Summary of the results in IRAFM in 2019

- Study of basic operations on fuzzy sets and fuzzy relations with mutually different domains.
- Study of the relational semantics for fuzzy propositional modalities with truth-value gaps.
- A new algebra for partial fuzzy logic is proposed and applied to the problem of dragonfly species recognition.
- Sequences of orthopairs are special sequences of rough sets dealing with refinement processes of information and missing data.
- Research on topological and dynamical properties of compact spaces. The main aspects included fixed points, minimality, homogeneity and surface dynamics.
- We studied possibilities for extension composition of fuzzy relations that includes "unavoidable features" and elaborates missing values.
- We studied minimal spaces with degenerate homeomorphism groups.
- We gave numerous interesting examples in rotation theory using an embedding technique called Brown-Barge-Martin embedding.
- We studied a class of embeddings of tent inverse limit spaces. We introduce techniques relying on the Milnor-Thurston kneading theory and use them to study sets of accessible points and prime ends of given embeddings.
- We studied the topology of non-uniformly hyperbolic attractors and study also the existence and prevalence of points with more complicated local structures in simple models of planar attractors, focusing on unimodal inverse limits setting.
- We proved that for a chainable continuum where every point has only finitely many coordinate projections contained in a zigzag there exists a planar embedding such that this point is accessible. We also studied a class of arc-like (circle-like) continua that can be described as inverse limit spaces with a single interval (circle) bonding map which is long-zigzag map.
- We proposed a new construction of ordinal sums of t-norms and t-conorms on bounded lattices using interior and closure operators.
- We studied the properties of phi-irregular sets, that is the sets of points for which the Birkhoff average diverges.
- We considered the properties of so called Slovak spaces (compact spaces with cyclic group of homeomorphisms generated by a minimal homeomorphism) and almost Slovak spaces (compact spaces in which the square of every homeomorphism is the power of the same minimal homeomorphism).
- We studied laws of large numbers for random variables evaluated using gradual numbers.
- We searched weak solution for bounded value problem, where weak solution has a form of inverse higher-degree F-transform.
- We obtained results in searching approximate solution of partial differential equations using higher-degree F-transform.
- We found various ways how extensional fuzzy numbers can be ordered inside the theory of MI-algebras.
- We finalized research in the area of F-transform and an image represented by a fuzzy function.
- We focused on the research of neural nets (techniques for preprocessing of data for supervised and semi-supervised classification
- We developed software for determination of selective color.
- We constructed mixing fully chaotic system.
- We developed a theory of soft topological spaces.
- We developed the notion of four-fold table in the context of mining fuzzy associations from data and studied its properties.
- We have developed algorithm for computation of fuzzy dynamic system given by partially linear functions on an interval.
- We studied nullnorms and uninorms on bounded lattices.
- We studied several aspects of (non-additive) measure and integral theory.
- We proposed a novel concept of Scatter for probability distribution (on [0,1]).
- We proposed some special dynamic weights allocation methods to gradually allocate weights and accumulate allocated parts to each criterion, and finally, obtained a total weights collection.
- We introduced Choquet integral on bounded posets.

- We defined parameterized families of OWA weights functions and discussed some related mathematical properties.
- We studied several generalizations of monotonicity. We proposed a new notion of monotonicity: strengthened ordered directional monotonicity.
- We studied relationships between F-transforms based on variants of fuzzy partitions and R-semimodules homomorphisms are investigated, where R are appropriate semirings defined on complete residuated lattices or MV -algebras.
- We introduced automata defined by monads in categories as special examples of monoids actions on free T-algebras, where T is a monad in a category.
- We introduced two categories of lower and upper lattice-valued F-transforms with fuzzy relations as morphisms.
- We defined fuzzy set powerset theory. The fact that this theory is defined by the monad are one of the key tools that enable the application of this theory also in computer science.
- For general powerset theories in categories, new terms of relational, closure, or partition powerset theories in these categories are introduced.
- The notion of a monadic automaton in a category with input and output morphisms and a language accepted by this monadic automaton are introduced.
- For general powerset theories in categories, relational power-set theories in these categories are introduced.
- We introduced a new preprocessing of data for neural nets.
- We studied properties of the quantifier Many and introduced we quantifiers „A few" and „Several".
- We applied fuzzy techniques to time series analysis, namely forecast and decomposition of seasonal and financial time series, and provided a method for identifying bull and bear phases of financial time series.
- We introduced a new construction of test spaces to the variational Galerkin method based on a uniform fuzzy partition as well as its generalized types.
- We provided characterization of maps with shadowing and limit shadowing for maps on the unit interval. We extend some older proving techniques, showing among other things, that for piecewise monotone interval maps both definitions are equivalent.
- We introduced and original algorithm for finding monotonous intervals in a time series evaluated by the same linguistic expression.
- We implemented in MATLAB - existing interpolation method with F-trnasform applied to Image Inpainting
- Lattice-valued fuzzy relations are shown to be a source of structuring elements in algebraic mathematical morphology. We consider adjoint morphological operators based on non-commutative monoidal operations.
- We studied fuzzy Fredholm integral equations and their approximate solutions
- A new image reconstruction (inpainting) method is proposed on the basis of extended non-local operators and their F-transform interpretation.
- New dimensionality reduction techniques are developed. We study manifolds where closeness is determined by fuzzy partition units.
- We study various approximation spaces: fuzzy topologies, pre-topologies, rough sets, etc., where closeness is determined by fuzzy relations. We show that they can be characterized as images of lattice-valued fuzzy sets after one of the two adjoint compositions.
- We focused on a design of deep NNs with kernels inspired by the higher degree F-transform. We show their usability for various image processing problems.
- We contributed to the theory of L-fuzzifying topology proposed by Ying's. We established the adjointness between the category of L-fuzzifying approximation spaces based on reflexive L-fuzzy relations and the category of L-fuzzifying pretopological spaces.
- We introduced the notion of LM-valued fuzzy partition and LM-valued F-transforms. Further, we established a relationship between LM-valued fuzzy rough sets and LM-valued F-transforms.
- The new topic focuses on ordering of extensional fuzzy numbers and the construction of metric spaces based on their arithmetics [132].
- We started to develop a prototype of a WEB version of LFLForecaster.
- We developed an algorithm for top-k search in relational databases when using non-monotonig evaluation function.

- We found with sociologists that one of the barriers of the asylum house users when visiting medical doctors is not bad treatment of medical staff but rather insufficient budget for the town transport.
- We developed a methodology for ensembling of regression models using fuzzy IF-THEN rules.