

RYERSON UNIVERSITY
DEPARTMENT OF MATHEMATICS
GRAPHS AT RYERSON (G@R) SEMINAR

Dr. Dejan Delic

Department of Mathematics, Ryerson University

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Location: ENG 210

**From Graph isomorphism to a New
Algorithm for Maltsev Constraint
Satisfaction Problems**

Abstract:

The famous problem of Gurevich, which has been the driving force behind the majority of research in descriptive complexity asks if there exists a logic in which all algorithmic problems on finite relational structures (or, equivalently, graphs), solvable in polynomial time, can be expressed. The current candidates for such logics are (1) extensions of the least fixed point logic LFP by rank operators over finite fields or rings, and (2) the Choiceless Polynomial Time with Counting, the tractable restriction of the BGS logic, formulated by Blass, Gurevich, and Shelah. The benchmark problems for testing whether a logic is a good candidate in the sense of Gurevich are (1) known tractable cases of the Graph Isomorphism Problem, and (2) problems arising from linear algebra, such as computing a determinant or the rank of a matrix.

It is known that certain tractable cases of the Graph Isomorphism Problem (more specifically, the isomorphism of graphs with bounded colour classes) can be reduced to constraint satisfaction problems with group templates or, more generally, to CSPs with finite Maltsev templates. The tractability of such problems follows from the Generalized Gaussian Elimination algorithm by Bulatov and Dalmau, which is algebraic in its nature and which heavily exploits the fact that the solution set must be relatively small, i.e. of polynomial size in n , the number of variables. Inspired by some recent sporadic results of R. Willard for the symmetric group S_3 and the quaternions Q_8 , we devise a different algorithm which is a blend of local consistency methods and solving systems of equations over finite fields and which yields definability in both logics which are currently known to be potential canonization logics for polynomial time. This method can also be extended to classes of CSPs more general than Maltsev ones.

ALL FACULTY, STAFF, STUDENTS AND GUESTS ARE WELCOME TO ATTEND