Summary report on research accreditation

I.   General information

Name of organization	Institute of Mathematics and Computer Science of the Academy of Sciences of Moldova
Organization type (*to underline*)	<u>Research institute</u> High education institution Ministerial research institute
Research mission of organization	The mission of the Institute of Mathematics and Computer Science of the Academy of Sciences of Moldova is to undertake theoretical research and to develop applications in mathematics and computer science, to coordinate investigations in these domains in the Republic of Moldova, to train highly qualified specialists through doctoral and post-doctoral programs.
Strategic research direction(s)	Strategic research direction: 2.2 Utilization of human, natural and information resources for sustainable development of the country's economy. In the framework of this direction there are two main priorities: **I. Priority direction: Mathematical support in finding solutions to the country's complex problems** Objectives: 1. Algebraic systems and differential equations for applications in cryptography, biology, ecology, and energetics. 2. Mathematical modeling of the deterministic and stochastic dynamic processes as a support for the society development. 3. Mathematical and high-performance computing methods, advanced numerical algorithms and supercomputers technologies for utilization in scientific research and innovative teaching. 4. Topological-algebraic structures and applications in analysis, automata theory and economical modeling. 5. Fundamental studies in discrete geometry, optimal control and evolutionary systems with practical aspects for quasicrystals. **II. Priority direction: Information systems and technologies** Objectives: 1. Research for advanced and perspective technologies (distributed computations: methods, tools, application execution environments; molecular computations). 2. Information systems for economic activities management. 3. Information systems for research-development-innovation activities management. 4. Information tools for collaborative nets and virtual communities. 5. Development of intelligent systems with impact on services provided to citizens in the information society. 6. Information security.
Evaluated period	2005-2009
Web of organization	www.math.md

II.   Research capacity (annual average for evaluated period)

Total number of	**91**

employees					
Number of scientific researches	**50**				
Number of researches who possess honorific titles, scientific degrees, scientific and scientific-didactical titles	ASM full members 3	ASM Corresponding members 2	Professor 7	Associated professor 0	Dr. habil. 9	Dr. (PhD) 30

Number of researches involved in international projects	FP7 (FP6) 4 (1)	STCU 25	Bilateral 29	Others 46
Number of young researches (under 35 years old)	Dr. (PhD) 2	PhD students 17	Others 11	
Financial resources (thousand MDL)	Public budget 3839.7	International projects/grants 404.6/264.1	Research contracts 49.2	
Distribution of expenditures (thousand MDL)	Salary 2613.6	Infrastructure development 348.4	Other 782.4	
Expenditures for infrastructure development (thousand MDL)	Equipments 180.2	IT infrastructure 168.2	Endowment of experimental resorts 0	
List of 3 basic research methods, installations, technologies (per accredited field)	1. Information system "Linguistic reusable resources" www.math.md/elrr 2. Bergman symbolic computation system http://servus.math.su.se/bergman/ 3. SonaRes decision support system for assistance of sonographic examinations			
List of provided scientific services	**1. Electronic register of clients for nominal holder of the securities "CD" version 2.1.** **2. Evidence of assets property rights of shareholders of the trust society "EMITENT", version 6.**			
List of editorial activities	3 numbers of the journals "Buletinul Academiei de Științe a Republicii Moldova. Matematica", "Computer Science Journal of Moldova" and 2 numbers of the "Quasigroups and Related Systems" journal are published annually.			

III. Distribution of number of research projects and themes during evaluated period

Institutional projects	2005 5	2006 6	2007 6	2008 6	2009 4
Projects in the frame of State Programmes	2005 0	2006 3	2007 7	2008 4	2009 3
Technological transfer projects	2005 0	2006 0	2007 0	2008 1	2009 1
Projects for equipment procurement	2005 0	2006 0	2007 0	2008 0	2009 0

Projects for young researches	2005 0	2006 0	2007 2	2008 2	2009 2
Projects in the frame of bilateral programmes	2005 0	2006 3	2007 3	2008 6	2009 9
International projects/grants	2005 6	2006 4	2007 5	2008 5	2009 3
List of 3 representative international projects/grants	BGP-III CRDF-MRDA (MOM2-3049-CS-03) "Algorithms for Dynamic System Design and Optimization in Communication Networks", 2005-2007, team leader – D. Lozovanu. STCU-4032 "Power and efficiency of natural computing: neural-like P (membrane) systems", 2007-2010, team leader – Iu. Rogojin. STCU-4035, "Informational tools for assistance of sonographic examinations", 2007-2010, team leader – C. Gaindric.				
Research contracts	2005 0	2006 0	2007 0	2008 4	2009 3
List of 3 representative research contracts	Contract Nr. 18 from 15.09.2008, Institute of Zoology. Contract Nr. 76T from 02.03.2009, Institute of Genetics and Plant Physiology. Contract Nr. 76T-1 from 10.10.2009, Institute of Microbiology and Biotechnology.				

IV.   Scientific publications

Total number of publications abroad	Books/Collection/Preprints 2/3/21	Chapters in books 2	Journal papers/Collection papers 153/53
Total number of publications in ISI journals and books	Books 2	Chapters in books 2	Journal papers 84
Total number of publications in the country	Books/Collections/Preprints 4/1/2	Chapters in books 4/1	Journal papers/Collection papers 85/25
Total number of conference abstracts	International abroad 202	International in the country 106	National 63
List of 5 representative publications (per accredited field)	***Theoretical and applied mathematics, modeling and optimization:*** 1. G. Belyavskaya, V. Izbash, G. Mullen. Check character systems using quasigroups, I. II. In: Olanda, Amsterdam, Springer, Designs, Codes and Cryptography, 37, 2005, pp. 215-227, 37, 2005, pp. 405-409 (ISI: 1.022). 2. Vulpe N., Artes J., Llibre J. Quadratic systems with a polynomial first integral: a complete classification in the coefficient space R^{12}. In: J. Differential Equations, 246, 2009, pp. 3535-3558 (ISI: 2.161). 3. Lozovanu D., Pickl S. Discrete Control and Algorithms for Solving Antagonistic Dynamic Games on Networks. In: Optimization, 2009, vol. 58, nr. 8, pp. 665-683 (ISI: 0.810). 4. Mishkoy Gh., Rykov V., Giordano S., Bejan A. Multidimensional Analogs of the Kendall Equation for Priority Queueing Systems: Computational Aspects. In: Automatics and Remote Control, Pleiades Publishing. USA, 2008, vol. 69, nr. 6, pp. 980-992 (ISI: 0.557).			

	5. Lugovoi P., Meish V., Rybakin B., Secrieru G. Numerical simulation of the dynamics of a reinforced shell subject to nestationary load. In: International Applied Mechanics, Springer. 2008, vol. 44, nr. 7, pp. 788-793 (ISI: 0.333).
	Computer science. Information technologies:
	6. Burțeva L., Cojocaru S., Gaindric C., Magariu G., Verlan T. Digital divide: A glance at the problem in Moldova. In: Information technologies communication and human development: Opportunities and challenges. Idea group Inc.2006 , Hershey, London, Melbourne, Singapore, pp. 77-115 (Reedited in Information Communication Technologies: Concepts, Methodologies, Tools and Applications, IGI global (6 volumes). Edited by Craig Van Slyke, University of Central Florida, IGI Global, Hershey, New York, USA, 2008, Volume IV, Chapter 5.21, pp. 2531- 2565).
	7. Burtseva L., Cojocaru S., Gaindric C., Jantuan E., Popcova O., Secrieru I., Sologub D. SONARES – A decision support system in ultrasound investigations. In: Computer Science Journal of Moldova, vol. 15, nr. 2 (44), 2007, Kishinev, pp. 153-177.
	8. M. Margenstern, Gh. Păun, Yu. Rogozhin, S. Verlan. Context-free insertion-deletion systems. In: Theoretical Computer Science, Elsevier, vol. 330, issue 2, 2005, pp. 339-348 (ISI: 0.995).
	9. A. Alhazov, E. Csuhaj-Varju, C. Martin-Vide, Yu. Rogozhin. On the Size of Computationally Complete Hybrid Networks of Evolutionary Processors. In: Theoretical Computer Science, Elsevier, 410, 2009, pp. 3188-3197 (ISI: 0.995).
	10. Boian E., Ciubotaru C., Cojocaru S., Colesnicov A., Demidova V., Malahova L. Lexical Resources for Romanian. In: Memoriile secțiilor științifice. Seria IV, tomul XXVI, 2003, Editura Academiei Române, București, 2005, pp. 267-278.
List of 5 citations	List of main citations upon articles published in ICI journals:
	⚔ MR2276503 (2008f:34065) Christopher, Colin; Llibre, Jaume; Pereira, Jorge Vitório Multiplicity of invariant algebraic curves in polynomial vector fields. Pacific J. Math. 229 (2007), no. 1, 63-117
	⚔ MR2446988 (2009i:68033) Díaz-Pernil, Daniel; Gutiérrez-Naranjo, Miguel A.; Pérez-Jiménez, Mario J.; Riscos-Núñez, Agustín A uniform family of tissue P systems with cell division solving 3-COL in a linear time. Theoret. Comput. Sci. 404 (2008), no. 1-2, 76-87
	⚔ MR2152961 Tenzina, V. V.(RS-MOSC) Some properties of the topological Baer radical of rings with topological Krull dimension. (Russian) Uspekhi Mat. Nauk 60 (2005), no. 2(362), 175-176 translation in Russian Math. Surveys 60 (2005), no. 2, 378-379
	⚔ MR1892697 (2003g:05057) Tuza, Zsolt; Voloshin, Vitaly; Zhou, Huishan Uniquely colorable mixed hypergraphs. Discrete Math. 248 (2002), no. 1-3, 221-236
	⚔ MR2543425 (2010m:16031) La Scala, Roberto; Levandovskyy, Viktor Letterplace ideals and non-commutative Gröbner bases. J. Symbolic Comput. 44 (2009), no. 10, 1374-1393
	⚔ MR2353212 (2009e:16035) France-Jackson, Halina On generalised prime essential rings and special and nonspecial radicals. Bull. Austral. Math. Soc. 76 (2007), no. 2, 263-268
	⚔ MR2426888 (2009e:20144) Keedwell, A. D. When is it hard to

show that a quasigroup is a loop? Comment. Math. Univ. Carolin. 49 (2008), no. 2, 241-247
- ⚔ MR2304338 (2008f:17006) Pérez-Izquierdo, José M. Algebras, hyperalgebras, nonassociative bialgebras and loops. Adv. Math. 208 (2007), no. 2, 834-876

List of main articles published in ISI journals:
- ⚔ MR2147466 (2006b:34087) Schlomiuk, Dana; Vulpe, Nicolae Geometry of quadratic differential systems in the neighborhood of infinity. J. Differential Equations 215 (2005), no. 2, 357-400
- ⚔ MR2448210 (2009g:34087) Schlomiuk, Dana; Vulpe, Nicolae The full study of planar quadratic differential systems possessing a line of singularities at infinity. J. Dynam. Differential Equations 20 (2008), no. 4, 737-775
- ⚔ MR2512198 (2010d:58004) Dovbush, Peter V. On normal and non-normal holomorphic functions on complex Banach manifolds. Ann. Sc. Norm. Super. Pisa Cl. Sci. (5) 8 (2009), no. 1, 1-15
- ⚔ MR2407379 (2009d:60343) Kolesnik, Alexander D. Random motions at finite speed in higher dimensions. J. Stat. Phys. 131 (2008), no. 6, 1039-1065
- ⚔ MR2320978 (2008a:54003) Arnautov, V. I.; Filippov, K. M. Lattices of topologies of algebraic systems. Algebra Discrete Math. 2006, no. 2, 1-16
- ⚔ MR2274640 (2007k:60340) Kolesnik, Alexander D. A four-dimensional random motion at finite speed. J. Appl. Probab. 43 (2006), no. 4, 1107-1118
- ⚔ MR2354332 (2008g:91080) Lozovanu, Dmitrii; Pickl, Stefan Algorithms for solving multiobjective discrete control problems and dynamic c-games on networks. Discrete Appl. Math. 155 (2007), no. 14, 1846-1857
- ⚔ MR2533938 (2010g:90142) Lozovanu, Dmitrii; Pickl, Stefan Algorithms for solving discrete optimal control problems with infinite time horizon and determining minimal mean cost cycles in a directed graph as decision support tool. CEJOR Cent. Eur. J. Oper. Res. 17 (2009), no. 3, 255-264
- ⚔ MR2540310 Alhazov, Artiom; Csuhaj-Varjú, Erzsébet; Martín-Vide, Carlos; Rogozhin, Yurii About universal hybrid networks of evolutionary processors of small size. Language and automata theory and applications, 28-39, Lecture Notes in Comput. Sci., 5196, Springer, Berlin, 2008
- ⚔ MR2290822 (2007k:68028) Alhazov, Artiom; Rogozhin, Yurii; Verlan, Sergey Minimal cooperation in symport/antiport tissue P systems. Internat. J. Found. Comput. Sci., 18 (2007), no. 1, 163-179

V. Innovation outputs

Total number of patents	Registered in the country 0	Registered abroad 0	Implemented 0
Total number of new developed methods and technologies	Registered 0	Non-registered 5	Implemented 3

Total number of new scientific products	Registered 0	Non-registered 5	Implemented 3
Total number of scientific outputs for central and local authorities (draft of law, strategies etc.)	Conceptual issues in development of telemedicine in the Republic of Moldova (C. Gaindric). Indicators for "digital divide" monitoring were developed (L. Burteva, S. Cojocaru, C. Gaindric, G. Magariu, T. Verlan). Recommendations for drafting some normative documents on information society creation in the Republic of Moldova were formulated (S. Cojocaru, C. Gaindric, P. Bogatencov).		
Total number of scientific outputs for educational institutions	Handbooks for high education 8	Handbooks for pre-university institutions /Chapter 7 /1	Delivered university courses 10
List of 5 representative innovation outputs (per accredited field)	1. Mathematical model for gas purification, in particular containing rigid particles, was developed. This model enables to determine geometry and parameters of corresponding installations. 2. Mathematical model describing the behavior of underground gas tanks subjected to dynamic loads (explosions or seismic action) was developed. 3. Computer monitoring technology for operational state and accidental risk of inflammable, explosive and toxic liquids depots. 4. SonaRes informational tools for assistance of sonographic examinations were created. A software for marking of regions of interest and similar images search was developed. 5. A database of linguistic reusable resources for Romanian language was developed. Together with electronic dictionary (about 1000000 words) these resources include morphological and syntactical information, synonyms, Romanian-English and Romanian-Russian translations.		

VI. Major scientific and innovation achievements

Short description of main scientific results and its confirmation (by awards, citations, development of international projects etc.)	It was proved that any n-ary operation which is defined on a transversal of an n-ary group by its n-ary subgroup has representation using convenient binary operations (generalization of Gluskin-Hossu theorem), CRDF-MRDA grant, citations on MathSciNet. Methods and algorithms that allow solving for discrete dynamic control multicriterial problems (nonlinear case) were developed. These results provide theoretical basis for the decision-making process in the various fields and are the subject of a monograph published in 2009 by the Springer publishing house, 2 grants CRDF-MRDA, the best paper awards for publication in this domain. An universal complete hybrid network of evolutionary processors (HNEP) with 7 nodes simulating circular Post machines was constructed. It was shown that this network can generate any recursively enumerable language, which solves the problem formulated by E. Csuhaj-Varjú, C. Martín-Vide and V. Mitrana in 2005. It was also demonstrated that the family of HNEPs with 2 nodes is not computationally complete, FP6 grant, CRDF-MRDA grants, STCU grant, multiple citations and publications in ISI journals.
Number of	2005 2006 2007 2008 2009

organization' invited speakers at international conferences	0	3	2	4	2
Short description of technological transfer and innovation results and its certification by implementation	1. **Information system "Linguistic reusable resources"**. It offers linguistic information and services (Romanian texts spell-checking, flexioning, morphological and syntactical information, synonyms, translations). This system is used for teaching, technical editing, research and is available for public access at www.math.md/elrr 2. **Bergman symbolic computation system**. Initially, it was developed by the Stockholm University and then extended in the framework of collaborative projects between the Institute of Mathematics and Computer Science of the Academy of Sciences of Moldova and Universities from Stockholm and Lund (Sweden). It offers the possibility to obtain analytical solutions for different commutative and non-commutative problems. Bergman is useful in research, teaching and solving engineering problems and is available for public access at http://servus.math.su.se/bergman/ 3. **Information system "Multimedia tools for facilitating Moldovan art promoting"**. It is used by the Academy of Music, Theatre and Fine Arts in development the portal "Musical art of Moldova", which promotes cultural treasures of our country for a wide circle of users. 4. **SonaRes decision support system for assistance of sonographic examinations**. It is used by a number of medical organizations, including Excellence Medical Center, Public Medical and Sanitary Institution (PMSI) Territorial Medical Association "Botanica" (mun. Chisinau), PMSI Republican Center for Medical Diagnostics (being the base for teaching and advanced training of physicians-sonographists); PSMI National Scientific Practical Center for Emergency Medicine. SonaRes contributes to raising the quality of ultrasound diagnostics of organs from abdominal region (gallbladder and pancreas), and, as a result, to population health promotion. 5. **Information support for research and implementation of advanced information technologies in academic institutions (based on 1Gbps technology implementation)**. It is used by institutions from the Department of Nature and Life Sciences of the Academy of Sciences of Moldova. This project has advanced the informatization process of an academic campus, offering a wide range of information services, which require high speed Internet access.				
Number of defended dr. habil. and dr. theses per year	2005 0/0	2006 0/2	2007 1/0	2008 1/2	2009 0/2

VII. Present/further involvement in the Seventh Framework Programme (FP7): specific programmes (Cooperation, Ideas, People, Capacities) of interest and its sub-divisions.

FP7 ongoing project:
261499 "High-Performance Computing Infrastructure for South East Europe's Research Communities (HP-SEE)".

FP7 proposal under examination:
"New hybrid bio- and quantum inspired models of computation applied to solving intractable problems in computer algebra and computer linguistics (HYBIQUA)" submitted on January 17, 2012, proposal reference number: FP7-317901.

VIII. Accredited research field and its evaluation by the National Council for Accreditation and Attestation of the Republic of Moldova (very good/good/ satisfactory)

Accredited research field I: Theoretical and applied mathematics, modeling and optimization - Good

Accredited research field II: Computer science. Information technologies   - Good

IX. Category (A/B/C) attributed by the National Council for Accreditation and Attestation of the Republic of Moldova to the organization

Category A

X. Institutional development actions planned for the next 5 years (maximum ½ page).

For 2010-2014 the following results are expected: 1) description of structure of some grupoids and quasigroups with various identities, of spectrum and number of such objects as Latin squares, systems of orthogonal operations, Boolean functions; 2) elucidation of properties of binary and n-ary operations (quasigroups) with elaboration on this basis of some cipher and cods; 3) qualitative the qualitative study of two- and multidimensional vector fields, determined by polynomial differential systems, oriented to the applicative mathematical models.

In the period 2010-2014 methods and numerical algorithms for solving the deterministic and stochastic problems that arise in discrete optimal control theory, queuing theory with priorities and Markov decision processes will be developed. The growing economic models will be studied, and some problems from applied mechanics based on high performance computing by using many processors clusters will be solved. The developed methods and algorithms will be grounded and tested. For each class of examined problems the proposed algorithms will be implemented as a software. The possible implementation of the research results in different areas will be analyzed.

In the period 2010-2014 the research for perspective technologies for the knowledge-based society will be done. Methods for knowledge acquisition, storage and representation, knowledge management techniques and an unique hierarchical structure (extended ontology) of the domain of ultrasound examination will be developed. New models of biomolecular computing (variants of membrane systems, networks of evolutionary processors, gene assembly), which will be applied for solution of intractable problems, will be modernized and optimized. There will be developed: a) execution environments based on formal models for solving problems in computational linguistics; b) technologies to facilitate adaptive human-computer interaction (intelligent interface) with application of natural language technology; c) principles and technologies for organization of the process of information storage, processing and visualization in large-scale distributed systems.

Director of the Institute of Mathematics and Computer Science
of the Academy of Sciences of Moldova,
doctor with habilitation   Cojocaru Svetlana