFILJEVA Irina and JANEČEK Jiří Title: <i>Graph Functions Similarity Determined by Preimage Problem</i>
17:40 – 18:00	Author(s): ULJANE Ingrida and ŠOSTAK Alexander Title: <i>Aggregation of operators of fuzzy mathematical morphology</i>
18:00 – 18:20	Author(s): ZÁMEČNÍKOVÁ Hana and PERFILIEVA Irina Title: <i>Laplace Operators – an overview</i>
19:00 – 20:30	DINNER

Restaurant**WEDNESDAY, FEBRUARY 2****Session 9****Room A**

8:50 – 9:10	Author(s): HALAŠ Radomír and MESIAR Radko Title: <i>On the decomposability of aggregation functions on direct products of posets</i>
9:10 – 9:30	Author(s): KALINA Martin Title: <i>Lattice Based Sum of Aggregation Functions on Bounded Lattices</i>
9:30 – 9:50	Author(s): HALAŠ Radomír Title: <i>On number of aggregation functions on finite chains</i>
9:50 – 10:10	Author(s): ŠELIGA Adam Title: <i>On the characterization of super- and sub-additive positively homogeneous aggregation functions</i>

Session 10**Room B**

- 8:50 – 9:10 **Author(s):** MASSANET Sebastia, RIERA Juan Vicente, BUSTINCE Humberto and FÉRNANDEZ Javier
Title: *On negation and antonym functions in the set of discrete fuzzy numbers*
- 9:10 – 9:30 **Author(s):** CÁNOVAS Jose and KUPKA Jiří
Title: *On two notions of fuzzy topological entropy*
- 9:30 – 9:50 **Author(s):** KUPKA Jiří
Title: *Properties of generalized fuzzy dynamical systems*
- 9:50 – 10:10 **Author(s):** ŠKORUPOVÁ Nicole
Title: *Simulations of fuzzy dynamical systems*

10:10 – 10:30

COFFEE BREAK**Congress Foyer****Session 11****Room A**

- 10:30 – 10:50 **Author(s):** URSÚA-MEDRANO Pablo, RODRÍGUEZ-MARTÍNEZ Iosu, BERNARDINI Angela, FERNANDEZ Javier and BUSTINCE Humberto
Title: *Evaluation of different aggregation functions in the pooling layer of a Convolutional Neural Network*
- 10:50 – 11:10 **Author(s):** PEKALA Barbara, DYCZKOWSKI Krzysztof, WILBIK Anna and SZKOŁA Jarosław
Title: *Federated learning with uncertainty in medical problems*
- 11:10 – 11:30 **Author(s):** URÍO-LARREA Asier, MARCO-DETCART Cedric, RODRÍGUEZ-MARTÍNEZ Iosu, BUSTINCE Humberto and FERNÁNDEZ Javier
Title: *Machine Learning system for Edge detection on Interval Valued Images*
- 11:30 – 11:50 **Author(s):** RODRÍGUEZ-MARTÍNEZ Iosu, DA CRUZ Asmus Tiago, PEREIRA DIMURO Graçaliz, URSÚA-MEDRANO Pablo, HERRERA Francisco and BUSTINCE Humberto
Title: *Feature downsampling on Convolutional Neural Networks via grouping functions*

Session 12**Room B**

- 10:30 – 10:50 **Author(s):** ADAMCZYK David and PERFILIEVA Irina
Title: *Analysis of low dimensional data representation by FT techniques*
- 10:50 – 11:10 **Author(s):** TAKAČI Aleksandar
Title: *Towards a unique database footprint using fuzzy sets, neural networks and Sugeno Integral*
- 11:10 – 11:30 **Author(s):** TRUONG Phuong and NOVÁK Vilém
Title: *Detection of structural breaks in time series using Fuzzy techniques and Chow test*
- 11:30 – 11:50 **Author(s):** KACZMAREK-MAJER Katarzyna
Title: *Stationarity of time series with fuzzy data*

12:00 – 13:00

LUNCH**Restaurant**

13:15 - 17:30	EXCURSIONS	
19:00 - 20:00	DINNER	Restaurant
20:30 - 21:30	CONCERT	

THURSDAY, FEBRUARY 3

INVITED TALK Congress

9:10 - 10:10	Speaker: Lenka Halčínová Title: <i>The concept of conditional aggregation</i>	
10:10 - 10:40	COFFEE BREAK	Congress Foyer

Session 13 Room A

10:40 - 11:00	Author(s): KAMINSKA Olha, CORNELIS Chris and HOSTE Veronique Title: <i>Fuzzy-Rough Regression Approaches for Emotion Intensity Ordinal Classification</i>
11:00 - 11:20	Author(s): SINGH Shivani and SOM Tanmoy Title: <i>Intuitionistic Fuzzy Rough Set Assisted Missing Data Imputation</i>
11:20 - 11:40	Author(s): DRYGAŚ Paweł Title: <i>On a certain operators on Atanassov's intuitionistic fuzzy sets theory</i>
11:40 - 12:00	Author(s): IGLESIAS-REY Sara, PAPČO Martin, BUSTINCE Humberto and LOPEZ-MOLINA Carlos Title: <i>Moderate Deviation Functions as Comparison Operators in Anisotropic Diffusion</i>

Session 14 Room B

10:40 - 11:00	Author(s): MOČKOŘ Jiří Title: <i>Semiring-valued fuzzy sets</i>	
11:00 - 11:20	Author(s): PASEKA Jan and SOLOVJOVS Sergejs Title: <i>Injective hulls in a category of V-monoids</i>	
11:20 - 11:40	Author(s): ZHANG Xia, PASEKA Jan, FENG Jianjun and CHEN Yudong Title: <i>Reflectors to quantales</i>	
11:40 - 12:00	Author(s): ONTKOVIČOVÁ Zuzana and KISELÁK Jozef Title: <i>Choquet-Radon-Nikodym derivatives and their use in fuzzy φ-divergence</i>	
12:15 - 13:30	LUNCH	Restaurant

Session 15**Room A**

13:40 - 14:00	Author(s): GRZEGORZEWSKI Przemysław Title: <i>On Association Analysis Between Fuzzy Data</i>
14:00 - 14:20	Author(s): FUMANAL-IDOCIN Javier, INDURÁIN Alfonso, MINÁROVÁ Mária, FERRERO-JAURRIETA Mikel and BUSTINCE Humberto Title: <i>A generalization of the gravitational clustering algorithm to detect anomalies</i>
14:20 - 14:40	Author(s): ANTUNES-SANTOS Felipe, LOPEZ-MOLINA Carlos, MIR-FUENTES Arnau, MENDIOROZ Maite and DE BAETS Bernard Title: <i>Fuzzy clustering for content-aware image smoothing</i>
14:40 - 15:00	Author(s): MIR-FUENTES Arnau, ANTUNES-SANTOS Felipe, FERNANDEZ Javier and LOPEZ-MOLINA Carlos Title: <i>Fuzzy clustering for center point detection in 2D objects</i>

Session 16**Room B**

13:40 - 14:00	Author(s): GRIGORENKO Olga and ŠOSTAK Alexander Title: <i>Topological properties of an extensional fuzzy metric space</i>
14:00 - 14:20	Author(s): BETS Raivis and ŠOSTAK Alexander Title: <i>Some Remarks on Strong Fuzzy Metrics</i>
14:20 - 14:40	Author(s): STUPŇANOVÁ Andrea Title: <i>The links between directional derivatives and other directional properties of functions</i>
14:40 - 15:00	Author(s): BEGANOVÁ Juliana, STUPŇANOVÁ Andrea and ŠPIRKOVÁ Jana Title: <i>Penalty Function Versus Moderate Deviation Function</i>

15:00 - 15:30	COFFEE BREAK	Congress Foyer
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16:30 - 17:30	FOOTBALL MATCH
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19:00 - 22:00	GALA DINNER
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FRIDAY, FEBRUARY 4**INVITED TALK****Congress**

9:30 - 10:30	Speaker: Marek Gagolewski Title: <i>Clustering and Aggregation</i>
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10:30 - 11:00	COFFEE BREAK	Congress Foyer
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INVITED TALK

Congress

11:00 - 12:00 **Speaker:** Libor Běhounek
 Title: *Making the domains of fuzzy sets explicit*

12:00 - 12:15 **CLOSING CEREMONY**

Congress

12:15 - 13:30 **LUNCH**

Restaurant