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Major Research Interests: **Optimisation, Algebra**
Other Interests: **Combinatorics, Algebraic Geometry**

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Much of the groundbreaking in mathematics happens on the border separating well-established areas. My research takes place at the crossroads of optimisation, algebra, geometry, and combinatorics, with all the pairwise combinations of the four allowed, that is, combinatorial optimisation, algebraic combinatorics, algebraic geometry, geometric combinatorics, etc. I do not shy forays into adjacent areas such as symbolic computation, computational complexity, or number theory.

It is the interplay of these fields that attracts me most. For instance, easiness of computing certain data related to a given class of real algebraic sets indicates that their topological invariants, such as Betti numbers, behave nicely, while NP-completeness of checking non-emptiness of these sets would to the contrary indicate “wild” topology.

Current projects include:

1. Algorithms and bounds for topological invariants of semialgebraic sets defined over quadratic maps, in particular with respect to needs of optimisation.
2. Use of classical algebraic geometry to understand efficient decompositions of nonnegative polynomials into sums of squares of rational functions.
3. Semidefinite programming based approximation algorithms for problems with symmetry that arise in engineering, combinatorics, and graph theory.
4. Determinantal representations of polynomial invariants of finite and classical groups, applied to graph recognition and algebraic complexity.

Long-term collaborators:

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|-------------------------|-------------------|
| S. Basu | (Georgia Tech), |
| E. de Klerk | (Tilburg Uni.) |
| D. Grigoriev, M.-F. Roy | (Uni. Rennes I), |
| B. Shapiro | (Stockholm Uni.), |
| C. Scheiderer | (Uni. Konstanz) |

Selected Publications

E. de Klerk, D.V. Pasechnik, A. Schrijver, Reduction of symmetric semidefinite programs using the regular *-representation. *Math. Prog. B* **109** 613-624 (2007)

E. de Klerk, J. Maharry, D.V. Pasechnik, B. Richter, G. Salazar, Improved bounds for the crossing numbers of $K_{m,n}$ and K_n , *SIAM J. Discr. Math.* **20**, 189-202 (2006)

D. Grigoriev, D.V. Pasechnik, Polynomial-time computing over quadratic maps I. Sampling in real algebraic sets, *Computational Complexity* **14** 20-52 (2005)

E. de Klerk, D.V. Pasechnik, Products of positive forms, linear matrix inequalities, and Hilbert 17-th problem for ternary forms. *Eur. J. Oper. Res.* **157** 39-45 (2004)

E. de Klerk, D.V. Pasechnik, J.P. Warners. Approximate graph colouring and MAX-k-CUT algorithms based on the theta-function. *J. Comb. Opt.* **8**, 267-294 (2004)

E. de Klerk, D.V. Pasechnik, Approximation of the stability number of a graph via copositive programming. *SIAM J. Opt.* **12** 875-892 (2002)

D. Grigoriev, E.A. Hirsch, D.V. Pasechnik. Complexity of semi-algebraic proofs. *Moscow Math. J.* **2** 647-679 (2002)

A.A. Ivanov, D.V. Pasechnik, S.V. Shpectorov. Extended F_4 -buildings and the Baby Monster, *Invent. Math.* **144** 399-433 (2001)

D.V. Pasechnik, Cheryl E. Praeger. On transitive permutation groups with primitive subconstituents. *Bull. London Math. Soc.*, **31** 257-268 (1999)

D.V. Pasechnik. Extended generalized octagons and the group He . *Geom. Dedicata*, **56** 85-101 (1995)

L. Brailovsky, D.V. Pasechnik, C.E. Praeger. Subsets close to invariant subsets for group actions. *Proc. AMS*, **123** 2283-2295 (1995)