

SIMONE GARATTI: CURRICULUM VITAE

BIOGRAPHICAL DATA

Name: **Simone Garatti**
Place and date of birth: **Brescia – August 21, 1976**
Nationality: **Italian**
Language: **Italian (mother tongue), English**
Contacts: **Politecnico di Milano**
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CURRENT POSITION

01/15 – : associate professor at the Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano (research field: Automatic Control – SSD ING-INF/04).

PAST POSITIONS AND APPOINTMENTS

01/05 – 12/14: assistant professor (tenured position) at the Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano (research field: Automatic Control – SSD ING-INF/04).
08/06 – 09/06: visiting scholar at the Department of Mechanical and Aerospace Engineering – University of California San Diego, USA.
03/04 – 12/04: research fellow at the Dipartimento di Elettronica e Informazione, Politecnico di Milano, Italy.
August 2003: visiting student at the Lund Institute of Technology, Sweden.

EDUCATION

03/01 – 02/04: Politecnico di Milano, Italy. Ph.D. student in Information Engineering (XVI cycle).
Ph.D. obtained *cum laude* in May 2004.
Thesis: Assessing the model quality in system identification – the asymptotic theory revisited and application to iterative control. *Advisor*: Prof. S. Bittanti; *Co-advisor*: Prof. M.C. Campi.
09/95 – 12/00: Politecnico di Milano, Italy. M.Sc. student in Computer Science Engineering.
M.Sc. obtained *cum laude* in December 2000.
Thesis: Una tecnica iterativa per la sintesi del regolatore basata su un approccio robusto in media.
Advisor: Prof. S. Bittanti; *Co-advisor*: Prof. M.C. Campi.

PUBLICATIONS

The research activity of Simone Garatti has focused on the development and theoretical analysis of innovative methods for control and system identification. His research topics include: randomized techniques for robust optimization in systems and control, white-box system identification, model quality assessment in system identification, iterative control design, and data-mining.

In this section, the complete list of publications is presented. A detailed description of the research activities in relation to the most significant 15 publications can be found in the last section of this CV.

A. International Journals

- [A.1] S. Garatti, M.C. Campi, S. Bittanti, "Assessing the quality of identified models through the asymptotic theory – When is the result reliable?", **Automatica (regular paper)**, **40(8)**: 1319-1332, 2004.
- [A.2] S. Garatti, S.M. Savaresi, S. Bittanti, L. La Brocca, "On the relationships between user profiles and navigation sessions in virtual communities: a data-mining approach", **Intelligent Data Analysis**, **8(6)**:579-600, 2004.
- [A.3] S. Garatti, M.C. Campi, S. Bittanti, "The asymptotic model quality assessment for instrumental variable identification revisited", **System & Control Letters**, **55(6)**: 494:500, 2006.
- [A.4] S. Garatti, S. Bittanti, D. Liberati, A. Maffezzoli, "An unsupervised clustering approach for leukemia classification based on dna micro-arrays data", **Intelligent Data Analysis**, **11(2)**: 175-188, 2007.
- [A.5] M. Campi, S. Garatti, "The exact feasibility of randomized solution of uncertain convex programs", **SIAM Journal on Optimization**, **19(3)**: 1211-1230, 2008.
- [A.6] M.C. Campi, G. Calafiore, S. Garatti, "Interval predictor models: identification and reliability", **Automatica (regular paper)**, **45(2)**: 382-392, 2009.
- [A.7] M.C. Campi, S. Garatti, M. Prandini, "The scenario approach for systems and control design", **Annual Reviews in Control**, **33(2)**:149-157, 2009.
- [A.8] S. Garatti, M.C. Campi, S. Bittanti, "Iterative robust control: speeding up improvement through iterations", **Systems & Control Letters**, **59(2)**:139-146, 2010.
- [A.9] S. Garatti, R.R. Bitmead, "On resampling and uncertainty estimation in linear system identification", **Automatica (regular paper)**, **46(5)**: 785-795, 2010.
- [A.10] M.C. Campi, S. Garatti, "A sampling-and-discarding approach to chance-constrained optimization: feasibility and optimality", **Journal on Optimization Theory and Applications**, **148(2)**:257-280, 2011.
- [A.11] S. Garatti, M.C. Campi, "Modulating robustness in control design – Principles and Algorithms", **IEEE Control System Magazine**, **33(2)**:36-51, 2013.
- [A.12] S. Garatti, S. Bittanti, "A new paradigm for parameter estimation in system modeling", **International Journal of Adaptive Control and Signal Processing**, **7(8)**:667-687, 2013.
- [A.13] A. Carè, S. Garatti, M.C. Campi, "FAST – Fast Algorithm for the Scenario Technique", **Operations Research**, **62(3)**:662-671, 2014.
- [A.14] M. Prandini, S. Garatti, R. Vignali, "Performance assessment and design of abstracted models for stochastic hybrid systems through a randomized approach", **Automatica (brief paper)**, **50(11)**: 2852-2860, 2014.
- [A.15] S. Garatti, "A counterexample to the uniqueness of the asymptotic estimate in ARMAX model identification via the correlation approach", **Systems & Control Letters**, **14(12)**:14-17, 2014.
- [A.16] L. Bisone, S. Bittanti, S. Canevese, A. De Marco, S. Garatti, M. Notaro, V. Prandoni, "A post-combustion carbon capture process by amines supported on solid pellets - with estimation of kinetic parameters", **Industrial & Engineering Chemistry Research**, **54(10)**:2743-2762, 2015.
- [A.17] A. Carè, S. Garatti, M.C. Campi, "Scenario min-max optimization and the risk of empirical costs", **SIAM Journal on Optimization**, **25(4)**:2061-2080, 2015.
- [A.18] L. Deori, S. Garatti, M. Prandini, "Trading performance for state constraint feasibility: a randomized approach", **Journal of the Franklin Institute**, **354(1)**:501:529, 2017.

- [A.19] K. Margellos, A. Falsone, S. Garatti, M. Prandini, "Dual decomposition for multi-agent distributed optimization with coupling constraints", **Automatica**, 85:149-158, 2017.
- [A.20] A. Carè, S. Garatti, M.C. Campi, "Scenario min-max optimization and the risk of empirical costs", **Journal of the Royal Statistical Society. Series B: Statistical Methodology**, 79(5):1367-1389, 2017.
- [A.21] M.C. Campi, S. Garatti, "Wait-and-judge scenario optimization", **Mathematical Programming – series B**, 167(1):155-189, 2018.
- [A.22] K. Margellos, A. Falsone, S. Garatti, M. Prandini, "Distributed constrained optimization and consensus in uncertain networks via proximal minimization", **IEEE Transactions on Automatic Control**, 63(5):1372-1387, 2018.
- [A.23] S. Formentin, S. Garatti, G. Rallo, S.M. Savaresi, "Robust direct data-driven controller tuning with an application to vehicle stability control", **International Journal of Robust and Nonlinear Control**, 28(12):3752-3765, 2018.
- [A.24] A. Falsone, K. Margellos, S. Garatti, M. Prandini, "Finite-Time Distributed Averaging Over Gossip-Constrained Ring Networks", **IEEE Transactions on Control of Network Systems**, 5(3):879-997, 2018.
- [A.25] S. Bittanti, S. Garatti, "Analysis of the Kobe earthquake time series via system identification and fault-detection techniques", **Boletín Geológico y Minero**, 129(3):525-534, 2018.
- [A.26] H. Ming, L. Xie, M.C. Campi, S. Garatti, P.R. Kumar, "Scenario-based Economic Dispatch with Uncertain Demand Response", **IEEE Transactions on Smart Grids**, published online, 2017.
<https://doi.org/10.1109/TSG.2017.2778688>
- [A.27] M.S. Modarresi, L. Xie, M.C. Campi, S. Garatti, A. Carè, A. Thatte, P.R. Kumar, "Scenario-based economic dispatch with tunable risk levels in high-renewable", **IEEE Transactions on Power Systems**, published online, 2018.
<https://doi.org/10.1109/TPWRS.2018.2874464>
- [A.28] L. Deori, S. Garatti, M. Prandini, "4-D Flight Trajectory Tracking: A Receding Horizon Approach Integrating Feedback Linearization and Scenario Optimization", **IEEE Transactions on Control Systems Technology**, published online, 2018
<https://doi.org/10.1109/TCST.2018.2810201>
- [A.29] M.C. Campi, S. Garatti, F.A. Ramponi, "A general scenario theory for non-convex optimization and decision making", **IEEE Transactions on Automatic Control**, published online, 2018.
<https://doi.org/10.1109/TAC.2018.2808446>

B. Chapters of international books

- [B.1] D. Liberati, S. Garatti, S. Bittanti, "Unsupervised mining of genes classifying Leukaemia", in: "**Encyclopedia of Data Warehousing and Mining**" (ed. J. Wang) – Idea Group Publishing, 2005.
- [B.2] M. Prandini, M.C. Campi, S. Garatti, "Controller design through random sampling: an example", in: "**Advance in control theory and applications**" (eds. C. Boniventi, A. Isidori, L. Marconi, C. Rossi) – Springer Verlag, LCNIS series, 2007.
- [B.3] S. Garatti, M. Prandini, "Design in presence of uncertainty: the scenario approach", in: "**Modern Computational Science 12, Optimization**" (eds. R. Leidl, A.K. Hartmann) – BIS-Verlag der Carl von Ossietzky Universität Oldenburg, 2012.
- [B.4] M.C. Campi, M. Prandini, S. Garatti, M. Prandini, "Scenario optimization for MPC", in: "**Handbook of Model Predictive Control**" (eds. S.V. Rakovic, W.S. Levine) – Birkhauser, 2019.

C. International conference proceedings

- [C.1] S. Bittanti, M.C. Campi, S. Garatti, "An iterative controller design scheme based on average robust control", **Proceedings of the 15th IFAC World Congress**, Barcelona, Spain, 2002.
- [C.2] S. Bittanti, M.C. Campi, S. Garatti, "New results on the asymptotic theory of system identification for the assessment of the quality of estimated models", **Proceedings of the 41st IEEE Conference on Decision and Control**, Las Vegas, Nevada USA, 2002.
- [C.3] S. Savaresi, S. Garatti, S. Bittanti, L. La Brocca, "Data-Mining of a large virtual community: relationships between the users DB and the web-log file", **Proceedings of the 3rd SIAM International Conference on Data Mining**, San Francisco, California USA, 2003.
- [C.4] S. Savaresi, S. Garatti, S. Bittanti, "Modeling the relationships between the user DB and the web-log file of a large virtual community", **Proceedings of the 13th IFAC Symposium on System Identification**, Rotterdam, The Netherlands, 2003.
- [C.5] S. Garatti, S. Bittanti, M.C. Campi, "Model quality assessment for Instrumental Variable methods: use of the asymptotic theory in practice", **Proceedings of the 42nd IEEE Conference on Decision and Control**, Maui, Hawaii USA, 2003.
- [C.6] S. Bittanti, M.C. Campi, S. Garatti, "Some critical implementation issues in iterative robust control design", **Proceedings of the 8th IFAC workshop on Adaptation and Learning in Control and Signal Processing**, Yokohama, Japan, 2004.
- [C.7] S. Bittanti, S. Garatti, D. Liberati, "From DNA microarrays to disease classification: an unsupervised clustering approach", **Proceedings of the 16th IFAC world congress**, Prague, Czech Republic, 2005.
- [C.8] M.C. Campi, G. Calafiore, S. Garatti, "New results on the identification of interval predictor models", **Proceedings of the 16th IFAC world congress**, Prague, Czech Republic, 2005.
- [C.9] S. Bittanti, S. Garatti, M.C. Campi, "Introducing robustness in iterative control", **Proceedings of the 44th IEEE Conference on Decision and Control**, Seville, Spain, 2005.
- [C.10] M.C. Campi, S. Garatti, "Modulating robustness in robust control: making it easy through randomization", **Proceedings of the 46th IEEE Conference on Decision and Control**, New Orleans, Louisiana USA, 2007.
- [C.11] S. Garatti, S. Bittanti, "Parameter estimation via artificial data generation with the 'two-stage' approach", **Proceedings of the 7th World Congress on Intelligent Control and Automation**, Chongqing, China, 2008.
- [C.12] M.C. Campi, S. Garatti, M. Prandini, "The scenario approach for systems and control design", **Proceedings of the 17th IFAC world congress** (also published in the volume "Plenary Papers, Milestone Reports & Selected Survey Papers", pp. 180-188), Seoul, Korea, 2008.
- [C.13] S. Garatti, S. Bittanti, "Estimation of white-box model parameters via artificial data generation: a two-stage approach", **Proceedings of the 17th IFAC world congress**, Seoul, Korea, 2008.
- [C.14] S. Bittanti, S. Garatti, "Revisiting the basic issue of parameter estimation in system identification – a new approach for multi-value estimation", **Proceedings of the 47th IEEE Conference on Decision and Control**, Cancun, Mexico, 2008.
- [C.15] S. Garatti, M.C. Campi, "L-inf layers and the probability of false prediction", **Proceedings of the 15th IFAC Symposium on System Identification (SYSID)**, Saint-Malo, France, 2009.
- [C.16] S. Garatti, S. Bittanti, "Parameter estimation in the Pacejka's tyre model through the TS method", **Proceedings of the 15th IFAC Symposium on System Identification (SYSID)**, Saint-Malo, France, 2009.

- [C.17] S. Garatti, R.R. Bitmead, "On re-sampling and uncertainty estimation in linear system identification", **Proceedings of the 15th IFAC Symposium on System Identification (SYSID)**, Saint-Malo, France, 2009.
- [C.18] M.C. Campi, S. Garatti, "Variable robustness control: principles and algorithms" (semi-plenary lecture), **Proceedings of 19th International Symposium on Mathematical Theory of Networks and Systems (MTNS)**, Budapest, Hungary, 2010.
- [C.19] S. Bittanti, S. Garatti, M. Sarati, "Parameter estimation in induction motors: a comparison between the PE and the TS paradigm", **Proceedings of the 18th IFAC World Congress**, Milan, Italy, 2011.
- [C.20] A. Carè, S. Garatti, M.C. Campi, "FAST: an algorithm for the scenario approach with reduced sample complexity", **Proceedings of the 18th IFAC World Congress**, Milan, Italy, 2011.
- [C.21] A. Carè, S. Garatti, M.C. Campi, "Randomized min-max optimization: the exact risk of multiple cost levels", **Proceedings of the 50th IEEE Conference on Decision and Control and European Control Conference**, Orlando, Florida USA, 2011.
- [C.22] S. Garatti, M. Prandini, "A simulation based approach to the approximation of stochastic hybrid systems", **Proceedings of the 4th IFAC Conference on Analysis and Design of Hybrid Systems (ADHS 12)**, Eindhoven, The Netherlands, 2012.
- [C.23] M.C. Campi, B.C. Csàji, S. Garatti, E. Weyer, "Certified system identification - towards distribution-free results" (plenary lecture), **Proceedings of the 16th IFAC Symposium on System Identification (SYSID)**, Brussels, Belgium, 2012.
- [C.24] S. Bittanti, S. Garatti, "System Identification and control: a fruitful cooperation over half a century and more" (plenary lecture), **Proceedings of the 31st Chinese Control Conference**, Hefei, China, 2012.
- [C.25] M. Prandini, S. Garatti, J. Lygeros, "A randomized approach to stochastic model predictive control", **Proceedings of the 51st IEEE Conference on Decision and Control**, Maui, Hawaii USA, 2012.
- [C.26] L. Deori, S. Garatti, M. Prandini, "Stochastic constrained control: trading performance for state constraint feasibility", **Proceedings of the 12th European Control Conference 2013**, Zurich, Switzerland, 2013.
- [C.27] A. Carè, S. Garatti, M.C. Campi, "Least Squares Estimates and the Coverage of Least Squares Costs", **Proceedings of the 52nd IEEE Conference on Decision and Control**, Florence, Italy, 2013.
- [C.28] A. Carè, S. Garatti, M.C. Campi, "Empirical cost distribution: a scenario approach to the construction of probability boxes with application to channel equalization", **Proceedings of the 13th European Control Conference 2014**, Strasbourg, France, 2014.
- [C.29] S. Bittanti, S. Garatti, "A model identification approach to the analysis of the Kobe earthquake time series", **Proceedings of the International Work-Conference on Time Series Analysis ITISE 2014**, Granada, Spain, 2014.
- [C.30] P. Panciatici, M.C. Campi, S. Garatti, S.H. Low, D.K. Molzahn, A.X. Sun, L. Wehenkel, "Advance optimization methods for power systems" (plenary lecture), **Proceedings of the 18th Power Systems Computation Conference (PSCC 2014)**, Wocrlaw, Poland, 2014.
- [C.31] L. Bisone, S. Bittanti, S. Canevese, A. De Marco, S. Garatti, M. Notaro, V. Prandoni, "Modeling and Parameter Identification for CO₂ Post-Combustion Capture by Amines Supported on Solid Sorbents", **Proceedings of the 19th IFAC World Congress**, Cape Town, South Africa, 2014.
- [C.32] L. Deori, S. Garatti, M. Prandini, "Computational approaches to robust Model Predictive Control: a comparative analysis", **Proceedings of the 19th IFAC World Congress**, Cape Town, South Africa, 2014.
- [C.33] L. Deori, S. Garatti, M. Prandini, "A model predictive control approach to aircraft motion control", **Proceedings of the 2015 American Control Conference (ACC 2015)**, Chicago, USA, 2015.

- [C.34] L. Deori, S. Garatti, M. Prandini, "Stochastic control with input and state constraints: a relaxation technique to ensure feasibility", **Proceedings of the 54th IEEE Conference on Decision and Control**, Osaka, Japan, 2015.
- [C.35] M.C. Campi, S. Garatti, F. Ramponi, "Non-convex scenario optimization with application to system identification", **Proceedings of the 54th IEEE Conference on Decision and Control**, Osaka, Japan, 2015.
- [C.36] H. Nasir, S. Garatti, E. Weyer, "Scenario based Stochastic MPC Schemes for Rivers with Feasibility Assurance", **Proceedings of the 15th European Control Conference**, Aalborg, Denmark, 2016.
- [C.37] K. Margellos, A. Falsone, S. Garatti, M. Prandini, "Constrained optimal control of stochastic switched affine systems using randomization", **Proceedings of the 15th European Control Conference**, Aalborg, Denmark, 2016.
- [C.38] K. Margellos, A. Falsone, S. Garatti, M. Prandini, "Proximal minimization based distributed convex optimization", **Proceedings of the 2016 American Control Conference**, Boston, MA, USA, 2016.
- [C.39] G. Rallo, S. Formentin, S. Garatti, S.M. Savaresi, "Vehicle stability control via VRFT with probabilistic robustness guarantees", **Proceedings of the 55th IEEE Conference on Decision and Control**, Las Vegas, NV, USA, 2016.
- [C.40] L. Deori, S. Garatti, M. Prandini, "A stochastic strategy integrating wind compensation for trajectory tracking in aircraft motion control", **Proceedings of the 55th IEEE Conference on Decision and Control**, Las Vegas, NV, USA, 2016.
- [C.41] A. Falsone, K. Margellos, S. Garatti, M. Prandini, "Distributed constrained convex optimization and consensus via dual decomposition and proximal minimization", **Proceedings of the 55th IEEE Conference on Decision and Control**, Las Vegas, NV, USA, 2016.
- [C.42] L. Bisone, S. Bittanti, M. Casnedi, S. Garatti, D. Pareschi, A. Pochiero, "Estimation in Centrifugal Compressors via Particle Filtering", **Proceedings of the 20th IFAC World Congress**, Toulouse, France, 2017.
- [C.43] A. Falsone, K. Margellos, S. Garatti, M. Prandini, "Linear programs for resource sharing among heterogeneous agents: the effect of random agent arrivals", **Proceedings of the 56th IEEE Conference on Decision and Control**, Melbourne, Australia, 2017.
- [C.44] S. Formentin, S. Garatti, M.C. Campi, S.M. Savaresi, "Tuning regularization via scenario optimization", **Proceedings of the 56th IEEE Conference on Decision and Control**, Melbourne, Australia, 2017.
- [C.45] F. Baronio, M. Baronio, M.C. Campi, A. Caré, S. Garatti, G. Perone, "Ventricular Defibrillation: Classification with G.E.M. and a Roadmap for Future Investigations", **Proceedings of the 56th IEEE Conference on Decision and Control**, Melbourne, Australia, 2017.
- [C.46] A. Falsone, L. Deori, D. Ioli, S. Garatti, M. Prandini, "Optimally shaping the stationary distribution of a constrained discrete time stochastic linear system via disturbance compensation", **Proceedings of the 56th IEEE Conference on Decision and Control**, Melbourne, Australia, 2017.

D. National Journals

- [D.1] D. Liberati, S. Bittanti, S. Garatti, Z. Zhao, M. Pappalettera, "Classificazione di leucemie mediante analisi di dati da microarray", **Automazione e Strumentazione** LIII(10):79-86, 2005.

E. Online public repository and technical reports

- [E.1] S. Garatti, "Finding relationships between the users DB and the web-log file of a large Internet community: a data mining approach", **Technical Report no. 2002.48** – Politecnico di Milano, DEI, 2002.

- [E.2] M.C. Campi, S. Garatti, “*The Exact Feasibility of Randomized Solutions of Robust Convex Programs*”, **Optimization Online** (http://www.optimization-online.org/DB_HTML/2007/07/1727.html), 2007
- [E.3] M.C. Campi, S. Garatti, “*Chance-constrained optimization via randomization: feasibility and optimality*”, **Optimization Online** (http://www.optimization-online.org/DB_HTML/2008/09/2092.html), 2008.
- [E.4] M. Prandini, S. Garatti, R. Vignali, “Performance assessment and design of abstracted models for stochastic hybrid systems through a randomized approach”, **ArXiv** (<http://arxiv.org/abs/1405.7197>), 2014.

TEACHING

Simone Garatti has served both as instructor and as teaching assistant in many courses offered by the Politecnico di Milano, mainly on the methodological aspects of system identification and adaptive control. He taught both Italian and English classes. In recent years, he has also given various graduate courses at foreign universities on advance topics in systems and control.

Undergraduate Teaching at national universities

- A.Y. 04/05 Semester I/II: instructor of the course “Progetto di identificazione ed analisi dei dati”, Politecnico di Milano. (2.5 cfu)
- A.Y. 05/06 Semester I/II: instructor of the course “Progetto di identificazione ed analisi dei dati”, Politecnico di Milano. (2.5 cfu)
- A.Y. 05/06 Semester I: instructor of the course “Progetto di I.M.A.D.”, Politecnico di Milano. (2.5 cfu)
- A.Y. 05/06 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)
- A.Y. 05/06 Semester II: instructor of the course “Identificazione dei Modelli ed Analisi dei Dati”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 06/07 Semester I/II: instructor of the course “Progetto di identificazione ed analisi dei dati”, Politecnico di Milano. (2.5 cfu)
- A.Y. 06/07 Semester I: instructor of the course “Progetto di I.M.A.D.”, Politecnico di Milano. (2.5 cfu)
- A.Y. 06/07 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)
- A.Y. 06/07 Semester II: instructor of the course “Identificazione dei Modelli ed Analisi dei Dati”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 07/08 Semester I/II: instructor of the course “Progetto di identificazione ed analisi dei dati”, Politecnico di Milano. (2.5 cfu)
- A.Y. 07/08 Semester I: instructor of the course “Progetto di I.M.A.D.”, Politecnico di Milano. (2.5 cfu)
- A.Y. 07/08 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)
- A.Y. 07/08 Semester II: instructor of the course “Identificazione dei Modelli ed Analisi dei Dati”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 08/09 Semester I: instructor of the course “Progetto di Automatica – parte 2”, Politecnico di Milano. (2.5 cfu)
- A.Y. 08/09 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)
- A.Y. 08/09 Semester II: instructor of the course “Model Identification and Data Analysis”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 09/10 Semester I: instructor of the course “Progetto di Automatica – parte 2”, Politecnico di Milano. (2.5 cfu)
- A.Y. 09/10 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)

- A.Y. 09/10 Semester II: instructor of the course “Model Identification and Data Analysis”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 10/11 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)
- A.Y. 10/11 Semester I: instructor of the course “Model Identification and Data Analysis – 2nd module”, Politecnico di Milano. (5 cfu)
- A.Y. 10/11 Semester II: instructor of the course “Model Identification and Data Analysis”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 11/12 Semester I: instructor of the course “Sistemi Adattativi ed ad Apprendimento”, Politecnico di Milano. (5 cfu)
- A.Y. 11/12 Semester I: instructor of the course “Model Identification and Data Analysis – 2nd module”, Politecnico di Milano. (5 cfu)
- A.Y. 11/12 Semester II: instructor of the course “Model Identification and Data Analysis”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 12/13 Semester I: instructor of the course “Adaptive Systems and Learning”, Politecnico di Milano. (5 cfu)
- A.Y. 12/13 Semester I: instructor of the course “Model Identification and Data Analysis – 2nd module”, Politecnico di Milano. (5 cfu)
- A.Y. 12/13 Semester II: instructor of the course “Model Identification and Data Analysis”, Politecnico di Milano – sede di Como. (5 cfu)
- A.Y. 13/14 Semester I: instructor of the course “Adaptive Systems and Learning”, Politecnico di Milano. (5 cfu)
- A.Y. 13/14 Semester I: instructor of the course “Model Identification and Data Analysis – 2nd module”, Politecnico di Milano. (5 cfu)
- A.Y. 14/15 Semester I: instructor of the course “Adaptive Systems and Learning”, Politecnico di Milano. (5 cfu)
- A.Y. 14/15 Semester II: instructor of the course “Identificazione dei modelli ed analisi dei dati 2”, Politecnico di Milano. (5 cfu)
- A.Y. 15/16 Semester I: instructor of the course “Adaptive Systems and Learning”, Politecnico di Milano. (5 cfu)
- A.Y. 15/16 Semester I: instructor of the course “Identificazione dei modelli e Data Mining [1]”, Politecnico di Milano. (7 cfu)
- A.Y. 16/17 Semester I: instructor of the course “Adaptive Systems and Learning”, Politecnico di Milano. (5 cfu)
- A.Y. 16/17 Semester I: instructor of the course “Identificazione dei modelli e Data Mining [1]”, Politecnico di Milano. (7 cfu)
- A.Y. 17/18 Semester I: instructor of the course “Adaptive Systems and Learning”, Politecnico di Milano. (5 cfu)
- A.Y. 17/18 Semester I: instructor of the course “Identificazione dei modelli e Data Mining [1]”, Politecnico di Milano. (7 cfu)

Total: 173,5 cfu

Graduate Teaching at national universities

- A.Y. 08/09: instructor of the course “Filtering, data analysis and optimization of uncertain systems”. Doctoral programme: “Ingegneria dell’informazione / Information Technology”, Politecnico di Milano.
- A.Y. 14/15: instructor of the course “Sample-based approaches to uncertain optimization – theory and applications”. Doctoral programme: “Ingegneria dell’informazione / Information Technology”, Politecnico di Milano.
- A.Y. 15/16: instructor of the course “OPTIMAL FILTERING AND DATA ANALYSIS - from Kolmogorov-Wiener to Kalman”. Doctoral programme: “Ingegneria dell’informazione / Information Technology”, Politecnico di Milano.

- A.Y. 16/17: instructor of the course “Data-based approaches to uncertain optimization – theory and applications”. Doctoral programme: “Ingegneria dell’informazione / Information Technology”, Politecnico di Milano.

Graduate Teaching at foreign universities

- Instructor of the course “Randomization in Systems and Control Design: the Scenario Approach”, HYCON-EECI Graduate School on Control 2012, Supélec, France, 13-17 February 2012 (in collaboration with M.C. Campi).
- Instructor of the course “Design in the presence of uncertainty: The Scenario Approach”, 4th Modern Computational Science Summer School, Oldenburg, Germany, 30-31 August 2012 (in collaboration with M. Prandini).
- Instructor of the course “Uncertain Optimization via Sample-based Approaches”, HYCON-EECI Graduate School on Control 2013, Supélec, France, 21-25 January 2013 (in collaboration with M.C. Campi).
- Instructor of the course “The Scenario Approach: Theory and Applications”, HYCON-EECI International Graduate School on Control 2014, Supélec, France, 27-31 January 2014 (in collaboration with M.C. Campi).
- Instructor of the course “The scenario approach for robust control, identification, and machine learning”, HYCON-EECI International Graduate School on Control 2015, Supélec, France, 2-6 February 2015 (in collaboration with M.C. Campi).
- Instructor of the course “The scenario approach for systems, control, and machine learning”, HYCON-EECI International Graduate School on Control 2018, Supélec, France, 29 January - 2 February 2018 (in collaboration with M.C. Campi).

Teaching Assistance

- A.Y. 00/01 Semester II: Teaching assistant of the course “Automatica I”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 01/02 Semester II: Teaching assistant of the course “Automatica I”, prof. Sergio Bittanti, Milano. (28 hours)
- A.Y. 02/03 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati” (V.O.), prof. Sergio Bittanti, Politecnico di Milano. (32 hours)
- A.Y. 02/03 Semester II: Teaching assistant of the course “Automatica I”, prof. Sergio Bittanti, Politecnico di Milano. (10 hours)
- A.Y. 03/04 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (10 hours)
- A.Y. 03/04 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati 2”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 03/04 Semester II: Teaching assistant of the course “Segnali e Sistemi”, prof. Patrizio Colaneri, Politecnico di Milano. (16 hours)
- A.Y. 03/04 Semester II: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano – sede di Bovisa. (20 hours)
- A.Y. 03/04 Semester II: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Savaresi, Politecnico di Milano – sede di Como. (8 hours)
- A.Y. 04/05 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 04/05 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati 2”, prof. Sergio Savaresi, Politecnico di Milano. (10 hours)
- A.Y. 04/05 Semester II: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Savaresi, Politecnico di Milano – sede di Como. (16 hours)
- A.Y. 04/05 Semester II: Teaching assistant of the course “Segnali e Sistemi”, prof. Patrizio Colaneri, Politecnico di Milano. (20 hours)
- A.Y. 05/06 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)

- A.Y. 05/06 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 05/06 Semester II: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Simone Garatti, Politecnico di Milano – sede di Como. (20 hours)
- A.Y. 06/07 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 06/07 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 06/07 Semester II: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Simone Garatti, Politecnico di Milano – sede di Como. (20 hours)
- A.Y. 07/08 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 07/08 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 07/08 Semester II: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Simone Garatti, Politecnico di Milano – sede di Como. (20 hours)
- A.Y. 08/09 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 08/09 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 09/10 Semester I: Teaching assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (20 hours)
- A.Y. 09/10 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 10/11 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 11/12 Semester I: Teaching assistant of the course “Sistemi Adattativi ed ad Apprendimento”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 12/13 Semester I: Teaching assistant of the course “Adaptive Systems and Learning”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 13/14 Semester I: Teaching assistant of the course “Adaptive Systems and Learning”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 14/15 Semester I: Teaching assistant of the course “Adaptive Systems and Learning”, prof. Simone Garatti, Politecnico di Milano. (20 hours)
- A.Y. 15/16 Semester I: Teaching assistant of the course “Adaptive Systems and Learning”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 16/17 Semester I: Teaching assistant of the course “Adaptive Systems and Learning”, prof. Simone Garatti, Politecnico di Milano. (8 hours)
- A.Y. 17/18 Semester I: Teaching assistant of the course “Adaptive Systems and Learning”, prof. Simone Garatti, Politecnico di Milano. (20 hours)

Total: 518 hours

Lab assistance

- A.Y. 02/03 Semester II: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (4 hours)
- A.Y. 03/04 Semester I: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (6 hours)
- A.Y. 03/04 Semester II: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano – sede Bovisa. (6 hours)
- A.Y. 04/05 Semester I: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (6 hours)

- A.Y. 05/06 Semester I: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (6 hours)
- A.Y. 06/07 Semester I: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (6 hours)
- A.Y. 07/08 Semester I: Lab assistant of the course “Identificazione dei modelli ed analisi dei dati”, prof. Sergio Bittanti, Politecnico di Milano. (6 hours)

Total: 40 hours

PhD Student Supervision

- 2004-2005: supervisor of the minor research project “Steering a timescale by application of control theory” developed by Marcello Farina as a student of the Information Engineering Doctorate of the Politecnico di Milano (XIX cycle).
- 2009-2010: supervisor of the minor research project “A new identification approach with application to uncertainty assessment for H-Infinity control” developed by Giovanni Alli as a student of the Information Engineering Doctorate of the Politecnico di Milano (XXIV cycle).
- 2010-2012: co-supervisor of the major research project “Data-Based Optimization for Applications to Decision-Making, Identification and Control – A Study of Coverage Properties” developed by Algo Caré as a student of the Computer Science and Automation Engineering Doctorate of the University of Brescia (XXV cycle).
- 2013-2015: supervisor of the major research project of Luca Deori as a student of the Information Engineering Doctorate of the Politecnico di Milano (XXVIII cycle).
- 2015-2017: co-supervisor of the major research project of Alessandro Falsone as a student of the Information Engineering Doctorate of the Politecnico di Milano (XXX cycle).

Thesis Supervision

Supervision of Master’s Thesis

- “Progetto di un controllore di profondità mediante il metodo VRFT”. Author: Gabriele Piccio. Supervisor: Simone Garatti. Co-supervisors: Sergio Bittanti. April 2016.
- “Identificazione di modelli lineari e catene di Markov per la predizione della velocità e della direzione del vento nel breve periodo”. Author: Antonella Costanzo. Supervisor: Simone Garatti. Co-supervisors: Sergio Bittanti and Maria Prandini. April 2013.
- “Metodi basati sulla randomizzazione per il controllo in ambito stocastico con vincoli sull'ingresso e sullo stato”. Author: Luca Deori. Supervisor: Simone Garatti. Co-supervisor: Maria Prandini. September 2012.
- “A neural network study of predicting seizures in epilepsy”. Author: Giuseppe Chindemi. Supervisor: Simone Garatti. Co-supervisor: Sergio Bittanti. July 2012.
- “Stima dei parametri incerti di un motore a induzione : tecniche di identificazione a confronto”. Author: Mattia Sarati. Supervisor: Simone Garatti. Co-supervisor: Sergio Bittanti. December 2009.

Co-supervision of Master’s Thesis

- “Energy Management of multi-building system via distributed optimization”. Author: Fabio Belluschi. Supervisor: Maria Prandini. Co-supervisors: Simone Garatti, Alessandro Falsone. April 2016.
- “Approssimazione di sistemi ibridi stocastici attraverso l’approccio a scenario”. Author: Riccardo Maria Vignali. Supervisor: Maria Prandini. Co-supervisor: Simone Garatti. July 2012.
- “Modello di un generatore a vapore e identificazione delle caratteristiche di un flusso bifase a partire dal transitorio dell’impianto”. Authors: Lino Fiorita, Eleonora Porro. Supervisor: Sergio Bittanti. Co-supervisors: Antonio de Marco, Simone Garatti, Carlo Sandroni. September 2009.
- “Tecniche di stima parametrica con applicazione al problema dell’identificazione dei parametri di Pacejka di un pneumatico”. Author: Carlo Sandroni. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. December 2008.

- “Application of VRFT (Virtual Reference Feedback Tuning) and MPC to a two-fluid single-pass heat exchanger”. Author: Paolo Varutti. Supervisors: Sergio Bittanti, Frank Allgower. Co-supervisor: Simone Garatti. April 2007.
- “Identificazione di parametri fisici in sistemi non lineari: un confronto fra tecniche tradizionali e un approccio black-box a 2 passi”. Author: Filippo Aspesi. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. December 2006.
- “La tecnologia microarray per lo studio di malattie tumorali: analisi dei dati mediante tecniche di data mining”. Author: Andrea Maffezzoli. Supervisor: Sergio Bittanti. Co-supervisors: Diego Liberati, Simone Garatti. July 2003.
- “Metodi basati sull’approccio montecarlo per la valutazione del prezzo di un’opzione finanziaria”. Author: Davide Ferraguti. Supervisor: Sergio Bittanti. Co-supervisors: Danilo Tilloca, Simone Garatti. February 2003.

Supervision of Bachelor’s Thesis

- “Identificazione di modelli per lo studio di un fenomeno franoso in località Cortenova (LC)”. Authors: Vincenzo Guerrisi, Daniele Gianola. Supervisor: Simone Garatti. Co-supervisor: Sergio Bittanti. September 2009.

Co-supervision of Bachelor’s Thesis

- “Stima di un parametro nel modello di una turbina: due metodi a confronto”. Author: Matteo Garza. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. February 2010.
- “Identificazione di un modello del rendimento settimanale del tasso di cambio dollaro USA-sterlina mediante i dati del COT report”. Author: Sergio Iommi. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. April 2008.
- “Modelli PARMA per lo studio della concentrazione di PM10 nella città di Padova”. Author: Gabriele Maggioni. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. September 2007.
- “Identificazione sull’indice del fatturato industriale italiano”. Author: Matteo Bertasa. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. September 2007
- “Analisi di serie temporali di temperature terrestri globali dal 1880 ad oggi tramite sistemi lineari e reti neurali”. Authors: Simone Fontolan, Alessandro Garghetti. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. September 2007
- “Metodi di data mining per la classificazione del traffico telefonico di utenti di una compagnia telefonica”. Author: Luca Sisler. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. July 2007.
- “Metodi di analisi di dati per la sintesi di nuovi farmaci: un caso di studio”. Author: Leonardo Scamazzo. Supervisor: Sergio Bittanti. Co-supervisors: Simone Garatti, Diego Liberati. September 2005.
- “Data mining per dati genici da microarray”. Author: Maria Pia Bazzano, Sabino Abruzzese. Supervisor: Sergio Bittanti. Co-supervisor: Simone Garatti. July 2003.

RESEARCH PROJECTS

National and international research projects

- National research project MIUR COFIN_2000 MM09198819_004 “Nuove tecniche per l’identificazione e il controllo adattativo di sistemi industriali” (duration: 24 months), 2001-2002.
- National research project MIUR COFIN_2002 2002094124_005 “Tecniche innovative per l’identificazione e il controllo adattativo di sistemi industriali” (duration: 24 months), 2003-2004.
- National research project MIUR COFIN_2004 2004097303_003 “Metodi ed algoritmi innovativi per l’identificazione e il controllo adattativo di sistemi tecnologici” (duration: 24 months), 2005-2006
- National research project MIUR PRIN_2006 2006094843_004 “Tecniche ed applicazioni innovative di identificazione e controllo adattativo” (duration: 24 months), 2007-2008.

- National research project MIUR PRIN_2008_20085FFJ2Z_005 "Nuovi algoritmi ed applicazioni di identificazione e controllo adattativo" (duration: 24 months), 2010-2011.
- European research project FP7 231143 "Echord: European Clearing House for Open Robotics Development" (duration: 42 months), 2011-2012.
- Research project Regione Lombardia "GREEN MOVE" (duration: 24 months), 2011-2012.
- European research project FP7 257005 "MoVeS: Modeling, Verification and Control of Complex System" (duration: 36 months), 2011-2013.
- European research project FP7 643921 "UnCoVerCPS: Unifying Control and Verification of Cyber-Physical Systems" (duration: 36 months), 2014-2017.

Research projects with industrial partners

- Tiscali SpA (research contract "Comunità virtuali in Internet: ricerca delle relazioni tra i profili degli utenti e i loro percorsi di navigazione mediante tecniche di data-mining", February 5, 2002).
- Whirlpool SpA (research contract "Tuning di modelli comportamentali per apparecchi elettrodomestici", November 26, 2004).

VISITING POSITIONS

August 2006 – September 2006: *visiting scholar* at the *Department of Mechanical and Aerospace Engineering, University of California San Diego, San Diego, CA, USA.*

August 2003: *visiting student* at the *Lund Institute of Technology, Lund, Sweden.*

AWARDS

2012: award for the best talk in the "Robust Control" session at the Convegno Annuale dei Docenti e Ricercatori Italiani in Automatica, Benevento, Italy, 2012.

2012: co-author of a plenary lecture contribution at the 16th IFAC Symposium on System Identification (plenary talk given by M.C. Campi).

2012: co-author of a plenary lecture contribution at the 31st Chinese Control Conference (plenary talk given by S. Bittanti).

2010: co-author of a semi-plenary lecture contribution at the 19th Symposium on Mathematical Theory of Networks and Systems (semi-plenary talk given by M.C. Campi).

2006: winner of a short-term researcher mobility fellowship from the National Research Council of Italy (CNR) (used as visiting scholar at the University of California San Diego (UCSD), San Diego, CA, USA).

2005: outstanding reviewer of Automatica.

OTHER SCIENTIFIC ACTIVITIES

Technical and Programme Committees

2017-*present*: member of the IFAC Technical Committee on System Identification and Adaptive Control.

2011-*present*: member of the IFAC Technical Committee on Modeling, Identification, and Signal Processing.

2010-*present*: member of the IEEE Control System Society Technical Committee on Computational Aspects of Control System Design.

Member of the: International Programme Committee of the The 18th IFAC Symposium on System Identification 2018; International Programme Committee of the 2016 IEEE Conference on Computer Aided Control System Design - Systems under Uncertainty, 2016; International Programme Committee of the 9th International Conference on Computational Management Science, 2012; National Organizing Committee of the 18th IFAC World Congress, 2011.

He served as Associate Editor for the 20th IFAC World Congress 2007; the 15th European Control Conference, 2009; the 14th European Control Conference, 2011; the 13th European Control Conference, 2010; the 12th European Control Conference, 2009; the 48th IEEE Conference on Decision and Control, 2007.

Invited seminars

December 2007: invited seminar at the *Operational Research Center – MIT*, Boston, MA, USA, and at the *Department of Electrical and Computer Engineering – North Eastern University*, Boston, MA, USA. (Talk entitled “The exact feasibility of randomized solutions to robust optimization: theory and applications”, in collaboration with prof. Marco Campi, Università di Brescia).

Review

Simone Garatti has served as a reviewer for many international journals (Annals of Operation Research, Automatica, IEEE Transactions on Automatic Control, IEEE Transactions on Circuits and Systems I, IET Control Theory and Applications, International Journal of Adaptive Control and Signal Processing, International Journal of Robust and Nonlinear Control, Journal of Complexity, Linear Algebra and its Applications, Mathematical Programming, SIAM Journal on Control and Optimization, SIAM Journal on Optimization) and for many international conferences (EUCA European Control Conference, IEEE American Control Conference, IEEE Conference on Decision and Control, IEEE Multi-conference on Systems and Control, IFAC Symposium on System Identification, IFAC World Congress).

OTHER UNIVERSITY ACTIVITIES

Since academic year 2008/2009, Simone Garatti has been member of the board for the evaluation of study plans for the Bachelor and Master programmes in Automation Engineering and Control of the Politecnico di Milano.

Since academic year 2013/2014, Simone Garatti has been member of the Information Engineering Doctorate Programme Committee of the Politecnico di Milano.

DESCRIPTION OF THE RESEARCH ACTIVITY

Randomized techniques for robust optimization in systems and control

DESCRIPTION: Many problems in systems and control are formulated or can be reformulated as constrained convex optimization problems, and, as such, are amenable of resolution via convex optimization techniques. However, the presence of an uncertain element, like e.g. an uncertain parameter of the system transfer function, may lead to an infinite amount of constraints, one for each value the uncertain element can take. In this case the optimization problem is called robust, and, although the vast majority of problems in systems and control can be casted in the robust optimization framework, the resolution of these types of problems is often impractical. In many cases, robust optimization has been proven even NP-hard.

The idea is that of considering a new optimization problem with a finite number of constraints, obtained by extracting at random a finite number of instances of the uncertain element (scenario approach, see [4]). The obtained optimization problem can be solved by means of standard convex optimization techniques at a relatively

low computational effort. A main issue, however, is the quantification of the reliability of the obtained solution, being this latter based on a sample of uncertainty only.

The fundamental achievement along this line of research was the proof of the fact that the solution is indeed robust not only for the extracted constraints but also for a large amount of the other, unseen, ones. Specifically, the exact quantification of the robustness level in dependence of the number of extractions was given in [2].

Based on this result, the research activity developed along two directions. On the one hand, the theoretical analysis was extended to comprise the case of constraint removal, which permits the user to modulate robustness in favor of performance, [5-6], and suitable modifications to the scenario algorithm were introduced so as to speed up the generalization process, [7]. On the other hand, the scenario approach fostered the introduction of new paradigms in systems and control and the resolution of problems otherwise deemed intractable. In this respect, [1] deals with an innovative method to disturbance rejection in presence of input saturation, in [3] interval predictor models are introduced and a theory of identification for these models is developed, while in [8] the scenario approach is used to design abstracted model for stochastic hybrid systems.

RESEARCH PRODUCTS: This research activity has led to many international conference and journal publications, among which a regular paper published in the *Automatica* journal, a long paper published in the *SIAM Journal on Optimization*, a long paper published in the *IEEE Control Systems Magazine*, and two conference papers associated to semi-plenary / plenary presentations (MTNS 2010, speaker: M.C. Campi - SYSID 2012, speaker: M.C. Campi). Simone Garatti was invited lecturer of four international graduate courses on the scenario approach (HYCON-EECI International Graduate School on Control 2012, 2013, and 2014 (in collaboration with M.C. Campi); 4th Modern Computational Science Summer School (in collaboration with M. Prandini)), and, on the same topic, he gave invited seminars at the Operational Research Center – MIT, Boston, MA, USA, and at the Department of Electrical and Computer Engineering – NorthEastern University, Boston, MA, USA, in 2007 (in collaboration with M.C. Campi).

SELECTED PUBLICATIONS

1. M. Prandini, M.C. Campi, S. Garatti, "Controller design through random sampling: an example", in: "Advance in control theory and applications" (eds. C. Boniventi, A. Isidori, L. Marconi, C. Rossi) – Springer Verlag, LCNIS series, 2007.
2. M.C. Campi, S. Garatti, "The exact feasibility of randomized solutions of uncertain convex programs", *SIAM Journal on Optimization*, 19(3): 1211-1230, 2008.
3. M.C. Campi, G. Calafiore, S. Garatti, "Interval predictor models: identification and reliability", *Automatica* (regular paper), 45(2): 382-392, 2009.
4. M.C. Campi, S. Garatti, M. Prandini, "The scenario approach for systems and control design", *Annual Reviews in Control*, 33(2):149-157, 2009.
5. M.C. Campi, S. Garatti, "A sampling-and-discarding approach to chance-constrained optimization: feasibility and optimality", *Journal on Optimization Theory and Applications*, 148(2):257-280, 2011.
6. S. Garatti, M.C. Campi, "Modulating robustness in control design – Principles and Algorithms", *IEEE Control System Magazine*, 33(2):36-51, 2013.
7. A. Carè, S. Garatti, M.C. Campi, "FAST – Fast Algorithm for the Scenario Technique", *Operations Research*, 62(3):662-671, 2014.
8. M. Prandini, S. Garatti, R. Vignali, "Performance assessment and design of abstracted models for stochastic hybrid systems through a randomized approach", *Automatica* (brief paper), accepted, 2014.

White-box system identification

DESCRIPTION: One basic problem in system identification is that of estimating an unknown parameter in a given model from measurements of input/output data (white-box identification). Existing methods, like Kalman Filtering and PEM identification, may suffer from a high computational burden and from the non-convergence of the estimate, and, in this respect, a tuning is required each time the estimation problem is posed. In certain applications, however, this tuning is not possible. Think e.g. to the problem of estimating the parameters

characterizing the behavior of a tire, where the estimator has to be implemented onboard as an electronic device. Clearly, the estimator must comply with parameter change, as due to tire consumption, without requiring any tuning of the device.

Within this research activity, a novel approach to parameter estimation, based on model simulation is proposed, [1]. The idea is that of generating via model simulation a number of possible values for the unknown parameter and the corresponding input/output data sequences. Then, based on this simulation-based data, the relationship between input/output data and the unknown parameter is established off-line. Clearly, this problem may be tough to solve and a two-stage approach is then proposed: in the first stage the information carried by the simulated data sequences is compressed in artificial data so as to reduce the problem dimensionality; then, in the second stage, the relationship between artificial data and the parameter is established via standard nonlinear function fitting techniques.

Simulations revealed that the two-stage approach may offer valuable improvements with respect to other approaches and, currently, the method is used for the estimation of parameters of an industrial plant.

RESEARCH PRODUCTS: In addition to the paper reported below, the research activity led to a number of conference publications, among which a contribution associated to a plenary presentation (Chinese Control Conference 2012, speaker: S. Bittanti).

SELECTED PUBLICATIONS

1. S. Garatti, S. Bittanti, "A new paradigm for parameter estimation in system modeling", *Journal of Adaptive Control and Signal Processing*, 7(8):667-687, 2013.

Model quality assessment in system identification

DESCRIPTION: Model quality assessment is a fundamental problem in system identification, since an identified model is of little use without an evaluation of the mismatch between the model and the true system generating the data. The most commonly used tool for evaluating the model error is the asymptotic theory of system identification, which returns ellipsoidal confidence regions for the system parameters. Yet, as is clear, guarantees hold true when the number of data points tends to infinite, so that, in practice, this theory has heuristic validity only. Despite the achieved results are correct in many cases, it may happen that, in presence of poor informative data, the returned confidence regions are completely unreliable, as shown in [1].

In this research activity, the conditions for the usability of the asymptotic theory have been critically discussed, both for prediction error methods (PEM), [1], and instrumental variable (IV) techniques, [2]. In both cases, a novel asymptotic theory, which holds under nonstandard assumptions comprising the case of non-informative data, has been developed, and, based on this theory the conditions the reliability of the asymptotic theory depends on have been spotted out. In particular, it has been shown that, though the asymptotic theory can be safely used for most of the usual model classes, this is not the case for Box-Jenkins models, which hence require some extra-care to avoid unreliable results.

To prevent the drawbacks highlighted in [1,2], in [3] novel techniques based on data re-sampling have been introduced so as to reconstruct based on a finite number of data points a guaranteed estimate of the whole probability distribution function of the parameter vector returned by PEM identification.

RESEARCH PRODUCTS: The research activity led to various international conference and journal publications, among which two regular papers in the *Automatica* journal.

SELECTED PUBLICATIONS

1. S. Garatti, M.C. Campi, S. Bittanti, "Assessing the quality of identified models through the asymptotic theory – When is the result reliable?", *Automatica* (regular paper), 40(8): 1319-1332, 2004.

2. S. Garatti, M.C. Campi, S. Bittanti, "The asymptotic model quality assessment for instrumental variable identification revisited", *Systems & Control Letters*, 55(6): 494-500, 2006.

3. S. Garatti, R.R. Bitmead, "On resampling and uncertainty estimation in linear system identification", *Automatica* (regular paper), 46(5): 785-795, 2010.

Iterative control design

DESCRIPTIONS: Iterative control has been widely studied in recent years as an efficient methodology for the design of high-performing controllers of complex plants. The idea behind iterative design is that, when the plant is exceedingly complex, the design of the controller in one shot is hazardous. Instead, one can perform a sequence of closed-loop identification and controller design steps, aiming at progressively learning how to increase the control performance through experience.

Standard techniques have a major drawback: since the controller update is based on the last identified model only, some caution is needed at each iteration to avoid instability. In turn this implies that an excessive number of iterations is usually needed to design the controller, eventually leading to an expensive design procedure.

In this research activity, a new iterative control scheme, which explicitly accounts for the presence of uncertainty in the plant description (iterative robust control), has been introduced, [1]. In this scheme, at each iteration, a model of the plant is identified along with an evaluation of its uncertainty; the controller then is updated based on both the identified model and the estimated level of uncertainty. In this way, the performance improvement through steps can be speeded out, while preserving, at the same time, the robust stability of the closed-loop. This leads to an algorithm that is able to design high-performing controllers with a reduced number of experiments on the plant.

RESEARCH PRODUCTS: Besides the journal paper reported below, this research activity led to various conference papers.

SELECTED PUBLICATIONS

1. S. Garatti , M. Campi, S. Bittanti, "Iterative robust control: speeding up improvement through iterations", *Systems & Control Letters*, 59(2):139-146, 2010.

Data-mining

DESCRIPTION: Data-mining is an emerging topic in the field of identification, whose objective is that of finding hidden relationships among data in huge databases. A prototype problem is e.g. that of classifying customers based on a track of their purchases.

In this research activity, the focus was on the analysis of two datasets: one about the behavior of users in a Virtual Internet Community, [1], and one about the gene expression of a number of patients as measured through the DNA-microarrays technology, [2]. In the first case, the aim was that of finding the correlation between user profiles and navigation types. In the second case, instead, the database referred to patients suffering from Leukemia, and the aim was that of classifying the disease based on gene expression only.

In both cases, unsupervised classification has been used so as to cluster the samples in a small number of representative categories and to simplify the subsequent information retrieval phase. Data pre-processing has been also used to improve the finally achieved results.

RESEARCH PRODUCTS: In addition to the papers reported below, this research activity led to some conference publications and to a contribution for the Encyclopedia of Data Warehousing and Mining.

SELECTED PUBLICATIONS

1. S. Garatti, S.M. Savaresi, S. Bittanti, L. La Brocca, "On the relationships between user profiles and navigation sessions in virtual communities: a data-Mining approach", *Intelligent Data Analysis*, 8(6): 579-600, 2004.

2. S. Garatti, S. Bittanti, D. Liberati, A. Maffezzoli, "An unsupervised clustering approach for leukaemia classification based on dna micro-arrays data", *Intelligent Data Analysis*, 11(2): 175-188, 2007.