

# Domenico Salvagnin

Curriculum Vitae - September 2018



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## Contact information

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## Research Interest

Theory and algorithms for Linear and Mixed Integer Linear Programming, Constraint Programming. Hybrid methods for Optimization.

## Education and Qualifications

- 2018-Today Associate professor in Operations Research at the Department of Information Engineering, University of Padova.
- 2018 National Academic Qualification as Full Professor.
- 2017 National Academic Qualification as Associate Professor.
- 2011-2018 Assistant professor at the Department of Information Engineering, University of Padova.
- 2009-2011 Post-doc position at the Department of Pure and Applied Mathematics, University of Padova.
- 2009 Ph.D. in Computational Mathematics (Operations Research) at the University of Padova. Thesis title: *Constraint Programming Techniques for Mixed Integer Linear Programs*. Defended on March 26th, 2009.
- 2006 Licensed Professional Engineer.
- 2005 Master Degree (summa cum laude) in Computer Engineering at the University of Padova. Thesis title: *A dominance procedure for Integer Programming*.

## Publications

### – Papers

1. M. Fischetti and D. Salvagnin. Feasibility Pump 2.0. *Mathematical Programming Computation*, 1:201–222, 2009.
2. M. Fischetti, D. Salvagnin, and A. Zanette. Fast approaches to improve the robustness of a railway timetable. *Transportation Science*, 43:321–335, 2009.

3. M. Fischetti and D. Salvagnin. Pruning Moves. *INFORMS Journal on Computing*, 22:108–119, 2010.
4. M. Fischetti, D. Salvagnin, and A. Zanette. A note on the selection of Benders' cuts. *Mathematical Programming B*, 124:175–182, 2010.
5. M. Fischetti and D. Salvagnin. A Relax-and-Cut Framework for Gomory's Mixed-Integer Cuts. *Mathematical Programming Computation*, 3:79–102, 2011.
6. T. Koch, T. Achterberg, E. Andersen, O. Bastert, T. Berthold, R. E. Bixby, E. Danna, G. Gamrath, A. M. Gleixner, S. Heinz, A. Lodi, H. Mittelmann, T. Ralphs, D. Salvagnin, D. E. Steffy, and K. Wolter. MIPLIB 2010 - Mixed Integer Programming Library version 5. *Mathematical Programming Computation*, 3:103–163, 2011.
7. M. Fischetti, M. Monaci, and D. Salvagnin. Three ideas for the Quadratic Assignment Problem. *Operations Research*, 60:954–964, 2012.
8. J. Lang, M. S. Pini, F. Rossi, D. Salvagnin, K. B. Venable, and T. Walsh. Winner determination in voting trees with incomplete preferences and weighted votes. *Autonomous Agents and Multi-Agent Systems*, 25:130–157, 2012.
9. M. Fischetti and D. Salvagnin. Approximating the split closure. *INFORMS Journal on Computing*, 25:808–819, 2013.
10. Q. Louveaux, L. Poirrier, and D. Salvagnin. The strength of multi-row models. *Mathematical Programming Computation*, 7:113–148, 2015.
11. H. D. Mittelmann and D. Salvagnin. Exact and Heuristic Approaches for Directional Sensor Control. *IEEE Sensors Journal*, 15:6633–6639, 2015.
12. H. D. Mittelmann and D. Salvagnin. On Solving a Hard Quadratic 3-Dimensional Assignment Problem. *Mathematical Programming Computation*, 7:219–234, 2015.
13. P. Belotti, P. Bonami, M. Fischetti, A. Lodi, M. Monaci, A. Nogales-Gómez, and D. Salvagnin. On Handling Indicator Constraints in Mixed Integer Programming. *Computational Optimization and Applications*, 1–22, 2016.
14. M. Fischetti, A. Lodi, M. Monaci, D. Salvagnin, and A. Tramontani. Improving branch-and-cut performance by random sampling. *Mathematical Programming Computation*, 8:113–132, 2016.
15. M. Fischetti, M. Monaci, and D. Salvagnin. Mixed-Integer Linear Programming Heuristics for the PrePack Optimization Problem. *Discrete Optimization*, 22:195–205, 2016.
16. M. Fischetti, M. Leitner, I. Ljubic, M. Luipersbeck, M. Monaci, M. Resch, D. Salvagnin, and M. Sinnl. Thinning out Steiner trees: A node-based model for uniform edge costs. *Mathematical Programming Computation*, 9:203–229, 2017.
17. M. Fischetti, L. Liberti, D. Salvagnin, and T. Walsh. Orbital Shrinking: Theory and Applications. *Discrete Applied Mathematics*, 222:109–123, 2017.
18. S. Brigadoi, D. Salvagnin, M. Fischetti, and R. J. Cooper. Array Designer: automated optimized array design for functional near-infrared spectroscopy. *Neurophotonics*, 5:5–19, 2018.
19. S. S. Dey, A. Iroume, M. Molinaro, and D. Salvagnin. Improving the Randomization Step in Feasibility Pump. *SIAM Journal on Optimization*, 28:355–378, 2018.
20. M. Fischetti, M. Monaci, and D. Salvagnin. Self-split parallelization for Mixed Integer Linear Programming. *Computers & Operations Research*, 93:101–112, 2018.

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**– Book chapters**

1. M. Fischetti, A. Lodi, and D. Salvagnin. “Just MIP it!” In: *Matheuristics*. Ed. by V. Maniezzo, T. Stuetzle, and S. Voss. Vol. 10. Annals of Information Systems. Springer US, 2010, pp.39–70.

**– Conference proceedings**

1. M. Fischetti, D. Salvagnin, and A. Zanette. Fast Approaches to Robust Railway Timetabling. In: *ATMOS*. 2007, pp.142–157.
2. R. Brafman, F. Rossi, D. Salvagnin, K. B. Venable, and T. Walsh. Finding the Next Solution in Constraint- and Preference-based Knowledge Representation Formalisms. In: *Principles of Knowledge Representation and Reasoning*. 2010, pp.425–433.
3. M. Fischetti and D. Salvagnin. A Relax-and-Cut Framework for Gomory’s Mixed-Integer Cuts. In: *CPAIOR*. 2010, pp.123–135.
4. M. Fischetti and D. Salvagnin. An In-Out Approach to Disjunctive Optimization. In: *CPAIOR*. 2010, pp.136–140.
5. T. Berthold and D. Salvagnin. Cloud Branching. In: *CPAIOR*. 2013, pp.28–43.
6. D. Salvagnin. Orbital Shrinking: a new tool for hybrid MIP/CP methods. In: *CPAIOR*. 2013, pp.204–215.
7. M. Fischetti, M. Monaci, and D. Salvagnin. Self-splitting of workload in parallel computation. In: *CPAIOR*. 2014, pp.394–404.
8. D. Salvagnin. Detecting and exploiting permutation structures in MIPs. In: *CPAIOR*. 2014, pp.29–44.
9. G. Gamrath, A. Melchiori, T. Berthold, A. Gleixner, and D. Salvagnin. Branching on multi-aggregated variables. In: *CPAIOR*. 2015, pp.141–156.
10. D. Salvagnin. Detecting Semantic Groups in MIP models. In: *CPAIOR*. 2016, pp.329–341.
11. M. Fischetti and D. Salvagnin. Chasing First Queens by Integer Programming. In: *CPAIOR*. 2018, pp.232–244.
12. D. Salvagnin. Symmetry Breaking Inequalities from the Schreier-Sims table. In: *CPAIOR*. 2018, pp.521–529.

**– Reports**

1. T. Berthold, A. Lodi, and D. Salvagnin. *Ten years of Feasibility Pump, and counting*. Tech. rep. DEI, University of Padova, 2017.

**– PhD thesis**

1. D. Salvagnin. “Constraint Programming Techniques for Mixed Integer Linear Programs”. PhD thesis. University of Padova, 2009.

**Prizes**

1. Winner of the 11th DIMACS Implementation Challenge for the best computer codes for Steiner Tree problems (codes *mozartballs*, *mozartduet* and *staynerd* jointly developed with Matteo Fischetti, Markus Leitner, Ivana Ljubic, Martin Luipersbeck, Michele Monaci, Max Reschand Markus Sinnl), 2014.

2. Computational Optimization and Applications 2016 Best Paper Award for the paper "On handling indicator constraints in mixed integer programming", together with Pietro Belotti, Pierre Bonami, Matteo Fischetti, Andrea Lodi, Michele Monaci and Amaya Nogales-Gómez.

## Plenary and semi-plenary lectures

### *Feasibility Pump 2.0*

13th Combinatorial Optimization Workshop, Aussois, France, January 2009

### *Three ideas for the Quadratic Assignment Problem*

MIP Workshop, Waterloo, Canada, June 2011

### *Hunting for split cuts*

16th Combinatorial Optimization Workshop, Aussois, France, January 2012

### *On Solving a Hard Quadratic 3-Dimensional Assignment Problem*

18th Combinatorial Optimization Workshop, Aussois, France, January 2014

### *Detecting and exploiting permutation structures in MIPs*

MIP Workshop, Columbus, USA, July 2014

### *Some experiments with Benders CGLPs*

22nd Combinatorial Optimization Workshop, Aussois, France, January 2018

## Invited lectures

### *Fast Approaches to Robust Railway Timetabling*

University of Newcastle, Australia, April 2010

### *A Relax-and-Cut Framework for Gomory's Mixed-Integer Cuts*

University of New South Wales, Sydney, Australia, April 2010

Zuse Institute, Berlin, Germany, July 2010

Institute Montefiore, University of Liege, Liege, Belgium, October 2010

### *Hunting for split cuts*

Zuse Institute, Berlin, Germany, August 2011

CORE, Louvain, Belgium, September 2011

University of Darmstadt, Germany, September 2012

Arizona State University, USA, January 2013

### *Detecting and exploiting permutation structures in MIPs*

Arizona State University, USA, September 2014

## Presentations and posters

### *A Local Dominance Procedure for Mixed-Integer Linear Programming*

AIRO Conference, Genova, Italy, September 2007

MIP Workshop Poster, New York, USA, August 2008

### *Minimal Infeasible Subsystems and Benders cuts*

AIRO Conference, Ischia, Italy, September 2008

### *Feasibility Pump 2.0*

Matheuristics Workshop, Bertinoro, Italy, June 2008

Workshop on Bound Reduction Techniques, CPAIOR, Pittsburgh, USA, May 2009

AIRO Conference, Siena, Italy, September 2009

### *Constraint Programming Techniques for Mixed Integer Linear Programs*

- AIRO Conference, Siena, Italy, September 2009  
*An In-Out Approach to Disjunctive Optimization*  
 CPAIOR Conference, Bologna, Italy, June 2010  
*A Relax-and-Cut Framework for Gomory's Mixed-Integer Cuts*  
 CPAIOR Conference, Bologna, Italy, June 2010  
*Hunting for split cuts*  
 SIAM OP11, Darmstadt, Germany, May 2011  
*Three ideas for the Quadratic Assignment Problem*  
 CPAIOR Conference, Berlin, Germany, May 2011  
 CREST Workshop, Tokyo, Japan, March 2012  
*Randomness and Tree Search*  
 ISMP, Berlin, Germany, August 2012  
*Orbital Shrinking: a new tool for hybrid MIP/CP methods*  
 CPAIOR Conference, Yorktown Heights, USA, May 2013  
*Detecting and exploiting permutation structures in MIPs*  
 CPAIOR Conference, Cork, Ireland, May 2014  
*Self-splitting of workload in parallel computation*  
 CPAIOR Conference, Cork, Ireland, May 2014  
*Detecting Semantic Groups in MIP models*  
 CPAIOR Conference, Banff, Canada, June 2016  
*Symmetry Breaking Inequalities from the Schreier-Sims table*  
 Porquerolles Workshop on Combinatorial Optimization, France, August 2017  
 CPAIOR Conference, Delft, Netherlands, June 2018  
*Chasing First Queens by Integer Programming*  
 CPAIOR Conference, Delft, Netherlands, June 2018

## Teaching

University of Padova:

- 2008/2009    lecturer in *Mathematical programming to support management decisions*, Mathematics.  
               lecturer in *Operations Research I*, Information Engineering.  
               teaching seminar *Implementation Techniques for LP and MIP solvers*.  
               teaching seminar *Asset Allocation with Excel and VBA*.
- 2009/2010    lecturer in *Operations Research*, Computer Science.  
               lecturer in *Operations Research I*, Information Engineering.  
               lecturer in *Optimization*, Mathematics.  
               teaching seminar *Optimization in the economic domain with GAMS*.
- 2010/2011    lecturer in *Operations Research*, Computer Science.  
               lecturer in *Methods and mathematical models for combinatorial optimization*,  
               Computer Science.  
               professor in *Operations Research*, Mathematics.
- 2011-2014    professor in *Models and software for discrete optimization*, Computer Engineering.

2017-Today professor in *Models and software for discrete optimization*, Computer Engineering.

Theses supervised:

- 2012 M. Perin *A software to compute the symmetry group of Integer Linear Problems*
- 2012 V. Polonio *A MIP formulation for ROADEF/EURO 2011-2012 (machine reassignment)*
- 2014 E. Pasin *Algorithms for 2D Bin Packing (a survey)*
- 2014 A. Melchiori *Experiments with branching on general disjunctions*

### Research Visits

- 2010 Visiting researcher at NICTA, Sydney, to study hybrid MIP/CP methods (joint work with prof. T. Walsh).
- 2010 Visiting researcher at Zuse Institute, Berlin, to work on the implementation/inclusion of Feasibility Pump 2.0 in the SCIP solver (joint work with T. Berthold).
- 2011 Visiting researcher at Zuse Institute, Berlin, to study and enhance primal heuristics within the SCIP solver (joint work with T. Berthold).
- 2011 Visiting researcher at Institute Montefiore, University of Liege, to study practical strategies for deriving cutting planes from multi-row unstructured MIP relaxations (joint work with prof. Q. Louveaux).
- 2012 Visiting researcher at Zuse Institute, Berlin, to work on the SCIP solver.
- 2013 Visiting researcher at Arizona State University, to work on assignment problems (joint work with prof. H. D. Mittelmann).
- 2014 Visiting researcher at Zuse Institute, Berlin, to work on cloud branching (joint work with G. Gamrath and T. Berthold).
- 2014 Visiting researcher at Arizona State University, to work on assignment problems (joint work with prof. H. D. Mittelmann).

### Professional Experiences

- 2006-2008 Participation to the *ARRIVAL (Algorithms for Robust and online Railway optimization: Improving the Validity and reliability of Large scale systems)* European project.
- 2006-Today Reviewer for *Mathematical Programming, Mathematical Programming Computation, INFORMS Journal on Computing, Annals of Operations Research, Computational Optimization and Applications, Computers & Operations Research, Annals of Mathematics and Artificial Intelligence, 4OR*.
- 2007-2009 Participation to the *Models and algorithms for robust network optimization* PRIN project, MiUR.
- 2009 Research grant on *Implementation and evaluation of new Benders decomposition techniques for Stochastic Programming*, University of Padova.

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2009-2011	Participation to the <i>Progetto di Eccellenza 2008-2009: Integer Programming and Combinatorial Optimization</i> project of the Fondazione Cassa di Risparmio di Padova e Rovigo.
2011-2013	Participation to the <i>Computational Integer Programming</i> project of the University of Padova.
2011-2013	Participation to the <i>Nonlinear aspects in primal MILP heuristics, and in robustness</i> PRIN project, MiUR.
2011-Today	Technical editor for <i>Mathematical Programming Computation</i> .
2013	Collaboration with ALSTOM on train timetabling problems.
2015	Program Committee member for CPAIOR-2014.
2014	Collaboration with Inthebra on car sharing problems.
2014	Scientific consultant for IBM ILOG CPLEX.
2015	Program Committee member for MIP2015.
2015-2017	Lead development scientist for IBM ILOG CPLEX.
2016	Senior Program Committee member for IJCAI-16.
2017	Program Chair and Conference Chair for CPAIOR-2017.
2017	Program Committee member for CPAIOR-2018.
2017-Today	Scientific consultant for IBM ILOG CPLEX.
2018	Program Committee member for AAI-2019.

## Languages

Italian (native), English (fluent).

## Skills

Advanced knowledge of the C/C++ programming language and Unix/Linux/Mac OS X.  
Expert on advanced usage of MIP solvers (CPLEX/GUROBI/SCIP) and CP solvers (Gecode).  
Good knowledge of the Python and Java programming languages, of algebraic modeling languages (OPL/GAMS/AMPL), of collaborative tools (Git/Subversion) and of Web development technologies.

## Spare Time

ACM Member since 2004.

Software development, trekking, digital photography, fine woodworking.

Domenico Salvagnin