

Mathematical Institute Slovak Academy of Sciences

Accreditation Report of the Mathematical Institute
for the Period 2003-2006

February 28, 2007

Editors: A. Dvurečenskij, K. Nemoga
Technical Editors: M. Hyčko, P. Vadovič

Questionnaire

Summary of the main activities of a scientific Organisation of the Slovak Academy of Sciences

Period: January 1, 2003 - December 31, 2006

I. Formal information on the assessed Organisation:

1. Legal name and address

Mathematical Institute of the Slovak Academy of Sciences,
Štefánikova 49, SK-814 73 Bratislava, Slovakia

2. Executive body of the Organisation and its composition

Directoriat	name	age	years in the position
director	Anatolij Dvurečenskij	57	1999 -
deputy director	Karol Nemoga	53	1990 -
scientific secretary	Karol Nemoga	53	1990 -

3. Head of the Scientific Board

doc. RNDr. Karol Nemoga, CSc.

4. Basic information about the research personnel

- i. Number of employees with a university degree (PhD students excluded) engaged in research and development and their full time equivalent work capacity (FTE) in 2003, 2004, 2005, 2006 and average number during the assessment period

ii. Organisation units/departments and their FTE employees with the university degree engaged in research and development

Research staff	2003		2004		2005		2006		average	
	No.	FTE	No.	FTE	No.	FTE	No.	FTE	No.	FTE
organisation in whole	53	32,31	57	33,18	59	35,87	59	37,67	57	34,758
Mathematical Institute, Bratislava	24	14,56	27	16,61	30	18,76	29	18,56	27,5	17,123
Dpt. of Computer Science, Bratislava	10	4,5	10	3,71	9	4	9	5	9,5	4,3025
Branch Mathematical Institute, Košice	14	10,15	14	9,35	14	9,6	14	9,6	14	9,675
Inst. of Math. And Comp. Science, Banská Bystrica	5	3,1	6	3,51	6	3,51	7	4,51	6	3,6575

5. Basic information on the funding

- i. Total salary budget¹ of the Organisation allocated from the institutional resources of the Slovak Academy of Sciences (SAS) in 2003, 2004, 2005, 2006, and average amount for the assessment period

Salary budget	2003	2004	2005	2006	average
total salary budget (millions of SKK)	11,423	11,485	12,194	13,578	12,170

6. URL of the Organisation's web site

MI SAS, Bratislava: <http://www.mat.savba.sk>,

Department of Computer Science, Bratislava: <http://www.ifi.savba.sk>

MI SAS, branch in Košice: <http://www.saske.sk/MI>,

Institute of Mathematics and Computer Science, Banská Bystrica: <http://www.savbb.sk>

II. General information on the research and development activity of the Organisation:

Mathematical Institute of the Slovak Academy of Sciences was founded on March 1, 1959, under the name Cabinet of Mathematics. It changed its name to Mathematical Institute in 1966. In 1978, the Branch of the Mathematical Institute, Košice, was founded; prof. RNDr. J. Jakubík, DrSc. is the Head of the Branch. In 1993, Cabinet of Computer Science was joined

¹ Sum of the brutto salaries without the fund contributions.

to Institute of Mathematics, today Department of Computer Science, the head is RNDr. Imrich Vr'čo, DrSc. In 2001, we have founded as a new branch of the Institute of Mathematics in Banská Bystrica, Institute of Mathematics and Informatics, the head is doc. RNDr. R. Nedela, DrSc.

From a small group at its beginning, the Institute culminated in the eighties, and after the economical changes in our country, many of our collaborators moved to work mainly at universities in Bratislava, Košice, Banská Bystrica and other Slovak universities, as well as in Czech republic, Austria, Germany, Switzerland, UK, USA, Canada.

Mathematical Institute always belonged to the top of Slovak mathematics. It is still a center of mathematical research in many branches of Math. Here many new mathematical ideas, schools, and seminars started to be a permanent part of the Slovak mathematical life. The first school was one of semigroup theory, prof. Š. Schwarz, with knotting algebraic structures, mainly theory of partially ordered groups, prof. J. Jakubík.

Here started also a world known famous Slovak school on graph theory, prof. Kotzig, prof. Bosák, prof. A. Rosa which also today has prominent representatives: Drs. I. Vr'čo, M. Kochol, O. Sýkora (he passed away unexpectedly in 2005), R. Nedela, M. Kochol, P. Mihok.

It is necessary to mention also the Slovak school on real function, prof. L. Mišík, Dr. J. Borsík, and on measure theory and integration, Drs. I. Dobrakov, M. Duchoň, prof. B. Riečan, Dr. J. Haluška. Nowadays topological methods are studied by profs. R. Frič, Ľ. Holá,

Another famous mathematical branch which initiated here was theory of dynamical systems (profs P. Brunovský, M. Medved', M. Fečkan, etc.). In the eighties, a group of statisticians and probabilists moved to the Institute (profs L. Kubáček, A. Pázman, S. Pulmannová, A. Dvurečenskij, G. Wimmer).

A very active group is concentrated around number theory: Drs O. Strauch, S. Jakubec, K. Nemoga.

Foundation of our Branch in Košice played an unrepeatable role in the development of the mathematical life in this eastern metropolis of Slovakia, namely in the work of Košice's mathematicians in two seminars, Seminar on Set Theory organized by prof. L. Bukovský, and Seminar on Algebraic and Topological Structures organized by Prof. Jakubík.

A famous Slovak computer science school has also one of its roots in the Institute of Mathematics, namely during activity of Prof. J. Gruska, he started to study the complexity of programming language. Then the whole school is working /worked here: Drs. I. Vr'čo, O. Sýkora, J. Hromkovič, M. Vajteršic, G. Jirásaková.

A world reputation gained the Mathematical Institute in quantum structures (Profs. S. Pulmannová and A. Dvurečenskij with their school). Theory of quantum structures was motivated by mathematical foundations of quantum mechanics, and both, Profs. S. Pulmannová (2001-02) and A. Dvurečenskij (2004-06), were presidents of International Quantum Structures Association.

Mathematical Institute SAS succeed during its all 48-year existence the highest level in basic research in mathematics which is comparable in the best international mathematical traditions. It belongs to the best institutes in the frame of the Slovak Academy of Sciences which was confirmed also by its activity within the last two years, 2005, 2006 at the evaluations of SAS. Mathematical research of the Mathematical Institute has a long tradition with internationally recognized results.

For Math of the 21st century one can say that it will be a strategy key of the cultural and economical development of all nations. Math is an integrated part of many technological discoveries, e.g. applications into IT, computer science, communication technologies, physics, finance and economy, fuzzy technologies, etc. The scientific level of any science or technology depends on the level of mathematical methods used in it. The impact of Math will be a determining for development of knowledge society and knowledge economy. Many of research programs within 6th -7th Frame Program have roots in mathematics and computer science.

Mathematical Institute during whole its history paid a great attention to Phd. study. Many tenths of famous Slovak mathematicians defended their PhD theses at our Institute, as well as their DrSc.-theses (the highest scientific degree in our country). Also after opening the border, in the last five years, one Italian, German, and one Maltese PhD student obtained their PhD degree at our Institute. One of a very important feature of our Institute is a long-year cooperation with our universities, because it is the most direct way how to transfer the most modern mathematical results among students. This collaboration is the most large one among institutes of the Slovak Academy of Sciences.

Nevertheless that after the political changes, there are very limited financial possibilities for our Library, it is the best in Slovakia. The last period we have started to collaborate with Zentralblatt für Mathematik, doing reviews of Slovak mathematical journals. Therefore we have a free access to database of Zentralblatt as well as hard copies.

We are publishing three journals: *Mathematica Slovaca* (since 1951; this year it will be published under Springer Verlag), *Tatra Mountains Mathematical Publications* (since 1993; each volume is dedicated to some special subject, and some volumes are indexed to Scientific Book Contents, CC/ Physical, Chemical & Earth Sciences), and in 2006 a new journal was founded, *Uniform Distribution Theory*.

1. Mission Statement of the Organisation as presented in its Foundation

Charter

Mathematical Institute of the Slovak Academy of Sciences, is a scientific organization with the budgetary economy. It was founded on March 1, 1959. The Institute is concentrating to the basic research in mathematics (mainly logic and set theory, number theory, algebraic and topological structures, quantum structures, discrete mathematics, real and functional analysis, dynamical systems, probability theory and mathematical statistics). In computer science theory, the research is focused to theory of algorithms and computing complexity and to theory of formal languages, automata and numerical systems.

The Institute provides advisory and expert analysis concerning the main scientific activity in area of applications of mathematical methods. It could according to Act 133/2002 *On Slovak Academy of Sciences* perform enterprise activity with respect to its main scientific activity like performing program tools, their sale and updating in area of applied mathematics, and to organize specialized seminars and conferences, and publishing publications in area of applied mathematics.

The Institute participates on pedagogical process at PhD studies according to valid legal regulations.

The Institute ensures publications of results concerned with research activity through the mathematical journals.

2. Summary of R&D activity pursued by the Organisation during the assessed period, from both national and international aspects and its incorporation in the European Research Area (max. 10 pages)

In period 2003-2006, the mathematical research was concentrated to the following groups.

Number theory and cryptography

- Analytical number theory and probabilistic number theory
- Algebraic and elementary number theory of solution of diophantic equations
- Cryptography

Uncertainty modeling by statistical methods, quantum structures, and fuzzy sets

- Statistical methods in measurement, linguistic, and medicine
- Quantum structures as mathematical base for quantum mechanics and quantum computing
- Fuzzy sets as mathematical base for modern fuzzy technologies

Ordered algebraic structures and discrete structures

- Ordered sets and algebraic structures
- Graphs and optimizing algorithms

Dynamical systems, real and functional analysis, and topology

- Periodic and chaotic solutions of nonlinear systems
- Numerical methods
- Integration in vector, topological and ordered spaces
- Topological methods
- Optimizing methods of gas transport in transit gas-pipe line system

Computer science and data processing

- New algorithms for extensive numerical and non-numerical problems for large systems of high effective computers
- Topological and communications network problems
- Data mining

Applications of mathematical research in praxis

- Cryptographic methods in state administration and for National Security Bureau
- Applications in optimizing methods to Slovak Gas Company
- Prevention and detection of defects in gas pipe line system
- Mathematical methods for Nuclear Power Plant Research Institute

The most important results

2003

a. Results of Pure Mathematics

A generalization of Čencov-Amari uniqueness was found for quantum information geometry. Dual affine alpha-connections and alpha-divergence were defined for von Neumann algebras, using the geometry of non-commutative L_p spaces. An upper bound was found for geodesic distances for monotone metrics on density matrices.

author: Anna Jenčová

project: 1/0264/03 New nonlinear methods of mathematical statistics

b. Results of Applied Mathematics

A computational complex for simulation and optimization of complex gas pipeline systems was further improved for the needs of gas transport. Modification of partial differential equations describing gas behavior was obtained. This enables acceleration of necessary computations. Complex is tested in the Slovak gas transport company.

authors: M. Bayer, R. Hajosy, A. Huček, M. Kontriš, K. Nemoga, P. Somora, M. Spál, T. Žáčik (head)

project: Algorithms for physical-mathematical model of gas flow

c. Results of International Projects

We have found a general relation between distribution of points in the unit square and distribution of differences of coordinates of these points in the unit interval. This gives a general point of view to some results of other authors. This paper is a product of a cooperation of Mathematical Institute SAS and the University in Saint-Etienne.

authors: O. Štrauch, M. Paštéka a G. Grekos

project: Research in number theory and their applications

d. Other Important Results

- A parallel two-sided block Jacobi algorithm was generalized.
- We solved a problem of Grande on a characterization of points of string quasi continuity.
- We found a new algorithm for boss choice in cycles.
- We showed that existence of at least one finitely additive state non-vanishing on each finite-dimensional subspaces of a Hilbert space gives a new completeness criterion.
- We solved a 15-years old problem on existence of a finitely additive state on $F(S)$ for an incomplete inner product space. One showed e.g. any incomplete hyperplane has the property.
- A partial solution of Pitrowksi's problem on the set of points of quasi continuous functions in metric spaces was found.
- We characterized a combinatorial characterization of allowed sets in the class of Arbault's sets and No-sets are perfect of the first category.
- The existence of periodic solutions for an oscillating bar was proved.
- A conditional law of large numbers and the Bayesian interpretation of maximal probability methods and maximal entropy were proved. We showed that maximalization of the Rényi-Tsallis entropy contradicts the conditional law of large numbers.
- We proved that there exists a bijection among torsion classes of Carathéodory vector lattices and vector lattices of generalized Boolean algebras.
- Some conditions for cancellation of direct products were studied for lattice ordered groups.
- Every abelian l-group that is a nontrivial lexicographical product is not affinely complete.
- Upper bounds for the Riemann distance with respect to monotone metric were found.
- We proved that upper estimations for state complexity of mirror pictures could be obtained by chaining binary regular languages.
- We proved that the number of nowhere zero integer valued k -tensions in graphs is a polynomial function on k .

- A notion of convergence with a regulator in an l-group was proved and the existence of Cauchy completion of such convergence was studied.
- The class of ordered convexities of Riesz groups was studied.
- A characterization of n -contractive t -norms a representation of a "two-fold" integral as a special case of composed aggregation operator was given.
- A new bipolar aggregation operator was presented.
- A generalization of graph decomposition uniqueness of infinite groups.
- We characterized invariants that are additive with respect to reducible hereditary graph properties.
- We suggested, implemented and tested a new parallel Jacobi SVD algorithm, and its version for grid topology of parallel computer.
- We suggested, implemented and tested a new parallel for matrix-vector multiplication by grammian of a block matrix with Toeplitz blocks whose row dimension is sharply different of its column dimension.
- A formula for length of uniqueness for a stationary markov source was derived.
- We found a new proof of the fact that every bounded distributive lattice is isomorphic to the lattice of ideals of some local matrix ring.
- The tensor product of universal groups of divisible effect algebras is a universal group of the tensor product of these effect algebras. We showed that the tensor product of two unit intervals of real numbers in the category of effect algebras is not a lattice giving an answer to an old open problem.
- A categorical isomorphism of pseudo MV-algebras and positive bounded minimal clans was proved.
- We proved that the space of tensors over Lie algebra in which the Lie bracket is given by commutators is a Hopf algebra. We characterized some types of double integrals appearing by solution to quantum Yang-Baxter equations.
- Lower estimations for three-parametric distributivity of the Sacks forcing were found.
- The stability of the graph property "To have a hamiltonian prism" was established.
- A new modification of the stream cipher for multiple secure usage was proved.
- We proved that the sequence of divisions of n th prime with n reduced modulo 1 has the same distribution function as $\log(n \log n) \bmod 1$
- New computing complexity results on the Nash equilibrium were obtained.
- A unitary theory of a large class of linguistic properties was established.

2004

a. Results of Pure Mathematics

Three coloring of graphs

To find a 3-colouring of a graph is a very difficult (NP-complete) problem even for special classes of graphs (planar, with maximal valency at most four, etc.). We have studied the subclasses of the class of graphs with valency at most four characterized by subgraphs induced by neighborhoods of maximal vertices. We have showed that for such subclasses, the 3-coloring problem is either NP-complete, or can be solved in linear time. We also present a linear algorithm for the 3-coloring of locally connected graphs.

author: Martin Kochol

project: 2/4004/04 Chromatic and Flow Problems in Graph Theory

b. Results of Applied Mathematics

Within the framework of cooperation with the ttc, Ltd. company a computational model for gas leak detection has been designed. Based on numerical simulations this model is able to detect gas leaks in pipeline systems. The model was implemented as a software modulus which has been successfully tested on simulated leak of ethylene in real conditions. After the tests the software modulus is being used in standard every-day operation.

authors: M. Bayer, R. Hajossy, A. Huček, M. Kontriš, K. Nemoga, P. Somora, M. Spál, T. Žáčik (head)

project: Gas Leak Detection Model

c. Results of International Projects

We established theory of entropy of effect algebras with the Riesz decomposition property. The presented results contain also entropy on MV-algebras, a most important case of effect algebras. We obtained new results concerning the primary problem of a joint refinement of partitions. The results were obtained within the framework of the joint Slovak-Italian project between the Mathematical Institute of the Slovak Academy of Sciences and Department of Mathematics and Computer Science, University of Salerno, Italy.

authors: A. Di Nola, A. Dvurečenskij, M. Hyčko, C. Manara

project: Algebraic and logical systems of Soft Computing, No. 15.

d. Other Important Results

- The Loomis-Sikorski theorem for monotone sigma complete effect algebras was proved.
- A notion of a state was introduced RI-monoids.
- The sequential topology of regular states in inner product spaces was studied. We showed that the limit of regular states is not necessarily a regular state.
- We describe situation when classical random variables have to be substituted by fuzzy random variables.
- A partial solution to the McCoy problem on approximation of relation by continuous functions in Vietoris topology was found.
- A proof of a strong hierarchy for a multilateral communication complexity was given.
- An answer to a problem of Conrad and Darnel (Order, 1998) on generalized Boolean extensions of vector lattice was presented.
- We characterized WYD metrics in the class of monotone metrics.
- We proved that a non-deterministic state complexity of regular languages representable by state non-deterministic finite automata can attain all values in the interval $[\log n, 2^n]$.
- We studied basis of cyclic and cut spaces in oriented graphs.
- We proved that the functor among finite-dimensional real vector space assigns the space of block structures is a polynomial of the first order.
- We applied entropic relation of uncertainty for quantum two-level systems.
- A characterization of n-contractive torsion t-norms was presented, and new methods of constructing left-continuous t-norms with anomalous couples were obtained.
- We proved new theorems of unicity of decomposition for retractor systems.
 - We classify discrete groups of automorphisms of type (k, m, n) having actions on surfaces integer-valued Euler characteristics.
- We derived enumeration formulas for number of maps of given genus with a given number of edges.
- A categorical equivalence between divisible effect algebras and rational vector spaces.
- A notion of metric semigroup was introduced and theory Kurzweil-Henstock integral in metric semigroups was developed.
- A model for rules learning system from stage classified data was constructed.

- We studied interrelation between usual and convex intersection number was studied and we gave the negative answer to the Halton hypothesis size of regular graphs.
- A calibration problem of measurement by etalon was solved under some conditions.
- We suggested an interval estimation for effects in clinical trials and some simulating procedures were established.

2005

a. Results of Pure Mathematics

RC groups in effect algebras

An RC-group was defined as a unital group G with a distinguished compression base with respect to which G satisfies the Rickart projection and general comparison properties. It was proved that a monotone sigma-complete RC-group is a union of subgroups each of which is a lattice ordered Dedekind sigma-complete RC-group. These results generalize situations in the self-adjoint parts of von Neumann algebras and Jordan algebras.

author: Sylvia Pulmannová

projects: VEGA2/3163/25 Mathematical Models of Quantum Structures; APVT-51-032002 Application of algebraic methods to the problems of modeling uncertainty and handling information; Center of Excellence SAS - Physics of Information I/2/2005

b. Results of Applied Mathematics

A new way how to compute the SVD of dense matrices of order 2000 - 10000 by the parallel block-Jacobi SVD algorithm has been designed, implemented and tested on the cluster of PCs. The main idea consists of the pre-processing of a matrix by its (multiple) QR (QL) decomposition with the column (row) pivoting. The number of outer iterations for well-conditioned matrices has been reduced by two orders of magnitude, whereas the parallel execution time has been decreased roughly ten times. In addition, a new genetic serial algorithm for the decomposition of the complete weighted graph into a defined number of cliques has been designed, implemented and tested. This algorithm is a part of the parallel block-Jacobi SVD algorithm and enables the implementation of a new class of parallel orderings. Results from first experiments will be available in year 2006.

author: Gabriel Okša

projects: VEGA 2/4136/25 Design and implementation of parallel algorithms for information retrieval and modification using linear algebra methods; EP/C513053/1 Parallel Jacobi-like algorithms for the singular value decomposition of large sparse matrices

c. Results of International Projects

Strauch, O., Porubský, Š.: Distribution of Sequences: A Sampler Schriftenreihe der Slowakischen Akademie der Wissenschaften, Band 1, Peter Lang, Frankfurt am Main, 2005, 570 pp.

The present monograph covers material focuses on the distribution properties of sequences. The sequences are listed together with their distribution functions, the discrepancy, diaphony, dispersion etc., depending on our present state of knowledge. The sequences are grouped according to a dominant feature, e.g. sequences involving logarithmic function, trigonometric functions, polynomials, pseudorandom number generators, circle sequences.

Many of them have numerical applications through the so-called Quasi-Monte Carlo method in numerical integration, when approximating the solutions of differential equations, in searching theory, in cryptology or in financial applications. Open problems are also included for further possible research. The book ends with an extended bibliography, followed by the name index and the subject index. The monograph is a result of a long scientific cooperation between Mathematical Institute of the Slovak Academy of Sciences and Institute of Computer Science of the Academy of Sciences of the Czech Republic.

authors: Oto Strauch, Štefan Porubský

project: VEGA 2/4138/25 Number theory and its applications Fuzzy Logics and Their Applications

d. Other Important Results

- We constructed Kolmogorov integral of the first order by an operator measure.
- V collaboration with Prof. Holland we studied top varieties of GMV-algebras.
- We showed that Riečan state and Bosbach state coincide for good pseudo BL-algebras solving an open problem.
- We strengthened a theorem of Erdős-Kunen-Mauldin.
- We presented new categorical techniques for effect algebras.
- We studied weighed Bergman spaces and Toeplitz algebras of operators with respect to different symbols.
- We derived a new relation between polynomial operation in pseudo MV-algebras and corresponding representing unital l-groups, as well as sequential topologies.
- By theory of MV-algebras we solved one problem by Ježek.
- We characterized sufficient mappings on Von Neumann algebras, and a factorization theorem was proved.
- We described states with respect to strong subadditive entropy for an infinite-dimensional Hilbert space.
- We prove deterministic state complexity of the cyclic shift over regular languages.
- We present a new method for number of nowhere zero streams showing the minimal counterexample for hypothesis has to be cyclic edge connective.
- We proved that a chain of real numbers generates the same convexity as the chain of integers.
- We constructed a new continuous functor in algebraic theory of surgeries.
- We studied Taylor tower of a special functor.
- We gave analytical and numerical entropic uncertainty relations for a class of trigonometric Cauchy quantum wave packets.
- For monounary algebras, we proved the Retract Theorem.
- We found conditions when a POV-measure is a coarse graining of another observable.
- Riesz ideals of a generalized effect algebras were characterized.
- We designed a spanner mobile and ad hoc nets.
- We characterized two-dimensional copulas, and three-dimensional distribution functions.
- We presented parallel genetic algorithms for the problem of nearest chains.
- In the space of continuous functions with the fine topology we characterized compact sets and generating uniformity.
- We gained precise results and estimations antibandwidth parameter, and for strong planar cut number.

2006

a. Results of Pure Mathematics

Theory of lattice ordered groups and its applications

Theory of lattice ordered groups nowadays serves e.g. also for description of many-valued logical systems. From this point of view, there was proved that a lattice ordered group which can be expressed as a non-trivial wreath product fails to be affine complete. There was found a one-to-one correspondence between K-radical classes of MV-algebras and K-radical classes of abelian lattice ordered groups. An analogous result was proved for radical classes which are closed with respect to direct products. The properties of the lattice of all sequential convergences (in which the Urysohn's axiom is not supposed to be valid) on an MV-algebra were described. One of Sikorski's results concerning Boolean algebras was generalized for the case of pseudo MV-algebras; an analogous result was proved for lattice ordered groups.

author(s): Ján Jakubík

projects: APVT-51-032002 Application of algebraic methods to the problems of modeling uncertainty and handling information; Center of Excellence SAS - Physics of Information I/2/2005

Lipschitz property of conjunctions in fuzzy logic

Basic operation which models the conjunction in fuzzy logics and related concepts is the so-called triangular norm. This operation can be further generalized (depending on the properties we require from corresponding conjunction) to e.g. t-subnorm or conjunctor. We have focused to investigation of the Lipschitz property of these conjunctions. When choosing the most convenient conjunction to be used, an important factor is whether we are able to estimate how the output errors of the process depend on input errors. This fact is connected with the stability of corresponding conjunction. This influence can be estimated by investigation of the Lipschitz property. Conjunctions can be further divided to classes according to parameters with which they fulfill the Lipschitz property. We have investigated properties of these classes (compactness, convexity) their characterization as well as relations between different classes. Further we have investigated the generalized Lipschitz property for t-norms and we have examined the classes of t-norms in this generalized case.

author(s): Andrea Mesiarová-Zemánková

projects: APVT 51-032002; VEGA 2/6088/26

b. Results of Applied Mathematics

Fast algorithms for gas dynamics simulations in pipelines

Fast algorithms for numeric simulations of gas dynamics in pipelines were developed in the project *The optimization model of natural gas transportation*. Computer implementation of the algorithms is used in the company SPP - preprava, a.s. (Slovak gas transport company) for transport predictions. Transport variants simulations are utilized for the gas transport network settings and controlling in the dispatching center in Nitra.

Head of the project group: RNDr. Tibor Žáčik, CSc.

Project: 1235 The optimization model of natural gas transportation ESF Project 13120200037 - Creation of a stable work group for a development and an application in a gas dynamic research

c. Results of International Projects

Perfect GMV-algebras and many valued logic

GMV-algebras correspond to the most modern algebraic description of many valued reasoning. Using a fundamental result of Dvurečenskij, we studied the variety of perfect GMV-algebras, and an equational base for these varieties was found. The varieties are important because they can be characterized by equations. They allow their usage for computers for dealing with classical and quantum information. We proved that perfect GMV-algebras are always intervals in the lexicographical product of an l-group with the group of integers. We showed that this variety contains uncountably many subvarieties whereas in the commutative case only countably many. We studied the Komori characterization of top varieties of GMV-algebras. We showed that we have only countably many and they fulfill analogical identities as the varieties of MV-algebras.

author(s): Anatolij Dvurečenskij, MI SAS Antonio di Nola (Salerno, Italy) Constantin Tsinakis (Vanderbilt, USA) Charles W. Holland (Bowling Green Uni, USA)

projects: Center of Excellence SAS - Physics of Information - I/2/2005; the grant VEGA No. 2/6088/26 APVT-51-032002; Slovak-Italian No. 15

references: [1] A. Di Nola, A. Dvurečenskij, C. Tsinakis, Perfect GMV-algebras. Comm. Algebra
[2] A. Dvurečenskij, Ch. Holland, Komori's characterization and top varieties of GMV-algebras.

Theory of experiments and sufficiency in quantum statistics

In classical and quantum statistics, sufficiency describes the situation when a "coarse-graining" (restriction, reduction) of a statistical model preserves all statistical information about the parameter. A new characterization of sufficient channels in terms of quantum Fisher information is proved in [1]. Some applications in quantum information theory and quantum statistics are possible. In [2], the theory of quantum statistical experiments is developed in parallel to the classical results. Statistical equivalence of experiments is defined in terms of sufficiency and a characterization of the equivalence classes is found. Two notions of convergence of experiments are studied and the quantum version of local asymptotic normality is proved. The paper provides a theoretical background for some asymptotic results of quantum statistics, e.g. the asymptotically optimal parameter estimation for qubits.

author(s): Anna Jenčová, MI SAS, Dénes Petz (Budapest), Madalin Guta (Nottingham)

projects: CEPI I/2/2005; EU Research Training Network Quantum Probability with Applications to Physics, Information Theory and Biology APVT-51-032002

references: [1] A. Jenčová, D. Petz, Sufficiency in quantum statistical inference. A survey with examples, IDAQP 9 (2006), 331-351.

[2] A. Jenčová, M. Guta, Local asymptotic normality in quantum statistics, quant-ph/0606213.

d. Other Important Results

- An Agliano-Montagna type decomposition for pseudo hoops was found.
- One proved that every proper analytical subgroup of the circle is possible to separate by an F-sigma set, and it can be covered by an F-set whose Lebesgues measure is zero.

- We present a new construction of direct limit of algebras using oriented graphs approaches.
- We characterized the minimal class of semicontinuous multifunctions with values in normal topological spaces.
- A Banaschewski type theorem for pseudo MV-algebras was proved.
- We studied direct products of GMV-algebras.
- We presented a linear algorithm for three-coloring of locally connected graphs.
- We obtained original results on geometric and topological properties of infinite-differentiable varieties and fibres.
- In collaboration with University in Bergene (Norway) tested a new version of numerical solution to 1D Schrödinger equation.
- We proved that the congruence lattice of a free lattice with at least \aleph_2 generators is not isomorphic to any congruence lattice with n -permuting congruencies.
- Effect algebras with a compression base in the sense of Foulis and Gudder we studied Rickart projections.
- The notion of an e -ring by Foulis was generalized for ordered abelian groups.
- We found a necessary and sufficient condition for a sequence of intervals $[k, k+N]$ to obtain a sequence $\phi(n)/n$ ($\phi(n)$ is the Euler function). We extended one Erdős' result.
- We showed that the van der Corputova have no good pseudo-random properties. We improved its properties using a quadratic generator.
- We obtained tight estimation of antibandwidth parameter for complete trees.
- We have a new design for new estimations methods for minor crossing number.

All above important results were obtained in a close collaboration with domestic mathematical centers and mainly with centers in Europe, USA, and Asia, as it follows when we see the list of publications of the Institute. From domestic mathematical centers it is necessary to mention Institute of Measurement SAS, Faculty of Math., Phys., Infor. Comenius Univ., Bratislava, Faculty of Natural Sciences of P.J. Šafárik Univ. Košice, Slovak University of Technology, Bratislava, Matej Bell Univ. B. Bystrica, Žilina Univ., Technical Univ. Košice, etc.

New conditions after political changes in our country opened also a new possibility to collaborate with our colleagues outside of Slovakia to be a valid and active member of the Mathematical European Research Space. Mathematical Institute collaborates with many important foreign mathematicians and mathematical centers. It is worthwhile to mention collaborations with Prof. A. Di Nola, Univ. Salerno, Prof. P. de Lucia, Univ. Naples, Prof. M. Dalla Chiara, Prof. D. Mundici, Univ. Florence, Prof. R. Giuntini, Univ. Cagliari, Prof. F. Montagna, Univ. Sienna, Profs. U. Marconi, R. Moresco, G. Artico, Univ. Padova, Profs. A. Boccuto, D. Candelloro, R. Ceppitelli, S. Caterino, Univ. Perugia (I), Prof. R. Hudson, Univ. Nottingham (UK), Profs. K. Ylinen, P. Lahti, Univ. Turku (SF), Profs. K. Svozil, H. Länger, TU Wien, Prof. R. Tichy, TU Graz, Prof. P. Klement, Univ. Linz, Prof. A. Amann, Univ. Innsbruck (A), Profs. D. Aerts, Free Univ., Brussels, K. Debieve, Prof. Duhoux, Univ. Louvain-la-Neuve (BE), Profs. G. Chevalier, R. Mayet, Univ. Lyon, G. Grekos, Univ. Saint-Etienne, L. Grigori, University d'Orsay, Paris, F. Wehrung, Univ. Caen (F), Profs. D. Buhagiar, E. Chetcuti, Univ. Malta, Prof. G. Altmann, Univ. Bochum (DE), Profs. C. Holland, Bowling Green State Univer., Prof. C. Tsinakis, Univ. Vanderbilt, R.A. McCoy, F. Marko, Pennsylv. Univ., D. Foulis, Univ. Massach., S. Gudder, Univ. Denver, J. Zsilinsky (USA), Prof. T. Sorevik, University of Bergen, Norway, Prof. A. Mednykh, Russia, Profs. Kwak, Univ. Pohang, Hee Sik Kim, Seoul, Korea, Prof. Breda, Slovenia, Prof. D. Petz, Budapest (HU), Profs. P. Pták, M. Navara, CVUT, Prague, Prof. S. Porubský, Czech Acad. Sci, Prague, Prof. J. Rachůnek, L. Kubáček, Univ. Olomouc, P. Hájek, M. Mares, Czech Acad. Sci., Prague (CZ), Prof. K. Györy, Debrecen (HU), etc.

Mathematical Institute has very active collaborations with Univ. of Bergen, Norway, Univ. of Loughborough, UK, Univ. Munster, Univ. St. Etienne, Univ. Salzburg, ETH Zurich, CVUT

Prague, Inst. Informatics CAS and Inst. Infom. Aut. CAS, Prague, Univ. Gdansk, etc. which can be confirmed to invitation to their universities, to participate at the organizations of conferences, or by invitations to present their talk at conferences, as well as by their visits at our Institute in all three cities, where we have branches. Our collaborators are members of editorial boards of many important scientific journals, and vice versa, many famous foreign scholars are members of the editorial boards of our journals.

As an example, Prof. A. Dvurečenskij was elected in Denver for a president of the International Quantum Structures Association for the period 2004-2006, and he was president of the 8th Biennial Meeting IQSA 2006, Malta.

In the Third and Fourth Framework Programs Mathematical Institute had couple of projects within this program. Unfortunately, when Framework Program started to be oriented more to applied projects, mathematical projects are not welcome in this Program. Anyway, the last year we started to participate at the 6th Framework Program, BAMOD, *Breath-gas analysis for molecular-oriented detection of minimal diseases* together with Univ. Innsbruck and Institute of Measurement SAS. Besides this program our Institute participated at programs of INTAS, COST, CEEPUS, NATO, ESF, bilateral projects, SR-France, SR-Italy, SR-Belgium, SR-Czech r., etc.

As an interesting fact of a large scientific international cooperation, we recall that our Institute has also a long-year collaboration with Slovak Gas Company, where we are optimizing transport of gas in a gas-pipe line system. At this project we collaborated with Institute of High Energy, Sarov, Russia, a former top secret Soviet institute where Soviet atomic bombs were developed.

3. Concept of R&D activity of the Organisation for the next four years (max. 5 pages)

i. Present state of knowledge and status of ongoing research related to the subject of the Concept, from both international and national perspective

Mathematics forms an organic unit. All its parts and their development are mutually interacting. Impulses for mathematical research accrue from the needs to solve problems appearing in mathematics itself in interaction with growth of new information as well as from interaction between mathematics and other scientific areas.

Institute of Mathematics is one of the most important mathematical centers in Slovakia which is studying development of theoretical mathematical questions having its source of inspiration in natural sciences (physics, biology, chemistry, astronomy, meteorology), technology (electro engineering, civil engineering, chemistry, transport, measurement, statistics, linguistic, nuclear technology), informatics (cryptography, IT), economy and banking, and applications of mathematical methods for optimizing, prevention and detection of defects of gas transport pipe line system.

On the other side there is a non-substitutable role of the Institute of Mathematics in increasing qualifying level of population via PhD study and participating at the education process in mathematics at our universities. The development of the information society and knowledge economy is temperamentally connected with usage of mathematical methods and extending its pieces of information. Its development will be inspired by new stimulus coming from prevention and spreading IT, quantum information, biological and medical systems, development of nanotechnologies and new materials, environment protection, as well as

from social law and economical knowledge. The level of other branches will be given by the level of their “mathematization”. Simulation and optimizing of technological, pharmaceutical, geological, meteorological and other techniques via mathematical methods allow them to minimize financial costingness of their own research.

It is worth recalling, in February 2006, the American president Mr. G. Bush decided to give 20 milliards USD from the resources assigned primary for experimental biology to development of mathematics and physics. This unexpected decision indicates that American mathematicians and physicists assured Mr. G. Bush that without serious development of both these branches it is not possible to expect serious results and development in other scientific branches. This convinces that mathematical and physical education is useful for any country, not only for USA.

ii. Organisation’s role or significance in the overall research effort within the field of the Concept on both the national and international scales

Mathematical Institute of the Slovak Academy of Sciences during whole his history belongs to top mathematical research centers in our country, whose results are comparable with the best mathematical tradition in the world. Namely in number theory and algebra, statistics, graph theory, quantum structures, topology, mathematical analysis, and computer science, etc. According to the last accreditation, the research programs of the Institute participate at the determination of world mathematical trends. The methods of our research are modern at a high international level. Our colleagues are very active in the World Mathematical Research Space which is confirmed by a large number of joint publications, activity in international research projects, invitations at prestige scientific meetings and universities, and visits of prominent mathematicians at our Institute. The high credibility of our institutes is confirmed also by successful doctoral studies of young mathematicians from EU countries (Italy, Germany, Malta). Our Institute of Mathematics is a fixed and important integral part of Math.

iii. Objectives of the Concept

The aim of our Institute for the next four years is to continue in basic mathematical research in which we gained important results. We will concentrate to the following fields:

1. Number theory and cryptography

Number theory belongs to the oldest mathematical fields and it has its origin already in antic Greece. Nevertheless it is one of the most important mathematical subjects which also today in time of informatics boom lives over its great development and it is its integral part. Extension and advanced technology of modern computers brought also a new and unexpected development of number theory. Nowadays security of informational data, banking or cryptography is staying on results of number theory.

Mathematical Institute SAS traditionally belongs among top Slovak mathematical centers of number theory, and its results belong among important world recognized results.

Number theory will belong among basic trends of the mathematical research with the following directions:

- Analytical number theory and probabilistic number theory
- Algebraic and elementary number theory of solution of diophantic equations
- Criteria of pseudo randomness
- Cryptography

2. Uncertainty modeling by statistical methods, quantum structures, and fuzzy sets

Uncertainty modeling is one of the basic problems of measurement in many scientific and technological areas having practical applications in every-day life, including economy. The notion of uncertainty is developing according to width and deep of our knowledge. Modeling is based on deep theoretical results, mainly mathematical statistics, algebraic structures, fuzzy and many-valued logic, and topological and categorical views. Mathematical Institute succeeds top results comparable with the highest world results namely in applications of statistical methods for example in medicine, metrology and linguistic. Measurement of observables in quantum mechanics is based on results of quantum structures, here MI SAS plays a leading role in worldwide scale. Results of our protagonists were published already in three monographs. The latest results show to the necessity of modeling compound systems by fuzzy approaches. Today fuzzy theory is a base of many modern fuzzy technologies. The results of our colleagues showed that there is an intimate connection between many-valued logic and algebraic structures, like MV-algebras or pseudo MV-algebras and lattice ordered groups.

Our colleagues achieved excellent results in those directions and MI SAS is collaborating with many domestic and foreigner centers.

Envisaged directions for this area are:

- Statistical methods in measurement, linguistic, and medicine
- Quantum structures as a mathematical base for quantum mechanics, quantum computing and soft computing
- Fuzzy sets as a mathematical base for modern fuzzy technologies

3. Ordered algebraic structures and discrete structures

In area of ordered algebraic and discrete structures and graph theory, Mathematical Institute SAS has a long-year and successful tradition which goes back the beginning of our Institute. Ordered structures like partially ordered sets and ordered groups are studying on many important mathematical centers. The problem nowadays is related with computational complexity, optimizing dissimilation and combining of many substructures. This is characteristic for microchip construction or for description of very complicate molecules or graphs coloring problems.

Envisaged planes for this research are:

- Ordered sets and algebraic structures
- Graphs and optimizing algorithms
- Algebraic combinatorics

4. Dynamical systems, real and functional analysis, and topology

Very complex processes in technological branches, dynamical systems, as well as in biological milieu need description via nonlinear differential systems. A chaotic behavior of these systems requests qualitative study between a discretization and original differential equations understood from dynamical theory point of view. Study of modern trends of both analytical and topological methods to boundary problems has at MI SAS a long tradition. Developed methods of convergence processes are basic for use of temporary computer facilities. For calculating and optimizing compound systems we are developing algorithms that are used with a great success in gas pipeline transport systems, as well as in tone systems.

Applications of these methods have a very large variety of applications in technology, national economy, environment protection, and make a large base of knowledge for practical use.

We are planning concentrate to the following directions:

- Periodic and chaotic solutions of nonlinear systems
- Numerical methods
- Integration in vector, topological and ordered spaces
- Topological methods
- Optimizing methods of gas transport in transit gas-pipe line system

5. Computer science and data processing

Computer science and data processing is a new paradigm in the area of data processing using Internet or WWW. In this conception we suppose access to globally distributive computational means as well as to information and knowledge. It is important that Slovakia will participate at this research.

Envisaged subvarieties of the research:

- New algorithms for extensive numerical and non-numerical problems for large systems of high effective computers and for a finding minor cut number
- Distributive calculations in modern communication systems
- Theoretical problems with accent to linear network deposition
- Parallelization of a two-sided Kogletlian and a one-side Jacobi methods for SVD calculations

6. Applications of mathematical research in praxis

Mathematical Institute SAS understand very well that nothing is more practical than a good theory. We are planning to continue with a successful collaboration with important Slovak enterprises and institutions. It will deal mainly with application in the following areas:

- Cryptographic methods in state administration and for National Security Bureau
- Applications in optimizing methods to Slovak Gas Company
- Prevention and detection of defects in gas pipeline system
- Mathematical methods for Nuclear Power Plant Research Institute

The scientific activity in above outlined directions is important not only to implement our Institute in a strategic area of development in IT, but the achieved results will represent also our concrete contribution to the knowledge society and the knowledge economy in Slovakia.

7. Participation at Phd studies and pedagogical activities

To achieve the envisaged plans is possible only in a collaboration with all generations in our Institute. The main ask will be to dedicated to the preparation of young colleagues for their mathematical career, and the best way is to incorporate them into research teams. This is possible to with a close cooperation with Slovak and foreign universities.

iv. Proposed strategies and methods to be applied, and time schedule

The project of the mathematical research at the Mathematical Institute of the Slovak Academy of Sciences for the next four years present a very courageous but realistic project which rise up from the best mathematical traditions of the Institute, and the newest trends and needs in mathematics. To perform this project we will collaborate with all mathematical centers at Slovak Academy of Sciences and at universities in Slovakia. We have some active scientific contracts with universities, as well our industry, and we have to continue in this direction. Here it is necessary to mention Institute of Measurement SAS, Faculty of Math., Phys., Infor. Comenius Univ., Bratislava, Faculty of Natural Sciences of P.J. Šafárik Univ. Košice, Slovak University of Technology, Bratislava, Matej Bel Univ. B. Bystrica, Žilina Univ., Technical Univ. Košice, etc. The development of the knowledge economy of Slovakia will be depend also on fact how it will be possible to implement mathematical research also into new companies in Slovakia (Pegeut, Volkswagen, Kia) and in domestic strategic enterprises. Therefore, it will growth also the number of students of mathematics at universities, to profound their mathematical education and to found mathematical teams there.

The economical power of USA depends also in their ability how they are able to incorporate mathematics into needs of technology and praxis. The mathematical level of USA increased also due to immigration of famous mathematicians from the former Soviet Union. Therefore, we need technical and economical conditions for mathematicians, as well as for any young researcher, to reverse brain storm back to Slovakia.

This is possible to do only in a very narrow collaboration with famous mathematical centers in Europe, and in the whole world. The mathematics cannot be divided to Slovak, German, or Russian one, only to good mathematics and to other one. Mathematical Institute is collaborating with many foreigner mathematical centers in abroad. We have many signed collaborations but also many informal but very active ones, and we will continue in looking for a new possibilities to be involved in projects in Framework Programs, COST, ESF, APVV, VEGA, etc. and in applications of mathematical methods in society and economy. The crucial key will be in our possibility in involving young mathematicians, Slovak and foreigner ones, into research teams via doctoral and post doctoral studies.

In number theory we are planning to collaborate with Prof. Pierre Liardet, Marseille, CMI, Prof. S. Porubský, Inst. Inform. Czech. Acad. Sci, Prague, prof. Georges Grekos, Univ. Saint-Etienne, France, Prof. F. Marko, Univ. Pennsylvania, USA, Prof. K. Györy, Debrecen Univ., Hungary.

Topological methods will be studied in an active collaboration with Prof. R.A. McCoy, USA, Prof. U. Marconi, R. Moresco, G. Artico, Padova, R. Ceppitelli, S. Caterino, Perugia, Italy, L. Zsilinszky, USA, etc.

Many-valued logic, quantum structures will be studied with Profs. C. Holland, Bowling Green Uni. C. Tsinakis, Uni. Vanderbilt, D. Foulis Uni. Mass. USA, Prof. A. Di Nola, Univ. Salerno, Prof. P. De Lucia, Uni. Naples, Prof. D. Petz, Budapest, Profs. P. Lahti and K. Ylino, Univ. Turku, Finland, Prof. P. Klement, Uni. Linz, Austria, Prof. D. Buhagiar, Uni. Malta, etc.

Graph theoretical research will be performed in a collaboration with Pohang Uni. of Science and Technologies, Korea, Uni. Ljubljana, Uni. Koper, Slovenia, Auckland University, New Zealand, Sobolev Inst. of the Russian Acad. Sci., Charles Univ. Prague, Univ. Southampton, U.K.

For example in area of computer science we are intended to collaborate with such important experts as Prof. L.A. Szekely, Univer. South Carolina, USA, Prof. D. Bokal, Univer. Ljubljana, Slovenia, Prof. A. Raspaud, Univer. Bordeaux, France, Prof. Z. Strakos, Inst. Informatics AV CR, Prague, Prof. V. Hari, Univer. Zagreb, Croatia, Prof. L. Grigori, Univ. d'Orsay, France, Prof. T. Sorevik, Univ. Bergen, Norway, Univ. Salzburg, Austria, etc.

The envisaged development plan of activity for Mathematical Institute in 2006-2010 is a typical example of an interdisciplinary project where problems of different areas of mathematics, as well as physics and logics are met. We will use mainly methods of algebras, probability theory, theory of l-groups and partially ordered groups, Hilbert spaces, functional analysis, many-valued logic, methods of fuzzy set theory, methods of quantum logics, t-norms, aggregation operators, graph theory and discrete mathematics, number theory and algebra, computer science, mathematical analysis, etc.

The envisaged methodology will outgoing from the interdisciplinarity of the plans where we use the newest methods known in the literature, respectively obtained by the investigators in the previous activities of the Institute and we suppose continuous solving the envisaged plans.

Progress of the given plans will follow the basic approaches of the mathematical research: that is, determination of hypotheses, formulation of the main assertions and their proofs, and founding the conditions when the assertions hold or not. Presentations of the obtained results on seminars and conferences and the publications in prestigious journals are assumed. We are planning to organize international conferences, and to participate at the most important scientific events to present the results of our own research, to publish the achieved results in the best scientific journals, and in monographs.

We are sure that also a small Slovakia could contribute to the world mathematical treasury with their own contributions in a narrow collaboration with colleagues from the whole world.

III. Partial indicators of the main activities:

1. Research output

- i. List of the selected publications documenting the most important results of basic research. Total number of publications in the whole assessed period should not exceed the average number of the research employees**

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2005:

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- [4] BATTELLI, F.— FEČKAN, M.: *Periodic solutions of symmetric elliptic singular systems*. In: Advanced Nonlinear Studies, vol. **5**, 2005, pp. 163-196. (0,306 – IF 2004)
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- [28] **MESIAROVÁ, A.:** *Extremal k-Lipschitz t-conorms*. In: International Journal of Uncertainty Fuzziness Knowledge-Based Systems, vol. **14 (3)**, 2006, pp. 247-257. (0,430 – IF2005)
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- [30] **PLOŠČICA, M.:** *Local separation in distributive semilattices*. In: Algebra Universalis, vol. **54**, 2005, pp. 323-335. (0,480 – IF2005)

ii. List of monographs/books published abroad

- [1] **HALUŠKA, J.:** *The Mathematical Theory of Tone Systems*. New York -- Basel -- Bratislava: Marcel Dekker, 2004., ISBN 0-8247-4714-3, xxx+380 pp., Published in cooperation with Ister Science, Ltd., Bratislava.
- [2] **STRAUCH, O.— PORUBSKÝ, Š.:** *Distribution of Sequences: A Sampler*. Frankfurt am Main: Peter Lang, 2005., Schriftenreihe der Slowakischen Akademie der Wissenschaften

iii. List of monographs/books published in Slovakia

- [1] **WIMMER, G.— ALTMANN, G.— HŘEBÍČEK, L.— ONDREJOVIČ, S.— WIMMEROVÁ, S.:** *Úvod do analýzy textov*. Bratislava: VEDA, 2003. (In Slovak)
- [2] **WIMMER, G.— PALENČÁR, R.— WITKOVSKÝ, V.:** *Spracovanie a vyhodnocovanie meraní*. Bratislava: VEDA, 2002. (In Slovak)
- [3] **KORBAŠ, J.:** *Lineárna algebra a geometria. I.* Bratislava: Fakulta matematiky, fyziky a informatiky Univerzity Komenského v Bratislave, 2003. (In Slovak)

iv. List of other scientific outputs specifically important for the Organisation

For the Mathematical Institute SAS, the most important part of its publishing activity is in publishing mathematical monographs, where results of many-year activity are concentrated. Nevertheless they are not listed at CC/WOS databases, for us they present the highlight of our activity.

v. Table of research outputs

Table Research outputs shows research outputs in number of specified entries; these entries are then divided by FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).

Research outputs	2003			2004			2005			2006			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
chapters in monographs, books published abroad	2	0,06	0,18	3	0,09	0,26	5	0,14	0,41	5	0,13	0,37	15	3,8	0,11	0,31
chapters in monographs, books published in Slovakia	0	0,00	0,00	0	0,00	0,00	1	0,03	0,08	0	0,00	0,00	1	0,3	0,01	0,02
CC publications*	52	1,61	4,55	58	1,75	5,05	66	1,84	5,41	52	1,38	3,83	228	57,0	1,64	4,68
scientific publications indexed by other databases (Zentralblatt MATH, MathReviews, INSPEC)	36	1,11	3,15	27	0,81	2,35	16	0,45	1,31	27	0,72	1,99	106	26,5	0,76	2,18
scientific publications in other journals	1	0,03	0,09	8	0,24	0,70	6	0,17	0,49	8	0,21	0,59	23	5,8	0,17	0,47
publications in proc. of international scientific conferences	18	0,56	1,58	24	0,72	2,09	20	0,56	1,64	11	0,29	0,81	73	18,3	0,53	1,50
publications in proc. of scientific conferences ^{nat.}	1	0,03	0,09	2	0,06	0,17	0	0,00	0,00	1	0,03	0,07	4	1,0	0,03	0,08
active participations at international conferences	39	1,21	3,41	35	1,05	3,05	36	1,00	2,95	43	1,14	3,17	153	38,3	1,10	3,14
active participations at national conferences	2	0,06	0,18	0	0,00	0,00	2	0,06	0,16	4	0,11	0,29	8	2,0	0,06	0,16

* We identify the CC list with the SCI list.

vi. Renormalized publications²

Renormalized publications = number of CC publications in the given year times authorship's portion of the Organisation times the journal impact factor in 2005 divided by the median impact factor in the research field

Renormalised publications	2003			2004			2005			2006		
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget
Renormalized publications	0	0,00	0,00	0	0,00	0,00	0	0,00	0,00	0	0,00	0,00

vii. Standard manuscript page count³

Standard manuscript page count	2003			2004			2005			2006		
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget
page count	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0

viii. List of patents and patent applications

ix. Supplementary information and/or comments on the scientific output of the Organisation

2. Responses to the scientific output

² This information is required only from the Organisations of the Section 2 of the Slovak Academy of Sciences.

³ This information is required only from the Organisations of the Section 3 of the Slovak Academy of Sciences.

Table **Citations** shows specified responses to the scientific outputs; these entries are then divided by the FTE employees with a university degree (from Tab. Research staff) for all Organisation at the respective year; finally these entries are divided by the total salary budget (from Tab. Salary budget).

Citations	2002			2003			2004			2005			total			
	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	No. / FTE	No. / salary budget	number	averaged number per year	av. No. / FTE	av. No. / salary budget
Web of Science	151	4,7	13,2	270	8,1	23,5	336	9,4	27,6	283	7,5	20,8	1040	260,0	7,5	85,5
MathReviews, Zbl Math, INSPEC, SCOPUS	102	3,2	8,9	146	4,4	12,7	101	2,8	8,3	86	2,3	6,3	435	108,8	3,1	35,7
(specify Database 1)	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0	0,0	0,0	0,0
in monographs, conf. proceedings and other publications abroad	36	1,1	3,2	47	1,4	4,1	37	1,0	3,0	53	1,4	3,9	173	43,3	1,2	14,2
in monographs, conf. proceedings and other publications in Slovakia	0	0,0	0,0	2	0,1	0,2	1	0,0	0,1	1	0,0	0,1	4	1,0	0,0	0,3

i. List of 10 top-cited publications and number of their citations in the assessment period

- [1] **A. DVUREČENSKIJ, — S. PULMANNOVÁ**, New Trends in Quantum Structures, Kluwer Academic Publ., Dordrecht, 2000, 541 + xvi pp. 99 citations
- [2] **DANČÍK, V.— ADDONA, T. A.— CLAUSER, K. R.— VATH, J. E.— PEVZNER, P. A.:** *De novo peptide sequencing via tandem mass spectrometry*. In: Journal of Computational Biology, vol. **6**, 1999, pp. 327--342. 90 citations

- [3] **A. DVUREČENSKIJ**, Pseudo MV-algebras are intervals in l-groups, J. Austral. Math. Soc. **72** (2002), 427--445. 43 citations
- [4] **G. WIMMER**, R. KOHLER, R. GROTHJAHU, G. ALTMANN, Towards a theory of word length distribution. J. Quantitative Linguistic **1** (1994), 98—106. 21 citations.
- [5] P. PTÁK, — **S. PULMANNOVÁ**, Orthomodular Structures as Quantum Logics, Kluwer Academic Publ., Dordrecht 1991. 20 citations
- [6] R.J. GREECHIE, — D.J. FOULIS, — **S. PULMANNOVÁ**, The center of an effect algebra, Order **12** (1995), 91--106. 17 citations
- [7] **A. DVUREČENSKIJ**, States on pseudo MV-algebras, Studia Logica **68** (2001), 301--327. 16 citations
- [8] **A. DVUREČENSKIJ**, Gleason's Theorem and Its Applications, Kluwer Academic Publisher, Dordrecht/Boston/London, 1993, 325+xv pp. 13 citations
- [9] **A. DVUREČENSKIJ**, Loomis—Sikorski theorem for sigma-complete MV-algebras and l-groups, J. Austral. Math. Soc. Ser. A **68** (2000), 261--277. 11 citations
- [10] SHAHROKHI, F., — **SÝKORA, O.**, — SZEKELY, L. A., — **VRŤO, I.**, The book crossing number of a graph, J. Graph Theory **21** (1996), 413-424. 9 citations

ii. List of top-cited authors from the Organisation (at most 10 % of the research employees) and their number of citations in the assessment period

- [1] Dvurečenskij 307 citations
- [2] Pulmannová 201 citations
- [3] Vrťo 119 citations
- [4] Wimmer 95 citations
- [5] Dančík 90 citations
- [6] Jakubík 49 citations

iii. Supplementary information and/or comments on responses to the scientific output of the Organisation

The following paper is according to SCI the most frequently quoted mathematical paper in database SCI written in Slovakia with 26 citations (in total it has 43 citations) in the last year.

A. DVUREČENSKIJ, Pseudo MV-algebras are intervals in l-groups, J. Austral. Math. Soc. **72** (2002), 427--445.

3. Research status of the Organisation in the international and national context

- **International/European position of the Organisation**

- i. **List of the most important research activities documenting international importance of the research performed by the Organisation, incl. major projects (details of projects should be supplied under Indicator 4). Collective membership in the international research organisations, in particular within the European Research Area**

- [1] Project SAS-CNR, Integrovanie vo vektorových priestoroch s ďalšími štruktúrami (Integration in vector spaces equipped with additional structures), bilateral project funded by CNR Roma, Italy
- [2] 42s2, Triangulárne normy (Triangular norms), bilateral project funded by SAIA and OAD
- [3] SK-42, Fuzzy riadenie (Fuzzy control), multilateral project funded by SAIA and OAD
- [4] COST 274, TARSKI (TARSKI), multilateral project funded by EU Brussel
- [5] GR/R37395, Paralelné a sekvenčné algoritmy pre kreslenie grafov s nízkym počtom priesečníkov (Parallel and sequential algorithms for low crossing graph drawing), multilateral project funded by EPSRC, UK
- [6] No. 24, Teória čísel a jej aplikácie (Number theory and its applications), bilateral project funded by Ministry of Education of Slovak Republic and France
- [7] Vyhľadávanie údajov v distribuovaných množinách dokumentov (Data retrieval in distributed data sets), bilateral project funded by Bundesministerium fuer Bildung, Wissenschaft und Kultur, Wien, Österreich
- [8] HPRN-CT-2002-00279, Kvantová pravdepodobnosť s aplikáciou na fyziku, teóriu informácie a biológiu (Quantum probability with applications to physics, information theory and biology), multilateral project funded by EU, Brussels
- [9] INTAS 03-51-4110, Univerzálna algebra a teória zväzov (Universal algebra and lattice theory), multilateral project funded by INTAS (EU)
- [10] No. 15, Algebraické a logické systémy soft computing (Algebraic and logical systems of soft computing), bilateral project funded by Ministry of Education of Slovak Republic and Italy
- [11] EPSRC GR/S76694/01, Silné rovinné priesečníkové čísla (Outerplanar crossing numbers), multilateral project funded by EPSRC agency, Swindon, UK
- [12] JPD3 200,13120200037, Vytvorenie stabilnej pracovnej skupiny pre rozvoj a aplikáciu výskumu v oblasti dynamiky plynu (Creation of a stable work group for a

development and an application in a gas dynamic research), project funded by ESF (50%) and Budget of Slovak Republic (50%)

- [13] COST 293, Grafy a algoritmy (Graphs and Algorithms), multilateral project funded by European Commission, EC, Brussels
- [14] EP/C513053/1, Paralelné Jacobiho algoritmy na rozklad riedkych matíc na singulárne čísla (Parallel Jacobi-like algorithms for the singular value decomposition of large sparse matrices), bilateral project funded by Engineering and Physical Sciences Research Council (EPSRC)
- [15] LSHC-CT-2005-019031, Analýza vydychovaných plynov pre molekulovo orientovanú detekciu zriedkavých chorôb (Breath-gas analysis for molecular-oriented detection of minimal diseases - BAMOD), multilateral project of 6th frame program funded by European Commission, Brussels
- [16] Austrian Grid (Austrian Grid), bilateral project funded by Bundesministerium fuer Bildung, Wissenschaft und Kultur, Wien, Österreich
- [17] Sk-Si-01706, Algebraické a topologické štruktúry v kombinatorike (Algebraic and topological methods in combinatorial structures), bilateral project funded by Ministry of Education of Slovak Republic and Slovenia

ii. List of international conferences (co-) organised by the Organisation

- [1] 16. Czech and Slovak International Number Theory Conference, Bratislava, Slovakia, 30. 6. - 4. 7. 2003
- [2] Tatrascript 2003, Bratislava, Slovakia, 26. – 28. 6. 2003
- [3] ITAT 2003, Information Technology-Applications and Theory, Sliezsky Dom, Slovakia, 17.-21. 9. 2003
- [4] AMADEUS 2003, Complex Pipeline Systems II, Smolenice, Slovakia, 6. - 9. 10. 2003
- [5] Summer School on General Algebra and Ordered Sets, Košická Belá, Slovakia, 31.8. - 6.9. 2003
- [6] 18th Summer Conference on Real Functions Theory, Stará Lesná, Slovakia, 5. - 10. 9. 2004
- [7] Fuzzy Sets and Their Applications (FSTA) 2004, Liptovský Ján, Slovakia, 25. - 31. 1. 2004
- [8] Wartascript 2004, Bedlewo/Poznań, Poland, 30. 6.- 3. 7. 2004
- [9] 11th International Colloquium on Structural Information and Communication Complexity (SIROCCO), Smolenice, Slovakia, 21. - 23. 6. 2004
- [10] EQUADIFF-11, Bratislava, Slovakia, 25. – 29. 6. 2005

- [11] International Workshop on IFS, Banská Bystrica, Slovakia, 22. 9. 2005
- [12] WG 2005, Metz, France, 15. – 18. 6. 2005
- [13] GD 2005, Limerick, Ireland, 12. – 14. 9. 2005
- [14] PARNUM 2005 (Parallel Numerics 05), Portorož, Slovenia, 20. – 23. 4. 2005
- [15] 17th International Czech & Slovak Number Theory Conference, Malenovice, Czech Republic, 5. – 10. 9. 2005
- [16] Sofsem 2005, Liptovský Ján, Slovakia, 22. – 28. 1. 2005
- [17] Moraviacrypt 2005, Brno, Czech Republic, 5. – 10. 9. 2005
- [18] Algoritmy 2005 (Conference on Scientific Computing), Podbanské, Slovakia, 13. – 18. 3. 2005
- [19] Austrian Grid 2005, Linz, Austria, 1. – 2. 12. 2005
- [20] Perspectives in Modern Statistical Inferences III, Mikulov, Czech Republic, 18. – 22. 7. 2005
- [21] KLIM 2005, Novosibirsk, Russia, 6. – 11. 6. 2005
- [22] 20th Summer Conference on Real Functions Theory, Liptovský Ján, Slovakia, 10. – 15. 9. 2006
- [23] FSTA 2006 (Fuzzy Sets Theory and Applications), Liptovský Ján, Slovakia, 30. 1. – 3. 2. 2006
- [24] 8th Biennial Congress of the International Quantum Structure Association, Malta, 9. – 14. 7. 2006
- [25] Hereditarnia 2006, Zakopané, Poland, September 2006
- [26] MFCS 2006, Stará Lesná, Slovakia, 28. 8. – 1. 9. 2006
- [27] PROBASTAT 2006, Smolenice, Slovakia, 5. – 9. 6. 2006

iii. List of international journals edited/published by the Organisation

- [1] *Mathematica Slovaca*
- [2] *Tatra Mountains Mathematical Publications* (some volumes are indexed to Scientific Book Contents, CC/ Physical, Chemical & Earth Sciences)
- [3] *Uniform Distribution Theory*

iv. List of edited proceedings from international scientific conferences and other proceedings

- [1] *Soft Computing*. Eds. **Chovanec F., Dvurečenskij A.** vol. 7, Berlin: Springer-Verlag, 2003.

- [2] *Proceedings Quantum Composite Systems and Foundations of Quantum Information Processing*, in: *International Journal of Theoretical Physics*. Eds. Bugajski S., Luczka J., **Pulmannová S.** vol. 42, Dordrecht: Kluwer Academic/Plenum Publishers, 2003.
- [3] *Tatra Mountains Math. Publ. (PROBASTAT '02)*. Eds. F. Štulajter, **G. Wimmer**, vol. 26, Bratislava: Matematický ústav SAV Bratislava, 2003.
- [4] *Tatra Mountains Math. Publ. (General Algebra and Ordered Sets)*. Eds. **Dvurečenskij, A., Ploščica, M.**, vol. 27, Bratislava: Matematický ústav SAV Bratislava, 2003.
- [5] *Proceedings 3rd Conference: Understanding and Creating Music*. Eds. Busanca G., Di Maio G., Nottoli G., Olivetti Bernardinelli M., **Riečan B.**, Caserta: Seconda Università degli Studi di Napoli, 2003.
- [6] *Tatra Mountains Math. Publ. (Real Functions)*. Eds. **J. Borsík, J. Haluška**, vol. 28, Bratislava: Matematický ústav SAV Bratislava, 2004.
- [7] *Tatra Mountains Math. Publ. (TATRACRYPT '03)*. Eds. O. Grošek, S. S. Magliveras, **K. Nemoga**, T. V. Trung, vol. 29, Bratislava: Matematický ústav SAV Bratislava, 2004.
- [8] *Parallel Numerics 05*. Eds. **Vajteršic M.**, Trobec R., Zinterhof P., Uhl A., Ljubljana, Slovenia: Jozef Stefan Institute and University of Salzburg, 2005.
- [9] *Tatra Mountains Math. Publ. (Quarter-Century of the Košice Branch of the Mathematical Institute)*. Eds. **R. Frič**, vol. 30, Bratislava: Matematický ústav SAV Bratislava, 2005.
- [10] *Special Issue Parallel Processing Letters*. Eds. **Vajteršic M.**, Trobec R., vol. 16, Singapore: World Scientific, 2006.
- [11] *Tatra Mountains Math. Publ. (WARTACRYPT '04)*. Eds. J. Jaworski, M. Kula, **K. Nemoga**, vol. 33, Bratislava: Matematický ústav SAV Bratislava, 2006.
- [12] *Tatra Mt. Math. Publs. -- Real Functions I, II.* Eds. **Borsík, J., Haluška, J.**, vol. 34, Bratislava: Mathematical Institute, Slovak Acad. Sci., 2006.
- [13] *Abstracts, Eighth International Conference FSTA 2006*. Eds. Klement E.P., Mesiar R., **Drobná E., Chovanec F.**, Liptovský Mikuláš: AOS, ISBN 80-8040-284-1, 2006.

- **National position of the Organisation**

- ii. **List of selected most important national projects (Centres of Excellence, National Reference Laboratories, Agency for the Promotion of Research and Development (APVV/APVT), National Research Programmes, Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA), and others)**

- [1] CE I/2/2005: Centrum Excelencie SAV, Fyzika informácie (Center of Excellence SAS - Physics of Information), in cooperation with Institute of Physics SAS
- [2] APVT-51-006904: Topologické štruktúry na funkcionálnych priestoroch a hyperpriestoroch, integrovane v usporiadaných vektorových priestoroch, spojité a pozitívne operátory (Topological structures on function spaces and hyperspaces, integration in ordered vector spaces, continuous and positive operators)
- [3] APVV-51-009605: Diskrétné štruktúry v algebre a geometrii (Discrete structures in algebra and geometry)

- [4] APVT-51-01502: Reprezentácie diskretných štruktúr a ich aplikácie (Representations of discrete structures and their applications)
- [5] APVT-51-027604: Problémy farbenia v teórii grafov (Colouring Problems in Graph Theory)
- [6] APVT-51-032002: Aplikácie algebraických metód na problémy modelovania neurčitosti a spracovania informácií (Application of algebraic methods to the problems of modelling uncertainty and handling information)
- [7] APVT-20-046402: Základy modelovania neurčitosti (Basics of uncertainty modelling)
- [8] VEGA 2/3165/23, 2/3165/25, 2/6087/26: Zovšeobecnenia spojitostí funkcií, vektorové integrovanie a rady (Generalizations of continuity of functions, vector integration and series)
- [9] VEGA 2/1131/21: Algebraické štruktúry súvisiace s usporiadaním a teóriou grafov (Algebraic structures related to ordering and graph theory)
- [10] VEGA 1/9056/22: Matematické modely neurčitosti a ich aplikácie (Mathematical models of uncertainty and their applications)
- [11] VEGA 1/0264/03: Nové nelineárne metódy matematickej štatistiky (New nonlinear methods of mathematical statistics)
- [12] VEGA 2/1130/21: Teória čísel (Number Theory)
- [13] VEGA 2/3164/23, 2/3164/25: Grafovotoretické problémy v informatike (Graphtheoretic problems in informatics)
- [14] VEGA 2/1097/21: Návrhy paralelných algoritmov vyhľadávania údajov metódami lineárnej algebry (Design of parallel algorithms for information retrieval using linear algebra methods)
- [15] VEGA 2/2060/22: Algebraické a kombinatorické vlastnosti grafov, máp, posetov a príbuzných štruktúr (Algebraic and combinatorial properties of graphs, maps, posets and related structures)
- [16] VEGA 2/1140/22: Kvalitatívne vlastnosti a bifurkácie diferenciálnych rovníc a dynamických systémov (Qualitative properties and bifurcations of differential equations and dynamical systems)
- [17] VEGA 1/0427/03, 1/3002/06: Metódy teórie množín v analýze a topológii (Methods of set theory in analysis and topology)
- [18] VEGA 2/1141/21: Niektoré otázky funkcionálnej, harmonickej a stochastickej analýzy (Some questions of functional, harmonic and stochastic analysis)
- [19] VEGA 1/0423/03, 1/3003/06: Algebraické štruktúry (Algebraic structures)
- [20] VEGA 1/9176/02: Symetrie a extrémálne vlastnosti grafov a máp (Symmetries and extremal properties of graphs and maps)

- [21] VEGA 2/4004/24, 2/4004/25, 2/4004/04: Chromatické a tokové vlastnosti grafov (Chromatic and flow properties of graphs)
- [22] VEGA 2/4134/21, 2/4134/24, 2/4134/25: Algebraické štruktúry súvisiace s usporiadaním a teóriou grafov (Algebraic structures related to ordering and graph theory)
- [23] VEGA 2/4135/24, 2/4135/25: Kvalitatívne vlastnosti a bifurkácie diferenciálnych rovníc a dynamických systémov (Qualitative properties and bifurcations of differential equations and dynamical systems)
- [24] VEGA 2/4136/24, 2/4136/25: Návrh a implementácia paralelných algoritmov na vyhľadávanie a modifikáciu údajov metódami lineárnej algebry (Design and implementation of parallel algorithms for information retrieval and modification using linear algebra methods)
- [25] VEGA 2/4137/21, 2/4137/25, 2/4137/04: Niektoré otázky funkcionálnej, harmonickej a stochastickej analýzy (Some questions of functional, harmonic and stochastic analysis)
- [26] VEGA 2/4138/24, 2/4138/25: Teória čísel a jej aplikácie (Number Theory and its applications)
- [27] VEGA 2/3163/23, 2/6088/26: Matematické modely kvantových štruktúr (Mathematical models of quantum structures)
- [28] VEGA 2/3163/25: Matematické modely kvantových štruktúr (Mathematical Models of Quantum Structures)
- [29] VEGA 1/2002/05: Tvorba a aplikácie pravdepodobnostných a fuzzy modelov neurčitosti (Creation and applications of probabilistic and fuzzy models of uncertainty)
- [30] VEGA 2/5065/25, 2/5065/05: Matematické metódy oscilatorických systémov a neurčitost' (Mathematical methods of oscillatory systems and uncertainty)
- [31] VEGA 2/5132/25: Kombinatorické reprezentácie diskretných a spojitých matematických štruktúr (Combinatorial representations of discrete and continuous mathematical structures)
- [32] VEGA 1/5133/25, 1/5133/26: Vlastnosti zeta funkcií kriviek nad konečnými poliami (Properties of zeta functions of curves over finite fields)
- [33] VEGA 1/2004/05: Grafy, grupy, plochy a symetrie (Graphs, groups, surfaces and symmetries)
- [34] VEGA 2/6089/26: Algoritmické a teoretické problémy sietí (Algorithmical and Theoretical Problems of Networks)
- [35] VEGA 1/3016/06: Nové nelineárne metódy matematickej štatistiky II (New nonlinear mathematical-statistical methods II)

[36] E-learningový systém programovania (E-learning system of programming)

iii. List of national scientific conferences (co)-organised by the Organisation

- [1] 38. konferencie slovenských matematikov, Liptovský Ján (Slovakia), 2006
- [2] PRASTAN 2006, Selce (Slovakia)
- [3] Seminár "Vzťah rozumu a viery a jeho miesto v univerzitnom vzdelávaní", Matematika a teológia, Ružomberok (Slovakia), 2006
- [4] Seminár v rámci Európskeho týždňa vedy, November 2006
- [5] PRASTAN 2005, Tajov (Slovakia)
- [6] Workshop "Matematické štruktúry", MI SAS Košice, Košice
- [7] Ján Bakos - cyklus Osobnosti v Štátnej vedeckej knižnici, Banská Bystrica, 2005
- [8] Blanka Kolibiarová - cyklus Osobnosti v Štátnej vedeckej knižnici, 2005
- [9] Duchovné hodnoty pre dnešok, Martin, 2005
- [10] Spomíname, V.Figuš Bystrý a Karol A. Medvecký, Ostrá Lúka – Bacúrov, 2005
- [11] Duchovné hodnoty pre dnešok, Myjava, 2004
- [12] Seminár MŠ SR o vyučovaní matematiky, prírodných a technických vied, Žilina, 2004
- [13] Odkaz významných slovenských vedcov - matematikov pre súčasnú generáciu, seminár, Banská Bystrica, 2004
- [14] Matematika v škole dnes a zajtra, Ružomberok, 2004
- [15] Smolenice Amadeus, Smolenice (Slovakia), 2003
- [16] Duchovné hodnoty pre dnešok, Dolný Kubín (Slovakia), 2003

iv. List of national journals published by the Organisation

v. List of edited proceedings of national scientific conferences/events

- **International/European position of the individual researchers**

- i. **List of invited/keynote presentations at international conferences, documented by an invitation letter or programme**

- [1] A. Dvurečenskij: *Inner Product Spaces and States*, CARTEMI 2004, Ischia, Italy

- [2] A. Dvurečenskij: *Recent Progress in Probability Theory of Inner Product Spaces*, Quantum Structures 2004, 7th Biennial Meeting IQSA, Denver, USA
- [3] R. Frič: *Convergence and Fuzzy Probability*, Quantum Structures 2004, 7th Biennial Meeting IQSA, Denver, USA
- [4] S. Pulmannová: *A Spectral Theorem for Sigma-MV Algebras*, CARTEMI 2004, Ischia, Italy
- [5] S. Pulmannová: *Tensor Product of Hilbert Space Effect Algebras*, Quantum Structures 2004, 7th Biennial Meeting IQSA, Denver, USA
- [6] Ján Borsík: *Functions of oscillation type*, International Conference on Real Functions Theory, Rowy, Poland
- [7] Anatolij Dvurečenskij: *New progress on pseudo MV-algebras*, Second Florence-Vienna Workshop on Logic and Computation, Univ. of Florence, Nov. 2-6, 2005, Florence, Italy
- [8] Peter Eliaš: *On inclusions between Arbault sets*, Workshop: Selected topics on topological groups and number theory, Vienna, Austria
- [9] Peter Eliaš: *No perfect set is permitted*, Workshop: Selected topics on topological groups and number theory, Vienna, Austria
- [10] Roman Frič: *Measure: measurability, duality, extension*, The International Conference on Real Functions Theory, Rowy, Poland
- [11] Roman Frič: *J. Novák, rozširovanie miery, sekvenčný obal*, Spomienkový seminár na J. Nováka, MÚ AV ČR, Praha, Czech Republic
- [12] Roman Frič: *Remarks on metrics*, XII. Czech-Polish-Slovak Mathematical School, Hluboš, Czech Republic
- [13] Martin Kochol: *Obmedzenia na kontrapríklady pre hypotézu o 5-toku*, STTI'05 – Současné trendy teoretické, Institut teoretické informatiky (ITI), Matematicko-fyzikální fakulta Univerzita Karlova, Prague, Czech Republic
- [14] Martin Kochol: *Applications of superposition in graph theory*, GRAFY 2005, Budmerice, Slovakia
- [15] Ladislav Stacho: *Ordered 3-colorings, Cycles and Colorings '05*, Tatranská Štrba, Slovakia
- [16] Anatolij Dvurečenskij: *On Loomis-Sikorski theorem for MV-algebras and effect algebras*, XII. Convegno di Analisi Reale e teoria della Misura (CARTEMI), Neapol, Italy
- [17] Anatolij Dvurečenskij: *Perfect and n-perfect GMV-algebras*, Ordered Structures in Many-Valued Logic, Massa Lubrense, Sorrento, Italy

- [18] Ján Haluška: *On algebras and symbols of Toeplitz operators acting on weighted Bergman spaces*, XII. Convegno di Analisi Reale e teoria della Misura (CARTEMI), Neapol, Italy
- [19] Ľubica Holá: *Relations approximated by continuous functions*, Youngstown Topology Conference, Youngstown, USA
- [20] Martin Kochol: *Linear algebra approach to graph coloring and flow problems*, International Symposium of Mathematical Programming, Rio de Janeiro, Brazil
- [21] Tibor Macko: *Automorphisms of some manifolds and algebraic theory of surgery*, 6th NRW Topology Meeting, Düsseldorf, Germany
- [22] Sylvia Pulmannová: *Effect algebras with compressions*, XII. Convegno di Analisi Reale e teoria della Misura (CARTEMI), Naples, Italy
- [23] Sylvia Pulmannová: *Sharp and fuzzy observables on effect algebras*, 8th Biennial IQSA Meeting Quantum Structures '06, Malta
- [24] Gejza Wimmer, *Professor Altmann - bridge between linguistics and mathematics*, Modern methods in Linguistics, Budmerice, Slovakia
- [25] Martin Zeman: *Progress on combinatorial analysis of extender models*, UCLA Logic Colloquium, USA
- [26] Martin Zeman: *Constructing global square sequences on fine structural extender models*, Miniworkshop "Feinstrukturtheorie und Innere Modelle", Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Nemecko

ii. List of employees who served as members of the organising and/or programme committees for international conferences

- [1] *Ján Borsík*
- [2] *Miloslav Duchoň*
- [3] *Anatolij Dvurečenskij*
- [4] *Roman Frič*
- [5] *Ján Haluška*
- [6] *Juraj Hromkovič*
- [7] *Marek Hyčko*
- [8] *Roman Nedela*
- [9] *Karol Nemoga*
- [10] *Gabriel Okša*
- [11] *Sylvia Pulmannová*
- [12] *Beloslav Riečan*

- [13] *Ondrej Sýkora*
- [14] *Marian Vajteršic*
- [15] *Peter Vojtáš*
- [16] *Imrich Vrto*
- [17] *Gejza Wimmer*

iii. List of employees who served as members of important international scientific bodies (e.g. boards, committees, editorial boards of scientific journals)

- [1] *Miloslav Duchoň* (1 journal)
- [2] *Anatolij Dvurečenskij* (1 journal)
- [3] *Michal Fečkan* (3 journals)
- [4] *Juraj Hromkovič* (3 journals)
- [5] *Ján Jakubík* (1 journal)
- [6] *Peter Mihók* (1 journal)
- [7] *Karol Nemoga* (1 journal)
- [8] *Sylvia Pulmannová* (3 journals)
- [9] *Beloslav Riečan* (4 journals)
- [10] *Ondrej Sýkora* (1 journal)
- [11] *Marian Vajteršic* (4 journals)
- [12] *Peter Vojtáš* (1 journal)
- [13] *Gejza Wimmer* (3 journals)
- [14] *Tibor Žáčik* (1 journal)

iv. List of international scientific awards and distinctions

- [1] Research grant from Alexander von Humboldt Foundation obtained (Vrto)
- [2] President of International Quantum Structures Association, elected in Denver, USA 2004 – 2006 (Dvurečenskij)
- [3] Member of committee for Academy of Sciences and Arts in Vojvodina, 2005, Serbia (Jakubík)
- [4] Memorial medal, Faculty of Mathematics and Physics, Charles university, Prague, Czech Rep., (Riečan)
- [5] The prize for the best mathematical article in *Mathematica Bohemica* for 2005 (Frič)

- **National position of the individual researchers**

- i. **List of invited/keynote presentations at national conferences documented by an invitation letter or programme**

ii. List of employees who served as members of organising and programme committees of national conferences

If we organize a scientific meeting in Slovakia, it is always an international one.

- [1] R. Frič
- [2] R. Nedela
- [3] B. Riečan

iii. List of employees serving in important national scientific bodies (e.g. boards, committees, editorial boards of scientific journals)

- [1] *Ján Borsík* (1 journal)
- [2] *Miloslav Duchoň* (2 journals)
- [3] *Anatolij Dvurečenskij* (2 journals, 4 scientific boards)
- [4] *Michal Fečkan* (1 journal)
- [5] *Roman Frič* (2 journals, 2 scientific board)
- [6] *Ján Haluška* (1 journal)
- [7] *Juraj Hromkovič* (1 journal)
- [8] *Ferdinand Chovanec* (1 journal)
- [9] *Stanislav Jakubec* (1 journal, 1 scientific board)
- [10] *Mária Jurečková* (1 journal)
- [11] *Július Korbaš* (1 journal, 1 scientific board)
- [12] *Karol Nemoga* (1 journal, 1 scientific board)
- [13] *Roman Nedela* (2 journals, 1 scientific board)
- [14] *Miroslav Ploščica* (1 journal)
- [15] *Sylvia Pulmannová* (2 journals, 1 scientific board)
- [16] *Beloslav Riečan* (4 journals, 3 scientific boards)
- [17] *Oto Strauch* (1 journal)
- [18] *Marian Vajteršic* (1 journal)
- [19] *Imrich Vrťo* (1 journal, 2 scientific boards)
- [20] *Gejza Wimmer* (2 journals)
- [21] *Tibor Žáčik* (2 journals)

iv. List of national awards and distinctions

- [1] The founding member of the first 10 members of the *Learning Society of the Slovak Academy of Science*, 2003– **A. Dvurečenskij**

- [2] Golden medal of University of P. J. Šafárik in Košice – **J. Jakubík**
- [3] Golden medal of Faculty of Mathematics and Informatics, Comenius University, Bratislava, 2003 – **J. Jakubík**
- [4] 2nd place in competition of young scientists organized in occasion of 50th anniversary of SAS, 2003 – **A. Jenčová**
- [5] Member of the *Learning Society of the Slovak Academy of Science*, 2003– **J. Hromkovič**
- [6] Award of the Literary Foundation for the Scientific and Technical Literature, 2003 in category of Natural Sciences– **J. Hromkovič**
- [7] *Learning Society of the Slovak Academy of Science*, emeritus member, 2004 – **J. Jakubík**
- [8] Medal of J. Hronec for achievements in Mathematical Sciences, 2004 – **R. Frič**
- [9] Award of the Literary Foundation for Scientific and Technical Literature 2003 in category of Social Sciences– **G. Wimmer**
- [10] Medal for along-year cooperation with Department of Automation, Informatics and Instrumentation, Slovak Technical University, Bratislava – **G. Wimmer**
- [11] The *Learning Society of the Slovak Academy of Science*, member, 2005 – **B. Riečan**
- [12] Honorary Citizen of the city of Tornala, 2006– **A. Dvurečenskij**
- [13] Scholar of the Year 2005 for the Slovak republic, 2006 – **A. Dvurečenskij**
- [14] Award of the Supporting Foundation of Š. Schwarz for the best PhD-students of SAS, 2003 – **T. Vetterlein**
- [15] The prize of the Slovak Literary Foundation 2005 for the monograph *The Mathematical Theory of Tone Systems, Marcel Dekker, Marcel Dekker, Ister Science, 2004*. **J. Haluška**
- [16] Award of the Supporting Foundation of Š. Schwarz for the best PhD-students of SAS, 2005– **A. Mesiarová - Zemánková**
- [17] Award of the Supporting Foundation of Š. Schwarz for the best PhD-students of SAS, 2006– **M. Hyčko**
- [18] Honoris Causa of the Military Academy gen. M. R. Štefánika, L. Mikuláš, 2006 – **B. Riečan**
- [19] Memorial medal of Faculty of Natural Sciences, Matej Bel University, Banská Bystrica, 2006 – **B. Riečan**
- [20] Memorial medal of Faculty of Management and Informatics, University of Žilina, Žilina, – **B. Riečan**
- [21] Award of the Slovak Academy of Sciences in category of international scientific cooperation 2006

- [22] The prize of the Slovak Literary Foundation 2006 for the monograph *Distribution of Sequences: Sampler Schriftenreihe der Slowakischen Akademie der Wissenschaften, Band 1, Peter Lang, Frankfurt am Main, 2005, 570 pp.* – **O. Strauch**
- [23] Award of the Literary Foundation for Scientific and Technical Literature 2005 in category of Natural and Technical Sciences – **O. Strauch**

Supplementary information and/or comments documenting international and national status of the Organisation

Our colleagues regularly are reviewing scientific papers for prestigious international journals, as well as they are many-year collaborators of Zentralblatt Mathematik and Mathematical Reviews. Besides they are evaluators of many international scientific projects. Prof. A. Dvurečenskij is for example is a panel member of the European Research Council. In 2006 four extensive contributions for Handbook of Quantum Structures were written following the invitations to contribute into it; it could appear in Spring 2007 by Elsevier. In addition, one monograph is since the last summer in the publishing house waiting for its appearing.

Many of our colleagues are members of important Colleges of the Slovak Academy of Sciences, prof. R. Frič was a member of the Accreditation Commission of the Slovak republic, Profs. A. Dvurečenskij and R. Nedela members of the Mathematical Subcommittee of the Accreditation Commission. Profs. J. Hromkovič and G. Wimmer are the Head of the DrSc. Commissions (DrSc. is the highest scientific degree in our country) and the Institute is a site of these two DrSc. commissions: (i) Computer Science, and (ii) Measurement Theory. In addition, the Institute is a site of a Commission for Probability and Statistics in PhD studies, and we participate at many Common Commissions for PhD-study. It is also worthwhile to mention also numerous activities in many organs of VEGA and APVV (grant commissions). Dr. Pulmannová is a member of a committee of the Slovak Literary Foundation.

We note that in the nineties 6 our colleagues gain the prestige scholarship of the Humboldt Foundation at German Universities.

Profs. A. Dvurečenskij, J. Jakubík, and B. Riečan are members the *Learning Society* of the Slovak Academy of Science.

4. Project structure, research grants and other funding resources

- **International projects and funding**
 - i. **List of major projects within the European Research Area – 5th and 6th Framework Programme of the EU, European Science Foundation, NATO, COST, INTAS, CERN, etc. (here and in items below please specify: type of project, title, grant number, duration, funding, responsible person in the Organisation and his/her status in the project, e.g. coordinator, principal investigator, investigator)**

- [1] 24, Teória čísel a jej aplikácie (Number theory and its applications), bilateral project funded by Ministry of Education of Slovak Republic and France, (home principal investigator – K. Nemoga, foreign principal investigator – G. Grekos), 1. 1. 2004 – 31. 12. 2005, 146 000 Sk
- [2] INTAS 03-51-4110, Univerzálna algebra a teória zväzov (Universal algebra and lattice theory), multilateral project funded by INTAS (EU), Avenue des Arts 58, B-1000, Brussels, Belgium, 1. 4. 2004 – 31. 3. 2007, 133 000 Sk (2005+2006)
- [3] 15, Algebraické a logické systémy soft computingu (Algebraic and logical systems of soft computing), bilateral project funded by Ministry of Education of Slovak Republic and Italy, (home principal investigator – A. Dvurečenskij, foreign principal investigator – A. Di Nola), 1. 1. 2004 - 31. 12. 2007, 220 000 Sk (2004-2006)
- [4] JPD3 200,13120200037, Vytvorenie stabilnej pracovnej skupiny pre rozvoj a aplikáciu výskumu v oblasti dynamiky plynu (Creation of a stable work group for a development and an application in a gas dynamic research), project funded by ESF (50%) and Budget of Slovak Republic (50%), Coordinator – T. Žáčik, Contact person – K. Nemoga, 3. 10. 2005 – 2. 10. 2008, 1 824 000 Sk (2005+2006)

ii. List of other international projects incl. funding

- [1] 31-611368, Kombinatorické problémy na prepojujúcich sieťach (Combinatorial problems on interconnection networks), bilateral project funded by NSERC CANADA, 350 Albert Street, Ottawa, CANADA K1A 1H5, (main coordinator – L. Stacho), 1. 4. 2006 – 31. 3. 2007, 0 Sk (used by foreign partner)
- [2] 261542, Kombinatorické problémy na prepojujúcich sieťach (Combinatorial problems on network topologies), bilateral project funded by NSERC CANADA, 350 Albert Street, Ottawa, CANADA K1A 1H5, (main coordinator – L. Stacho), 1. 4. 2002 – 31. 3. 2003, 0 Sk (used by foreign partner)

iii. List of other important projects and collaborations without direct funding

- [1] 0.80/59/00, Algoritmy pre fyzikálno-matematický model prúdenia plynu (Algorithms for physical-mathematical model of gas flow), bilateral cooperation with University of Sarov, Russia, (home principal investigator: T. Žáčik, foreign principal investigator: G. S. Klishin), 3. 10. 2000 – 30. 6. 2003
- [2] Miery vo vektorových priestoroch a fuzzy miery (Measures in vector spaces and fuzzy measures), bilateral project with Catholic university, Louvain, Belgium (home main investigator - M. Duchoň, foreign main investigator - Camille Debieve), 1. 1. 2002 – 31. 12. 2004

- [3] Fuzzy logiky a ich aplikácie (Fuzzy Logics and Their Applications), bilateral project with UI AV, Czech Republic, (home principal investigator: M. Duchoň, foreign principal investigator: P. Hájek), 1. 1. 2002 – 31. 12. 2005
- [4] Fuzzy systémy a ich aplikácie (Fuzzy Systems and Their Applications), bilateral project with UTIA AV, Czech Republic, (home principal investigator - M. Duchoň, foreign principal investigator – M. Mareš), 1. 1. 2002 – 31. 12. 2005
- [5] Project SAS-CNR, Integrovanie vo vektorových priestoroch s ďalšími štruktúrami (Integration in vector spaces equipped with additional structures), bilateral project funded by CNR Roma, Italy, l.ventura@dcfire.cnr.it (Ján Haluška – home principal investigator), (Domenico Candeloro – foreign principal investigator), 1. 1. 2001 – 31. 12. 2003
- [6] 42s2, Triangulárne normy (Triangular norms), bilateral project funded by SAIA and OAD (home principal investigator – R. Mesiar, foreign principal investigator – E. P. Klement), 1. 4. 2003 – 30. 6. 2004
- [7] SK-42, Fuzzy riadenie (Fuzzy control), multilateral project funded by SAIA and OAD, (home principal investigator – R. Mesiar, foreign principal investigator – E. P. Klement), 1. 9. 2003 – 31. 8. 2004
- [8] COST 274, TARSKI (TARSKI), multilateral project funded by EU Brussel, (home principal investigator – R. Mesiar, foreign principal investigator – G. Schmidt), 15. 7. 2001 – 31. 12. 2005
- [9] GR/R37395, Paralelné a sekvenčné algoritmy pre kreslenie grafov s nízkym počtom priesečníkov (Parallel and sequential algorithms for low crossing graph drawing), multilateral project funded by EPSRC, UK, (home principal investigator – I. Vrťo, O. Sýkora, foreign principal investigator – O. Sýkora), 1. 5. 2001 – 31. 4. 2004
- [10] Vyhľadávanie údajov v distribuovaných množinách dokumentov (Data retrieval in distributed data sets), bilateral project funded by Bundesministerium fuer Bildung, Wissenschaft und Kultur, Wien, Österreich, (home principal investigator – M. Vajteršic, foreign principal investigator – J. Volkens), 1. 10. 2004 – 31. 12. 2005
- [11] HPRN-CT-2002-00279, Kvantová pravdepodobnosť s aplikáciou na fyziku, teóriu informácie a biológiu (Quantum probability with applications to physics, information theory and biology), multilateral project funded by EU, Brussels, (foreign principal investigator – M. Schermann), 1. 9. 2002 – 31. 8. 2006
- [12] EPSRC GR/S76694/01, Silné rovinné priesečníkové čísla (Outerplanar crossing numbers), multilateral project funded by EPSRC agency, Swindon, UK, (home principal investigator – I. Vrťo, O. Sýkora, foreign principal investigator – O. Sýkora), 1. 1. 2004 – 31. 12. 2006

- [13] COST 293, Grafy a algoritmy (Graphs and Algorithms), multilateral project funded by European Commission, EC, Brussels, (home principal investigator – I. Vrto, foreign principal investigator – X. Munoz), 20. 10. 2004 – 19. 10. 2008
- [14] EP/C513053/1, Paralelné Jacobiho algoritmy na rozklad riedkych matic na singularne čísla (Parallel Jacobi-like algorithms for the singular value decomposition of large sparse matrices), bilateral project funded by Engineering and Physical Sciences Research Council (EPSRC), www.epsrc.ac.uk, (home principal investigator – G. Okša, foreign principal investigator – O. Sýkora), 1. 1. 2005 – 31. 10. 2005
- [15] LSHC-CT-2005-019031, Analýza vydychovaných plynov pre molekuloovo orientovanú detekciu zriedkavých chorôb (Breath-gas analysis for molecular-oriented detection of minimal diseases - BAMOD), **multilateral project of 6th frame program** funded by European Commission, Brussels, (home principal investigator – V. Witkovský, foreign principal investigator – A. Amann), 1. 2. 2006 – 31. 1. 2008
- [16] Austrian Grid (Austrian Grid), bilateral project funded by Bundesministerium fuer Bildung, Wissenschaft und Kultur, Wien, Österreich, (home principal investigator – M. Vajteršic, foreign principal investigator – J. Volkert), 1. 10. 2004 – 30. 9. 2006
- [17] Sk-Si-01706, Algebraické a topologické štruktúry v kombinatorike (Algebraic and topological methods in combinatorial structures), bilateral project funded by Ministry of Education of Slovak Republic and Slovenia, (home principal investigator – M. Škoviera, foreign principal investigator – A. Malnic), 1. 1. 2006 – 31. 12. 2007

- **National projects and funding**

- i. **List of projects supported by the Agency for the Promotion of Research and Development (APVV/APVT), National Research Programmes, and their funding**

- [2] CE I/2/2005: Centrum Excelencie SAV, Fyzika informácie (Center of Excellence SAS - Physics of Information), in cooperation with Institute of Physics SAS, 1. 1. 2005 – 31. 12. 2008, 520 000 Sk (2005+2006)
- [3] APVT-51-006904: Topologické štruktúry na funkcionálnych priestoroch a hyperpriestoroch, integrovane v usporiadaných vektorových priestoroch, spojité a pozitívne operátory (Topological structures on function spaces and hyperspaces, integration in ordered vector spaces, continuous and positive operators), 1. 1. 2005 – 31. 12. 2007, 890 000 Sk (2005+2006)
- [4] APVV-51-009605: Diskrétné štruktúry v algebre a geometrii (Discrete structures in algebra and geometry), 1. 3. 2006 – 1. 3. 2009, 1 239 000 Sk (2006)

- [5] APVT-51-012502: Reprézentácie diskretných štruktúr a ich aplikácie (Representations of discrete structures and their applications), 1. 9. 2002 – 31. 10. 2005, 605 000 Sk
- [6] APVT-51-027604: Problémy farbenia v teórii grafov (Colouring Problems in Graph Theory), 1. 1. 2005 – 31. 12. 2007, 1 757 000 Sk (2005+2006)
- [7] APVT-51-032002: Aplikácie algebraických metód na problémy modelovania neurčitosti a spracovania informácií (Application of algebraic methods to the problems of modelling uncertainty and handling information), 1. 1. 2004 – 31. 12. 2006, 545 000 Sk
- [8] APVT-20-046402: Základy modelovania neurčitosti (Basics of uncertainty modelling), 1. 1. 2004 – 31. 12. 2006, 720 000 Sk
- [9] VEGA 2/3165/23, 2/3165/25, 2/6087/26: Zovšeobecnenia spojitostí funkcií, vektorové integrovanie a rady (Generalizations of continuity of functions, vector integration and series), 1. 1. 2003 – 31. 12. 2005 (2/3165/23, 2/3165/25), 104 000 Sk, 1. 1. 2006 – 31. 12. 2008. 35 000 Sk (2006)
- [10] VEGA 2/1131/21: Algebraické štruktúry súvisiace s usporiadaním a teóriou grafov (Algebraic structures related to ordering and graph theory), 1. 1. 2001 – 31. 12. 2003, 86 000 Sk (2003)
- [11] VEGA 1/9056/22: Matematické modely neurčitosti a ich aplikácie (Mathematical models of uncertainty and their applications), 1. 1. 2002 – 31. 12. 2004, 129 000 Sk (2003+2004)
- [12] VEGA 1/0264/03: Nové nelineárne metódy matematickej štatistiky (New nonlinear methods of mathematical statistics), 1. 1. 2003 - 31. 12. 2005, 42 000 Sk (2005)
- [13] VEGA 2/1130/21: Teória čísel (Number Theory), 1. 1. 2001 - 31. 12. 2003, 105 000 Sk (2003)
- [14] VEGA 2/3164/23, 2/3164/25: Grafovotoretické problémy v informatike (Graphtheoretic problems in informatics), 1. 1. 2003 - 31. 12. 2005, 438 000 Sk
- [15] VEGA 2/1097/21: Návrhy paralelných algoritmov vyhľadávania údajov metódami lineárnej algebry (Design of parallel algorithms for information retrieval using linear algebra methods), 1. 1. 2001 - 31. 12. 2003, 56 000 Sk
- [16] VEGA 2/2060/22: Algebraické a kombinatorické vlastnosti grafov, máp, posetov a príbuzných štruktúr (Algebraic and combinatorial properties of graphs, maps, posets and related structures), 1. 1. 2002 – 31.12. 2004, 45 000 Sk (2003+2004)
- [17] VEGA 2/1140/22: Kvalitatívne vlastnosti a bifurkácie diferenciálnych rovníc a dynamických systémov (Qualitative properties and bifurcations of differential equations and dynamical systems), 1. 1. 2001 – 31. 12. 2003, 51 000 Sk (2003)

- [18] VEGA 1/0427/03, 1/3002/06: Metódy teórie množín v analýze a topológii (Methods of set theory in analysis and topology), 1. 1. 2003 – 31. 12. 2005 (1/0427/03), 86 000 Sk, 1. 1. 2006 – 31. 12. 2008 (1/3002/06), 60 000 Sk (2006)
- [19] VEGA 2/1141/21: Niektoré otázky funkcionálnej, harmonickej a stochastickej analýzy (Some questions of functional, harmonic and stochastic analysis), 1. 1. 2001 – 31. 12. 2003, 113 000 Sk (2003)
- [20] VEGA 1/0423/03, 1/3003/06: Algebraické štruktúry (Algebraic structures), 1. 1. 2003 – 31. 12. 2005 (1/0423/03), 63 000 Sk, 1. 1. 2006 – 31. 12. 2008 (1/3003/06), 49 000 Sk (2006)
- [21] VEGA 1/9176/02: Symetrie a extrémálne vlastnosti grafov a máp (Symmetries and extremal properties of graphs and maps), 1. 1. 2002 – 31. 12. 2004, 17 000 Sk (2003+2004)
- [22] VEGA 2/4004/24, 2/4004/25, 2/4004/04: Chromatické a tokové vlastnosti grafov (Chromatic and flow properties of graphs), 1. 1. 2004 – 31. 12. 2006, 157 000 Sk
- [23] VEGA 2/4134/21, 2/4134/24, 2/4134/25: Algebraické štruktúry súvisiace s usporiadaním a teóriou grafov (Algebraic structures related to ordering and graph theory), 1. 1. 2004 – 31. 12. 2006, 146 000 Sk
- [24] VEGA 2/4135/24, 2/4135/25: Kvalitatívne vlastnosti a bifurkácie diferenciálnych rovníc a dynamických systémov (Qualitative properties and bifurcations of differential equations and dynamical systems), 1. 1. 2004 – 31. 12. 2006, 141 000 Sk
- [25] VEGA 2/4136/24, 2/4136/25: Návrh a implementácia paralelných algoritmov na vyhľadávanie a modifikáciu údajov metódami lineárnej algebry (Design and implementation of parallel algorithms for information retrieval and modification using linear algebra methods), 1. 1. 2004 – 31. 12. 2006, 396 000 Sk
- [26] VEGA 2/4137/21, 2/4137/25, 2/4137/04: Niektoré otázky funkcionálnej, harmonickej a stochastickej analýzy (Some questions of functional, harmonic and stochastic analysis), 1. 1. 2004 – 31. 12. 2006, 345 000 Sk
- [27] VEGA 2/4138/24, 2/4138/25: Teória čísel a jej aplikácie (Number theory and its applications), 1. 1. 2004 – 31. 12. 2006, 285 000 Sk
- [28] VEGA 2/3163/23, 2/3163/25, 2/6088/26: Matematické modely kvantových štruktúr (Mathematical models of quantum structures), 1. 1. 2003 – 31. 12. 2005 (2/3163/23, 2/3163/25), 567 000 Sk, 1. 1. 2006 – 31. 12. 2008 (2/6088/26), 120 000 Sk (2006)
- [29] VEGA 1/2002/05: Tvorba a aplikácie pravdepodobnostných a fuzzy modelov neurčitosti (Creation and applications of probabilistic and fuzzy models of uncertainty), 1. 1. 2005 – 31. 12. 2007, 114 000 Sk (2005+2006)

- [30] VEGA 2/5065/25, 2/5065/05: Matematické metódy oscilatorických systémov a neurčitosť (Mathematical methods of oscillatory systems and uncertainty), 1. 1. 2005 – 31. 12. 2007, 49 000 Sk (2005+2006)
- [31] VEGA 2/5132/25: Kombinatorické reprezentácie diskretných a spojitých matematických štruktúr (Combinatorial representations of discrete and continuous mathematical structures), 1. 1. 2005 – 31. 12. 2007, 62 000 Sk
- [32] VEGA 1/5133/25, 1/5133/26: Vlastnosti zeta funkcií kriviek nad konečnými poliami (Properties of zeta functions of curves over finite fields), 1. 1. 2005 – 31. 12. 2007, 26 000 Sk (2005+2006)
- [33] VEGA 1/2004/05: Grafy, grupy, plochy a symetrie (Graphs, groups, surfaces and symmetries), 1. 1. 2005 – 31. 12. 2007, 21 000 Sk (2005+2006)
- [34] VEGA 2/6089/26: Algoritmické a teoretické problémy sietí (Algorithmic and theoretical problems of networks), 1. 1. 2006 – 31. 12. 2008, 192 000 Sk (2006)
- [35] VEGA 1/3016/06: Nové nelineárne metódy matematickej štatistiky II (New nonlinear mathematical-statistical methods II), 1. 1. 2006 – 31. 12. 2008, 53 400 Sk (2006)
- [36] E-learningový systém programovania (E-learning system of programming), 28. 2. 2004 – 31. 12. 2005

i. Number of projects supported by the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education (VEGA) for each year, and their funding

VEGA	2003	2004	2005	2006
number	13	15	17	17
funding (millions of SKK)	0,894	0,919	1,124	1,216

• Summary of funding from external resources

External resources	2003	2004	2005	2006	total	average
external resources (millions of SKK)	0,200	4,314	11,180	5,797	21,491	5,373
external resources transferred to cooperating research organisations (millions of SKK)	0,000	0,000	6,300	0,000	6,300	1,575
ratio between external resources and total salary budget	0,018	0,376	0,917	0,427	1,737	0,434
overall expenditures from external as well as institutional resources(millions of SKK)	20,154	25,139	34,218	30,415	109,926	27,482

Supplementary information and/or comments on research projects and funding resources

In the Third and Fourth Framework Programs Mathematical Institute had couple of projects within this program. Unfortunately, when the Framework Program started to be oriented more to applied projects, mathematical projects are not welcome in this Program. Anyway, the last year we started to participate at the 6th Framework Program, BAMOD, *Breath-gas analysis for molecular-oriented detection of minimal diseases* together with Univ. Innsbruck and Institute of Measurement.

5. Organisation of PhD studies, other pedagogical activities

i. List of accredited programmes of doctoral studies (as stipulated in the previously effective legislation as well as in the recently amended Act on the Universities)

11 – 02 – 9 Algebra and number theory (to September 2006)

11 – 04 – 9 Mathematical analysis (to September 2006)

11 – 06 – 9 Probability and mathematical statistics (to September 2006)

11 – 80 – 9 Theoretical computer science (to September 2006)

11 – 14 – 9 Applied mathematics (to September 2006)

11 – 81 – 9 Theory of mathematic education (to September 2006)

9 – 1 – 9 Applied mathematics (from September 2006) (together with Faculty Mathematics, Physics, and Informatics of the Comenius Univ., Bratislava)

- ii. Summary table on doctoral studies (number of internal/external PhD students; number of students who completed their study by a successful thesis defence; number of PhD students who quitted the programme)

PhD study	31.12.2003			31.12.2004			31.12.2005			31.12.2006		
number of potential PhD supervisors	31			32			32			33		
PhD students	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted	number	defended thesis	students quitted
internal	8	0	2	8	0	3	5	5	1	6	1	2
external	18	1	0	14	0	0	15	0	2	10	1	1
supervised at external institution by the research employees of the assessed organisation	9	1	0	23	0	0	24	0	0	27	5	0

- iii. Postdoctoral positions supported by

a) *external funding (specify the source)*

b) *internal funding - the Slovak Academy of Sciences Supporting Fund of Stefan Schwarz*

Thomas Vetterlein

Andrea Mesiarová-Zemánková

Marek Hyčko

- iv. Summary table on pedagogical activities in undergraduate programmes for each year

Teaching	2003	2004	2005	2006
lectures (hours/year)	984	1296	1033	899
practicum courses (hours/year)	961	1067	1135	1037
supervised diploma works (in total)	43	53	33	30
members in PhD committees (in total)	15	18	19	19
members in DrSc. committees (in total)	2	7	7	7
members in university/faculty councils (in total)	11\18	10\17	7\14	7\11
members in habilitation/inauguration committees (in total)	3\6	6\7	4\6	4\10

v. List of published university textbooks

- [1] GROŠEK, O.— NEMOGA, K.— SATKO, L.— ZANECHAL, M.: *Kryptológia, základy a aplikácie v bankovníctve - X*. Bratislava: FEI STU, 2003. (In Slovak) , 150 p.
- [2] DROBNÁ, E.: *Cvičenie z matematiky VI, Obyčajné diferenciálne rovnice*. Liptovský Mikuláš: Vojenská akadémia v Liptovskom Mikuláši, 2004. (In Slovak), ISBN 80-8040-243-4
- [3] ČERNÁK, Š.—PAVLUŠ, M.: *Matematika I - skriptá*. Košice: AMS Fakulta BERG, 2004. (In Slovak)
- [4] MIHÓK, P.— BUCKO, J.— LACKOVÁ, D.— RÉVÉSZOVÁ, L.— ŠIŠKOVIČOVÁ, D.: *Informatika I.* Košice: Ekonomická fakulta TU Košice, 2004. (In Slovak)
- [5] MIHÓK, P.— BUCKO, J.— LACKOVÁ, D.— RÉVÉSZOVÁ, L.— ŠIŠKOVIČOVÁ, D.: *Informatika I.* Košice: Ekonomická fakulta TU v Košiciach, 2005. ISBN 80-8073-327-9, 170 strán. (arch. č. 41784) (In Slovak).
- [6] VAJTERŠIČ, M.: *Digitale Rechenanlagen*. Salzburg: Salzburg Universitaet, 2005. (In German)
- [7] ČERNÁK, Š.—PAVLUŠ, M.: *Matematika I (skriptá)*. Košice: Stavebná Fakulta, TU v Košiciach, 2006. (In Slovak)
- [8] MIHÓK, P.— RÉVÉSZOVÁ, L.: *Ekonomické informačné systémy*. Košice: Ekonomická fakulta TU, 2006. (In Slovak)

vi. Number of published academic course books

vii. List of joint research laboratories/facilities with the universities

- [1] 2001-2005 Institute of Mathematics and Computer Science, Banská Bystrica
(cooperation with University of Matej Bel, Banská Bystrica)

viii. Supplementary information and/or comments on doctoral studies and pedagogical activities

According to the old system of PhD study, our Institute had rights for 6 programs in mathematics. In a new system which is performed with a strong connection with universities, we have only one, because, we could have a program if only some Slovak university has it. For examples, algebra and number theory or computer science is nowhere at our universities because they haven't any specialist in the program, therefore, it is not at our Institutes, however we have specialists.

Nevertheless that scholarships for PhD-studies in our country are very low, every year we have applicants for the doctoral study. We recall that to have applicants from Slovakia is not easy even for faculties. Due to regulations from Slovak Academy of Sciences, we could accept at most three students at our Institute. The level of our PhD-study is traditionally very high confirmed also by a fact that in the last years three young mathematicians of EU (Italy, Germany, Malta) obtained their PhD degree at our Institute. Besides of leading our own PhD-students in both forms internal and external, plenty of our colleagues are PhD-tutors of students on many Slovak universities. During the period 2003-06 we have 7 successful defenses.

The Institute is the center of the whole Slovak Commission for PhD-study in Probability and Mathematical Statistics.

6. Direct output to the society

(applications of results, popularisation and outreach activities)

i. List of the most important results of applied research projects

- [1] Cryptographic methods in state administration and for National Security Bureau
[2] Applications in optimizing methods to Slovak Gas Company
[3] Prevention and detection of defects in gas pipeline system
[4] Mathematical methods for Nuclear Power Plant Research Institute

ii. List of the most important studies commissioned for the decision-making authorities, the government and NGOs, international and foreign organisations

- [1] *Karol Nemoga* collaborated with Ministry of Interior SR and with the National Security Bureau SR on applications of cryptology methods. It deals with a long-year collaboration together with FEI Slovak Technical University.
- [2] *Karol Nemoga* collaborated also with the Nation Bank of Slovakia on increasing knowledge on prevention in banking sphere.

iii. List of the most important popularisation activities

- [1] M. Duchoň: article „Komplexné informačné služby pre medzinárodnú matematickú obec - Zentralblatt MATH v SAV“, *Správy SAV* **39** (2003) No. 9, 14–14
- [2] A. Dvurečenskij: article „In honor of Prof. Ján Jakubík on the occasion of his 80th birthday“, *Soft Computing* **7** (2003), 439 – 439
- [3] A. Dvurečenskij: article “Professor Ján Jakubík octogenarian - doyen of Slovak mathematicians”, *Tatra Mt. Math. Publ.* **27** (2003), 1-6
- [4] A. Dvurečenskij, Š. Luby: article “Moji intelektuáli, Veda, Bratislava 2003”, *Obzory mat. fyz. inform.* **32** (2003), 64-68.
- [5] A. Dvurečenskij: “Doyen of Slovak mathematicians - Prof. RNDr. Ján Jakubík, DrSc.—osemdesiatnik”, *Správy SAV* **39** (2003) No. 10, 12-12.
- [6] J. Haluška: presentation “Od prírody k tónovému systému”, Bratislavské Hudobné Slávnosti, Conference Hudba - Umenie - Myslenie, October 8 - 10, 2003, Bratislava, organizer: Comenius University
- [7] J. Haluška: representation of Slovakia on European conference on Protestant Music (CEMER--EKEK), Strassbourg, September 18. – 21., 2003, presentation in Section: *Vorstellen der Verbandinfos durch die Delegierten*
- [8] J. Jakubík: interview "S matematikou je to ako so športom, treba prekonávať stále nové méty", *Korzár* (redactor K. Jurkovičová)
- [9] František Marko: presentation "Lie algebras", Faculty Series Lectures, Pennsylvania State University, Hazleton, 2002.
- [10] František Marko: presentation "Comparison of Educational Systems in Europe and USA", Pennsylvania State University, Hazleton, 2003.
- [11] B. Riečan: 5 articles, 2 TV, 1 Radio, 4 concerts, 2003
- [12] M. Duchoň: article “Fuzzy logiky a ich aplikácie (Projekt Matematického ústavu SAV a Ústavu informatiky AV ČR)”, *Správy SAV* **40** (2004), No. 4, 6-6

- [13] A. Dvurečenskij: article "Professor Sylvia Pulmannová", Math. Slovaca **54** (2004), i -- vii.
- [14] A. Dvurečenskij: "Prof. RNDr. Jur Hronec, DrSc., akademik SAV". In Slovenskí vzdelanci. Doctosimi Slovaciae IV., ústredná knižnica SAV, VEDA, Bratislava, 2004, pp. 15 – 17.
- [15] M. Duchoň: Komplexné informačné služby pre slovenskú matematickú obec - Zentralblatt MATH - Journals and Serials v Slovenskej republic, Obzory matematiky , fyziky a informatiky
- [16] Dvurečenskij, A.: "*Foreword to Quarter-century of the Košice Branch of the Mathematical Institute*", Tatra Mt. Math. Publ. **30** (2005), i-i
- [17] A. Dvurečenskij, K. Nemoga : European week of science – debate with students of mathematical High School - Gymnázium J. Hronca, in Bratislave, 2005
- [18] A. Huček: TV interview "Pyramídové hry", TV Markíza (redactor Danica Kleniová), 2005
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iv. List of patents issued abroad, incl. revenues

v. List of the patents issued in Slovakia, incl. revenues

vi. List of licences sold abroad, incl. revenues

vii. List of licences sold in Slovakia, incl. revenues

viii. List of contracts with industrial partners, incl. revenues

- [1] Contract with SPP, Inc. for Amadeus Studio System, 2004 – 2007, 18 mil. Sk
 [2] Contract with ttc, Ltd. on gas leak detection system, 2005, 300 000 Sk
 [3] Contract for Services on Amadeus Studio and MartiD systems, 2005-2006, 1,7 mil. Sk yearly

ix. List of research projects with industrial partners, incl. revenues

- [1] Contact with SPP for Amadeus System is partly research supporting.

x. Summary of outreach activities

Outreach activities	2003	2004	2005	2006	total
studies for the decision sphere, government and NGOs, international and foreign organisations	3	3	3	2	11
articles in press media/internet popularising results of science, in particular those achieved by the Organization	12	8	3	48	71
appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	3	0	2	16	21
public popularisation lectures	6	0	1	13	20

xi. Supplementary information and/or comments on applications and popularisation activities

Many of our collaborates contributed also to applications and popularizations of the mathematical research. Besides a very important collaboration with the Slovak Gas Company, we participated at the European Science Week, where we had talks at Slovak high schools in Bratislava, Košice, Banská Bystrica, Liptovský Mikuláš, and Tornala. An important estimation was the award the Scholar of the Year which fixed about 65 responses in TVs, radios, journals and newspapers. Important contributions were made in the journal Quark where we have propagated the results of our Institute, and also some interesting problems of Math including a story about solution of Poincare hypothesis. This was possible

due to a new Public Relation Department at the Slovak Academy of Sciences. Our mathematics showed that is not any jackstraw but an important part of our science. We hope to be active in popularization of Math also in future because this is a unique way how to show for our politicians, government and people the importance of the basic research, in particular of mathematics, for Slovakia.

7. Background and management. Staffing policy and implementation of findings from previous assessments

i. Summary table of personnel

Personnel	2003	2004	2005	2006
all personel	80	76	85	87
research employees from Tab. Research staff	53	57	59	59
FTE from Tab. Research staff	32,31	33,18	35,87	37,67
averaged age of research employees with university degree	47,08	47,86	47,7	47,53

ii. Professional qualification structure

Number of	2003	2004	2005	2006
DrSc. / DSc.	12	16	16	18
PhD / CSc.	22	35	34	33
Prof.	5	8	8	9
Doc./Assoc. Prof.	9	19	21	20

iii. Status and development of research infrastructure incl. experimental, computing and technical base (description of the present infrastructure, premises, and material and technical resources. Infrastructure, instrumentation and major technical equipment necessary for the achievement of the objectives specified in the research Concept)

A particularity of our Institute is a high qualified structures of our colleagues. In the evaluated period, three DrSc. degrees were defended, one university professorship, and many PhD's. We plan to continue in this important activity in human sources also for the next period.

The research activity of the Mathematical Institute of SAS needs fortunately only a few material and technological equipments. Due to grant and application activities, our computer pool is equipped with sufficiently many PCs with the latest PC versions and programs. Of course, during the time it will be necessary to update them with new and modern computer tools.

iv. Status and development of bibliographic resources, activities of the Organisation's library and/or information centre

The library of our Institute belongs to the best mathematical ones in Slovakia. Each our branch has also own small library in Košice, Department of Computer Sciences, as well as in B. Bystrica. The library contains over 12 500 items of books and 12 000 items of journals. In view of economical problems, the growth of library is not so intensive as in the past.

The Institute is editing three journals: *Mathematica Slovaca* (since 1951), *Tatra Mountains Mathematica Publications* (since 1993), and *Uniform Distribution Theory* (since 2006). We use these journals for exchange with other journals. In addition, we have own Preprint Series. Institute is also a site of Slovak branch of Zentralblatt MATH, therefore, we obtain the printed version and a direct access to its electronic database. Our Institute is a unique place in Slovakia which has also printed version of Mathematical Reviews and access to MATHSCI. In addition, we have accesses to journals edited by greatest publishing houses like Springer-Verlag, Birkhauser, partially to Elsevier.

v. Describe how the results and suggestions of the previous assessment were taken into account

Our Institute was accredited in 2003 according to its activity in the period 1999-2002 with the highest grade A. The Accreditation very high estimated the level of the mathematical research at our Institute comparable with world trends, with a very active collaboration with domestic and foreign important mathematical centers, with grant and economical activities, with excellent Phd studies. One member of the commission had only one recommendation to publish Annual Repots. This we didn't fulfill in a short printed form while we present our annual activities for many years at our website.

vi. Supplementary information and/or comments on management, research infrastructure, and trends in personnel development

Other information relevant to the assessment