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Research interests

- Hybrid Systems
- Computability over Continuous Data
- Domain Theory
- Admissible Set Theory
- Generalised Recursion Theory and Computability Theory

Research achievements

Pfaffian Hybrid Systems. Pfaffian hybrid systems, which we recently introduced in [18], are a sub-class of o-minimal hybrid systems which capture rich continuous dynamics and yet can be studied using finite bisimulations. In particular Pfaffian hybrid systems include hybrid systems with continuous dynamics definable by functions such as \exp , \sin , \cos , and other trigonometric functions in appropriate domains. The existence of finite bisimulations is crucial for most decidability results for hybrid systems. We have investigated complexity of algorithms for finite bisimulations of Pfaffian hybrid systems [18, 10]. Based on these results we studied satisfiability of viability constraints and invariants [16, 8]. As part of CICADA project we develop tools for reachability analysis for Pfaffian hybrid systems.

Computability over Continuous Data. One of the main direction in Computer Science is effective reasoning about algorithms and data structures. In order to do that one should first investigate computability or noncomputability of considered data in principle. In a series of papers [20, 21, 19, 17] using arguments from definability theory we logically have characterised computable continuous data. In order to do this we have proposed the notion of majorant-computability and developed logical approach to computability over continuous data. This approach is based on representations of continuous data by suitable structures without the equality test and Σ -definability in extensions of the structures by hereditarily

finite sets. One of the main features of the notion of majorant-computability is that on the one side it is independent from concrete representations of the elements of structures on the other side it is flexible, i.e. we can change the language of Σ -formulas to express appropriate computability properties. As part of CICADA project we prove basic principles for Σ -definability which provide tools for effective reasoning about computable continuous data [6, 3, 2].

Σ -constraints for Hybrid systems. We have developed a logical framework based on Σ -definability for reasoning about hybrid systems, in particular, for investigation of reachability problems. As part of CICADA project we propose the specification of a hybrid system, abbreviated as *SHS*, in which continuous and discrete parts are formalised by finite Σ -formulas in the same language. Using Σ -constraints we show that for these specifications reachability problems are computably enumerable [1].

I also working on incorporation of the results and ideas developed in the theory of inductive definitions domain theory, generalised recursion theory to make reasoning about real numbers, real functions and higher type continuous data.

Degrees

1996: Ph.D. in Mathematics, the Sobolev Institute of Mathematics, Novosibirsk.

Thesis: '*Generalised computability on the real numbers*'.

Supervisor: Professor S. S. Goncharov.

Official referees: Professor A. A. Mal'sev and Professor V. V. Rybakov.

Description: Notions of majorant-computability on the real numbers, weak-computability on filter structures were introduced. A novel model-theoretic language of Σ -approximations was developed and used to obtain logical characterisations of computability on abstract filtered structures, in particular on the reals. The logical characterisations were used to give solutions to a number of open problems concerning properties of computable objects.

1988: M.Sc. in Mathematics, Faculty of Mathematics, Novosibirsk State University.

Thesis: ' *Σ -definability and computability on the reals*'.

Supervisor: Professor S. S. Goncharov.

Description: Properties of Σ -sets and functions on the real numbers were investigated and correlated with different approaches to computability on the reals.

Education

1990–1996: PhD studies at the Sobolev Institute of Mathematics, Novosibirsk.

1988–1990: Research fellow at the laboratory 'Computability and applied logic', the Sobolev Institute of Mathematics, Novosibirsk.

1987–1988: M.Sc. studies at Faculty of Mathematics, Novosibirsk State University.

1983–1987: Undergraduate studies at Faculty of Mathematics, Novosibirsk State University.

1981–1983: Secondary grammar school in Sarapul, (Diploma with Honours) Russian Federation.

1973–1981: Basic school in Sarapul, (Diploma with Honours) Russian Federation.

Awards

Lavrent'ev Medal: 'Best young scientist of Siberia,' Siberian Branch of Russian Academy of Science, 2000.

Gold Medal: 'Best scholar,' Russian Ministry of Education, 1983.

Recent Talks at conferences and workshops

1. Domain theory workshop, Novosibirsk, 11-14 September, 2007.
2. Workshop Computable models and numberings, Novosibirsk, 6-11 August, 2007.
3. CCA 2007 Computability and complexity in analysis, Siena, 2007.
4. CiE 2007, Computation and logic in real world, Siena, 2007.
5. Dagstuhl Seminar Seminar No 07648, 2007.
6. Proof, Computation, Complexity International workshop 2007, Swansea.
7. Computability in Europe, CiE'06, 2006.
8. Dagstuhl Seminar Seminar N 06021 Reliable Implementation of Real Number Algorithms: Theory and Practice, 2006.
9. RAAG Annual Meeting 2005, Passau.
10. Computability in Europe, CiE'05, 2005.
11. Annual Conference of the European Association for Computer Science Logic, CSL'04, 2004.
12. Dagstuhl Seminar N 0406, Real Computation and Complexity, 2004.
13. Workshop on Domain theory, Constructive Mathematics and Topology, Munchen, 2003.
14. 10th International Conference on Logic for Programming Artificial Intelligence and Reasoning (LPAR'03), Alma-Ata, 2003.
15. Computer Science Logic and 8th Kurt Gödel Colloquium (CSL-KGS'03), Vienna, 2003.
16. Perspectives of system informatics (PSI'03), Novosibirsk, 2003.

Recent Publications

References

- [1] Margarita Korovina, Oleg Kudinov, Σ -constraints for Hybrid Systems, CCA'08, submitted, 2008.
- [2] Margarita Korovina, Oleg Kudinov, Comparative Analysis of Some Models of Computation over Effectively Enumerable Topological Spaces, CCA'08, submitted, 2008.
- [3] Margarita Korovina, Oleg Kudinov, Basic Principles for Σ -definability, The Annals of Pure and Applied Logic, submitted, 2008.
- [4] Margarita Korovina, Nicolai Vorobjov, Safety Properties Verification for Pfaffian Dynamics, accepted for CiE'08, 2008.
- [5] Margarita Korovina, Oleg Kudinov, Basic Principles for Σ -definability, Schriften zur Theoretischen Informatik, Bericht Nr. 08-01, Siegen 2008.
- [6] Margarita Korovina, Oleg Kudinov, The Uniformity Principle for Σ -definability, Journal of Logic and Computation, accepted, 2008.
- [7] Andrei Morozov and Margarita Korovina, On Σ -definability without equality over the real numbers, Mathematical Logic Quarterly, journal, 54, No 5, pages 498–508, 2008.
- [8] Margarita Korovina, Nicolai Vorobjov, Computing Combinatorial Types of Trajectories in Pfaffian Dynamics, Journal of Logic and Algebraic Programming, accepted, 2008
- [9] Andrei Morozov and Margarita Korovina, On Σ -representability of countable structures over real and complex numbers. Algebra and Logic, journal, accepted, 2008.
- [10] Margarita Korovina, Nicolai Vorobjov, Upper and Lower Bounds on Sizes of Finite Bisimulations of Pfaffian Hybrid Systems, Theory of Computing Systems, journal, Springer, , DOI 10.1007/s00224-007-9019-4, 2008.
- [11] Andrei Morozov and Margarita Korovina, Countable structures Σ -representable over continuous structures. Doklady Akademii Nauk, (Proceedings of the Russian Academy of Sciences), journal, Vol.76, No. 2, pages 739–740, 2007.
- [12] Andrei Morozov and Margarita Korovina, Remarks on Σ -definability without the equality test over the Reals. Electronic Notes in Theoretical Computer Science, Elsevier, v. 202C, pp. 305-313, 2008.
- [13] Margarita Korovina and Oleg Kudinov. The Uniformity Principle for Σ -definability with Applications to Computable Analysis. In S.B. Cooper, B. Löwe, and A. Sorbi, editors, *CiE'07, Lecture Notes in Computer Science vol. 4497*, pages 416–425, Springer, 2007.

- [14] Margarita Korovina, Nicolai Vorobjov, Satisfiability of Viability Constraints for Pfaffian Hybrid Systems, *Lecture Notes in Computer Science vol. 4378*, Springer, 2007.
- [15] Margarita Korovina, Nicolai Vorobjov, Upper and Lower Bounds on Sizes of Finite Bisimulations of Pfaffian Hybrid Systems. In Proc. CiE'06, *Lecture Notes in Computer Science vol. 3988*, 267–276, Springer, 2006.
- [16] Margarita Korovina, Nicolai Vorobjov, Satisfiability of Viability Constraints for Pfaffian Hybrid Systems, in PSI'06, *Lecture Notes in Computer Science vol. 4378*, Springer, 2007.
- [17] Margarita Korovina, Oleg Kudinov, Towards Computability of Higher Type Continuous Data, In Proc. CiE'05, *Lecture Notes in Computer Science vol. 3526*, pp 235–241, Springer, 2005.
- [18] Margarita Korovina, Nicolai Vorobjov, Pfaffian hybrid systems, In Proc. CSL'04. *Lecture Notes in Computer Science vol. 3210*, pp 430–441, Springer, 2004.
- [19] M.V. Korovina, Gandy's Theorem on Abstract Structures without the Equality Test, In Proc. LPAR'03, *Lecture Notes in Artificial Intelligence vol. 2850*, pp. 290–301, Springer, 2003.
- [20] M.V. Korovina, Recent Advances in Σ -definability over Continuous Data Types In proc. PSI'03, *Lecture Notes in Computer Science vol. 2890*, pp. 238-247, Springer, 2004.
- [21] M Korovina. Computational aspects of Σ -definability over the real numbers without the equality test. In Proc. CSL'03. *Lecture Notes in Computer Science vol. 2803*, pp. 330–344, Springer, 2003.