

Giorgio Gnecco – CV

Born in Genoa (Italy), 01/03/1979

Contacts

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Present position

Post-Doc at DIST (University of Genoa)

Studies and past positions

1997: "Maturità Scientifica" at Liceo Scientifico "M. L. King", Genova, Italy (60/60)

2000: Diploma in violin (recognized as a Bachelor's Degree – Italian Law 268/2002)

2001: Diploma in viola (recognized as a Bachelor's Degree – Italian Law 268/2002)

December 2004: "Laurea Quinquennale" (Master's Degree) in Telecommunications Engineering (110/110 cum Laude). Thesis: "*Application of Support Vector Machines to Optimal Control Problems*". Supervisors: Proff. Marcello Sanguineti and Riccardo Zoppoli. Average examination mark before the thesis: about 29.54/30.

2005: qualification test ("Esame di Stato") for the profession of Engineer

2005: collaboration with the Dept. of Biophysical and Electronic Engineering (DIBE) - University of Genoa (Prof. B. Bianco) on "Definition of optimality criteria for the choice of the parameters for the Cole-Davidson model, and application to a particular case"

2005: qualified in the competition for the Ph.D. in Computer Science at the University of Milano-Bicocca, Italy

2005: qualified in the competition for the Ph.D. in Mathematics and Applications at the University of Genoa. Three-years fellowship.

2006-2008: Ph.D. student in Mathematics and Applications at the University of Genoa

April 2009: Ph.D. in Mathematics and Applications. Thesis: "*Functional Optimization by Variable-Basis Approximation Schemes*". Supervisor: Prof. Marcello Sanguineti

2009: Post-Doc at the Dept. of Computer and Information Science (DISI) - University of Genoa

2010: Post-Doc at the Dept. of Communications, Computer, and System Sciences (DIST) - University of Genoa

2011: collaboration with the Dept. of Communications, Computer, and System Sciences (DIST) - University of Genoa (Prof. R. Zoppoli), on "Comparison between linear and nonlinear one-hidden layer approximating networks"

2011: Post-Doc at the Dept. of Communications, Computer, and System Sciences (DIST) - University of Genoa

Research topics

1. Functional optimization
2. Neural networks for functional optimization and function approximation
3. Dynamic optimization
4. Team optimization
5. Learning from data
6. Combinatorial optimization in telecommunications networks

1) Functional optimization

Functional optimization problems, originally studied in the calculus of variations, model a variety of problems in practically all fields of applied mathematics. They arise, e.g., in statistics, optimal control, management and economic sciences, and learning from data. In all these problems, it is required to find a function that is optimal, in a sense specified by a suitable cost functional, among a set of admissible functions satisfying given constraints. This motivates the term “functional optimization”, sometimes called “infinite-dimensional programming”, since the admissible sets are infinite-dimensional spaces or their infinite-dimensional subsets. Depending on the context, the admissible functions may represent, e.g., routing strategies in telecommunications networks, decision functions in optimal control problems, and approximations of regression functions in devices that learn from examples. In solving such problems, the infinite dimension makes it difficult to apply most tools typically used in finite-dimensional optimization (nonlinear programming). Moreover, often the approaches based on the calculus of variations do not provide solutions in explicit form. As a consequence, it is particularly important to search for suboptimal solutions.

I have focused my attention on the search for suboptimal solutions expressed as functions with a fixed structure, in which a certain number of parameters has to be optimized. For example, this is the case with linear combinations of Gaussians with variable centers and variances: the coefficients of the combinations, together with the components of the vectors representing the centers and the variances, are the parameters to be optimized. Quite intuitively, the need to minimize the computational effort - in terms of both time and memory requirements – associated with the search for good parameter values motivates the interest in suboptimal solutions containing a small number of such parameters.

My research activity in this field has been devoted to the investigation of functional optimization problems for which one is able to guarantee, via suitable choices of the structures of parametrized suboptimal solutions, that one does not incur the so-called “curse of dimensionality”, i.e., a rapid increase (typically, an exponential increase), with respect to the number of arguments of the admissible functions, of the number of parameters required to guarantee a desired accuracy of suboptimal solutions. The problems that I have investigated belong mainly to the fields of dynamic optimization, team optimization, and learning from data.

2) Neural networks for functional optimization and function approximation

Suboptimal solutions to functional optimization problems can be searched for among linear combinations of a given number of computational units with a simple structure (e.g., sinusoidal functions, Gaussians, and sigmoids) containing some parameters to be optimized (e.g., centers and variances for the Gaussian case). Classical methods for the search of suboptimal solutions to functional optimization problems (e.g. the Ritz method) employ linear approximation schemes, for which the basis functions are fixed and the unique parameters to be tuned are the coefficients of the linear combinations.

Several theoretical and numerical studies have shown that often approximation schemes based on basis functions containing adjustable inner parameters have advantages over linear approximation schemes. For instance, they may require a total number of parameters (i.e., the coefficients of the linear combinations and the inner parameters of the basis functions) much smaller than the one required by linear approximation schemes, for the same quality of suboptimal solutions. In general, the inner parameters cause the loss of linearity, so one has nonlinear approximation schemes. Examples are one-hidden layer neural networks with sigmoidal, trigonometric or radial computational units. They have been systematically used in an extension of the Ritz method, known as ERIM (Extended Ritz Method). In practice, looking for suboptimal solutions in the form of nonlinear approximation schemes, the original functional optimization problem is reduced to a finite-dimensional nonlinear programming problem. It consists in finding the optimal values of all the parameters: the coefficients of the linear combinations of the parameterized basis functions and their inner parameters.

The approximation capabilities of families of function approximators can be fruitfully exploited in the search of suboptimal solutions to functional optimization problems. In particular, my research activity in this field has been devoted to the investigation of structural properties (e.g., smoothness) of the optimal solutions to various kinds of functional optimization problems, in order to choose function approximators that are suitable to the given problem, and to investigate the quality of the associated suboptimal solutions, in dependence of the total number of parameters.

The connections between the problem of function approximation and the one of functional optimization have motivated my investigation of the comparison between the approximation capabilities of certain linear and nonlinear approximation schemes, and the study of new approximation error bounds for some families of functions. Then I have applied the obtained estimates in the “sup-norm” to dynamic optimization problems and to the search for approximate solutions to Fredholm integral equations. Estimates in the “ L_2 norm” have been applied to team optimization problems.

I have also studied some relationships between “classical” norms (e.g., Lebesgue's and Sobolev's ones) and a norm known in the literature as “variation norm”, which is associated with the kind of basis functions used in nonlinear approximation schemes. Such a norm plays a relevant role in estimating the accuracies of suboptimal solutions to functional optimization problems.

Finally, I have specialized the general methodology described above to some families of particularly important functional optimization problems: dynamic optimization, team optimization and learning from data.

3) Dynamic optimization

In dynamic optimization, a decision maker has to make sequential decisions, with the aim to minimize a given cost expressed as the sum of costs associated with each decisional stage. Such problems have a variety of applications in Operations Research, such as production planning, portfolio optimization, and optimal choice of consumption.

In such problems, nonlinear approximators can be used to approximate either the optimal strategies of the decision maker or the so-called value functions inside Approximate Dynamic Programming (ADP), a technique used to solve approximately Bellman's equation arising in dynamic programming. In both cases, I have derived conditions under which certain nonlinear approximation schemes are able to mitigate the curse of dimensionality: the number of parameters that is necessary to guarantee a given accuracy of suboptimal solutions depends in a “mild way” (polynomially) on the number of decisional variables. Such conditions include the interiority of the optimal strategies, convexity properties of the transitional and final costs, and a degree of smoothness that is proportional to the number of decisional variables.

Among the problems that I have investigated in this context, there are perturbations of the classical LQ and LQG problems in optimal control and optimal consumption (in both its deterministic and stochastic versions), for which I have developed both theoretical investigations and numerical simulations. Finally, I have studied an application to geometric optics (which can be formulated as a dynamic optimization problem thanks to the existing links between the eikonal equation and dynamic programming).

For the case in which the number of parameters of the nonlinear approximation schemes varies among the stages, I have studied, both theoretically and numerically, the optimization problem associated with the determination of the optimal distribution of the number of parameters among the stages.

4) Team optimization

Team optimization problems are characterized by the simultaneous presence of several decision makers with a partial and individual information on the environment they interact with, but having a common objective (differently from game theory, where each player has in general a different objective). Such problems model many optimization contexts and have various applications, such as bandwidth allocation and congestion control.

My research activity in this field has been devoted to the study of problems with only one decisional stage, since several team optimization problems can be formulated in this context or can be reduced to it (e.g., the classical Witsenhausen's counterexample). I have studied smoothness properties of the optimal strategies in production planning problems in the presence of decentralization. For the famous and still unsolved “Witsenhausen's

counterexample”, I have estimated the accuracies of certain kinds of suboptimal solutions. Finally, I have considered simplifications arising in team optimization problems (with respect to their general formulation) when the interaction among the decision makers is limited and is modeled by a graph of the interactions (“Network Team Optimization Problems”).

5) Learning from data

I have investigated suboptimal solutions to both supervised and unsupervised learning problems using kernel methods. Such techniques map nonlinearly the input data to an infinite-dimensional space and apply in such a space linear techniques of supervised or unsupervised learning. To this aim, they compute the inner products in such a space using a function which is called “kernel”.

Often, in these problems a so-called “representer theorem” is available, which provides the structure of the optimal solution. However, typically such solution depends on a number of parameters that is proportional to the number of training examples. When the training set is of large cardinality, this may require an excessive computational effort and cause ill-conditioning. Thus, suboptimal solutions with a simple structure are of interest, e.g., in order to reduce the memory requirements and the time needed (during the testing phase) for the classification of a new example (for the case of supervised learning) or for the evaluation of the “features” (for the case of unsupervised learning), once the training phase has been completed.

As concerns supervised learning, I have considered various forms of regularization (e.g., Tikhonov’s regularization and weight decay). In the context of unsupervised learning, my research activity has been devoted to Kernel Principal Component Analysis. In both cases, I have investigated the accuracy of suboptimal solutions when varying the number of parameters to be optimized for certain nonlinear approximation schemes. Among the techniques that I have used, a relevant role was played by tools coming from “Statistical Learning Theory”, which often allows one to keep under control the difference between the expected risk and the empirical risk.

6) Combinatorial optimization in telecommunications networks

My research activity in this field has been devoted to the study of structural properties of the optimal solutions to certain problems of generalized knapsack, formulated in a stochastic context. Such problems arise, e.g., in Call Admission Control for telecommunications networks with admission regions characterized by nonlinear constraints. This problem is particularly important when one wants to impose given requirements of Quality of Service (QoS) on the ongoing connections, minimizing at the same time the probability that an incoming connection is rejected by the control system. The combinatorial optimization problem known as “generalized stochastic knapsack” is characterized by nonlinearities in both the objective functions and the constraints; for this reason, “ad hoc” techniques are required to solve it. The deterministic version where, in addition, there are no nonlinear constraints on the capacity of the knapsack is known as the “knapsack problem”, a well-known NP-hard problem.

For the “generalized stochastic knapsack”, I have investigated structural properties of the optimal strategies belonging to the class of “coordinate-convex policies” (e.g., presence of thresholds and relationships between the locations of adjacent corner points).

Such properties allow one to restrict the search for the optimal strategies. After studying how the number of strategies that satisfy such properties depends on the form of the nonlinear boundary of the admission region, I have analyzed how the optimal value of the objective varies as a consequence of a variation of the admission region itself. This investigation has been motivated by the fact that admission regions with “simple” boundary make it easier to find the associated optimal strategies.

Finally, I have studied some criteria to find suboptimal “coordinate-convex” strategies that can be locally improved. On the basis of such criteria, I have proposed a greedy algorithm for the approximate solution of the “generalized stochastic knapsack” problem. The related simulation results show a significant improvement of the objective with respect to the decisional strategies adopted in the initialization stage.

Post-Laurea training

Ph.D courses at the University of Genoa

- "Stochastic Processes" (E. Sasso).
- "Calculus of Variations" (D. Percivale and T. Zolezzi).
- "Elliptic Equations and Sobolev Spaces" (M. Chicco).
- "Regularization Methods for High-Dimensional Learning" (F. Odone and L. Rosasco).

Ph.D courses at other universities

- "A Short Course in Nonlinear Optimization" (A. Wachter, IBM TJ Watson Research NY) – University of Bologna, March 2007.
- EURO-FGI course "Game Theory with Application to Telecommunications" (V. Fragnelli) – University of Eastern Piedmont, 10-14 December 2007.
- "A Short Course in Convex Optimization" (K. Scheinberg, Columbia University, NY) – University of Bologna, July 2009.

International schools and workshops

- "The Analysis of Patterns" - "Ettore Majorana Center ", Erice, Italy - 28 October - 6 November 2005
- "Mathematical Foundations of Learning Theory - II" - Paris, École Normale Supérieure, May-June 2006
- Workshop "Complex Networks - Equilibrium and Vulnerability Analysis with Applications" (A. Nagurney, University of Massachusetts at Amherst) – University of Catania, 10-12 March 2008.
- "Graph Theory, Algorithms and Applications" - "Ettore Majorana Center ", Erice, Italy, 8-16 September 2008.
- "C.I.R.O. Summer School", Bertinoro, Italy, 28 June-3 July 2010.

Periods as visiting scientist

October 2007: visiting scientist at the Institute of Computer Science of the Academy of Sciences of the Czech Republic (joint research with Věra Kůrková on learning from data and neural networks)

Scientific/organization activity

2012: Member of the International Program Committee of the 13th Conf. on Engineering Applications of Neural Networks (EANN 2012).

2011: Member of the International Program Committee of the 12th Conf. on Engineering Applications of Neural Networks (EANN 2011).

2010: Member of the International Program Committee of the 20th Int. Conf. on Artificial Neural Networks (ICANN 2010).

2008: Scientific Secretary of the Local Organizing Committee of the 7th Int. Conf. "Mathematical Problems in Engineering, Aerospace, and Sciences" (ICNPAA 2008)

June 2008: official violinist at the 7th Int. Conf. "Mathematical Problems in Engineering, Aerospace and Sciences", ICNPAA 2008

September 2007: official violinist at the 38th Conf. of the Italian Association of Operations Research (AIRO 2007)

Reviewer activity

Reviewer for international journals

- SIAM Journal on Optimization.
- Automatica.
- International Journal of Information Technology & Decision Making.
- IEEE Transactions on Neural Networks.
- Neural Networks.
- Neurocomputing.
- Neural Computing & Applications.
- Neural Processing Letters.
- Applied Mathematical Sciences.

Reviewer for international conferences

- Int. Conf. on Adaptive and Natural Computing Algorithms, 2007.
- 47th IEEE Conference on Decision and Control, 2008.
- Int. Conf. on Artificial Neural Networks, 2009.
- 49th IEEE Conference on Decision and Control, 2010.
- Int. Conf. on Artificial Neural Networks, 2010.
- Int. Conf. on Informatics in Control, Automation and Robotics, 2011.
- 50th IEEE Conference on Decision and Control and European Control Conference, 2011.
- 12th Conf. on Engineering Applications of Neural Networks, 2011.

Reviewer for monographs

•Complex-Valued Neural Networks: Utilizing High-Dimensional Parameters, T. Nitta, Ed. (Publisher: Medical Information Science Reference), 2009

Partecipation at conferences as speaker

- AIRO WINTER 2011, Cortina d'Ampezzo, Italy, 7-12 February 2011.
- EURO 2010, Lisbona, Portogallo, 11-14 July 2010.
- SOFSEM 2010, Špindlerův Mlýn, Check Republic, 23–29 January 2010.
- International Network Optimization Conference (INOC 2009), Pisa, Italy, April 2009.
- Int. Conf. on Mathematical Science and Engineering (ICMSE 09), Venice, Italy, 28-30 October 2009.
- AIRO 2009, Siena, Italy, September 2009.
- AIRO 2007, Genova, Italy, September 2007.
- AIRO 2005, Camerino, Italy, September 2005.

Invited talks

- 22 October 2007: invited talk at the Institute of Computer Science - Academy of Sciences of the Czech Republic, Prague.
- 7 October 2009: invited talk al seminario SLIPGURU - DISI, University of Genoa.

Editorial activity

2009: Guest Editor of the Special Issue "Mathematical Problems in Engineering" in the international journal "Applied Mathematical Sciences"

Since 2011: Associate Editor for the international journal "Mathematics in Engineering, Science and Aerospace"

International projects

Since September 2007: member of the project 2004-2009 "*Learning from data by neural networks and kernel methods: An approach based on approximate optimization*", among University of Genoa, National Research Council of Italy, and Czech Academy of Sciences

Member of the project 2010-2012 "*Complexity of neural-network and kernel computational models*", among University of Genoa, National Research Council of Italy, and Czech Academy of Sciences

National (Italian) projects

2007 – 2008: member of the Italian Research Program of National Interest (PRIN – MIUR) "*Models and algorithms for robust network optimization*" .

2006: member of the "Progetto di Ateneo 2006" of the University di Genoa "*Application of the extended Ritz method to control problems*"

2008: member of the "Progetto di Ateneo 2008" of the University di Genoa "*Solving functional optimization problems through nonlinear approximators and learning from data*"

2010 – 2011: member of the Italian Research Program of National Interest (PRIN – MIUR) "*Adaptive state estimation and adaptive optimal control*".

Institutional activity at university

Since 2011: Member of CNIT ("Consorzio Nazionale Interuniversitario per le Telecomunicazioni").

Since 2007: qualified expert ("Cultore della Materia") in Operations Research, within the "Laurea" courses "Logistics and Transportation Engineering" and "Telecommunications Engineering" at the University of Genoa

Since 2007: member of the examination committees for the following courses at the University of Genoa:

- "Operations Research 1" ("Laurea" course in Logistics and Transportation Engineering)
- "Operations Research 2" ("Laurea" course in Telecommunications Engineering)
- "Mathematical and Statistical Methods and Operations Research" ("Laurea" course in Logistics and Transportation Engineering)
- "Operations Research 2" ("Laurea" course in Telecommunications Engineering)
- "Operations Research 1" ("Laurea" courses in Information Technology Engineering, Electronic Engineering, and Logistics and Transportation Engineering)

Laboratory activity

Since 2005: member of the NOCC laboratory (Nonlinear Optimization, Complexity, and Control Laboratory) at DIST – University of Genoa

Teaching activity

Operations Research 1 for Electronic Engineering 2005-06: course notes

Operations Research 1 for Electronic Engineering 2006-07: lectures with exercises

Operations Research 1 for Civil and Environmental Engineering 2006-07: lectures with exercises

Mathematical and Statistical Methods and Operations Research 2010-2011: lectures with exercises

Operations Research 1 for Information Technology Engineering and Electronic Engineering 2011-12: lectures with exercises

Publications

International journals

- 1.G. Gnecco, M. Sanguineti, M. Gaggero, "*Suboptimal solutions to team optimization problems with stochastic information structure*", **SIAM Journal on Optimization**, to appear.
- 2.G. Gnecco, M. Sanguineti, "*New insights into Witsenhausen's counterexample*", **Optimization Letters**, DOI: 10.1007/s11590-011-0339-6.
- 3.G. Gnecco, V. Kůrková, M. Sanguineti, "*Accuracy of approximations of solutions to Fredholm equations by kernel methods*", **Applied Mathematics and Computation**, to appear.
- 4.G. Gnecco, V. Kůrková, M. Sanguineti, "*Can dictionary-based computational models outperform the best linear ones?*", **Neural Networks**, vol. 24, pp. 881-887, 2011.
- 5.G. Gnecco, M. Sanguineti, "*On a variational norm tailored to variable-basis approximation schemes*", **IEEE Transactions on Information Theory**, vol. 57, pp. 549-558, 2011.
- 6.M. Cello, G. Gnecco, M. Marchese, M. Sanguineti, "*CAC with nonlinearly-constrained feasibility regions*", **IEEE Communications Letters**, vol. 15, pp. 467 – 469, 2011.
- 7.G. Gnecco, V. Kůrková, M. Sanguineti, "*Some comparisons of complexity in dictionary-based and linear computational models*", **Neural Networks**, vol. 24, pp. 171-182, 2011.
- 8.G. Gnecco, "*A comparison between fixed-basis and variable-basis schemes for function approximation and functional optimization*", **Journal of Applied Mathematics**, vol. 2012, article ID, 806945, 17 pages, 2012.
- 9.A. Alessandri, G. Gnecco, M. Sanguineti, "*Minimizing sequences for a family of functional optimal estimation problems*", **Journal of Optimization Theory and Applications**, vol. 147, pp. 243–262, 2010.
- 10.G. Gnecco, M. Sanguineti, "*Suboptimal solutions to dynamic optimization problems via approximations of the policy functions*", **Journal of Optimization Theory and Applications**, vol. 146, pp. 764-794, 2010.
- 11.G. Gnecco, M. Sanguineti, "*Estimates of variation with respect to a set and applications to optimization problems*", **Journal of Optimization Theory and Applications**, vol. 145, pp. 53-75, 2010.
- 12.G. Gnecco, M. Sanguineti, "*Regularization techniques and suboptimal solutions to optimization problems in learning from data*", **Neural Computation**, vol. 22, pp. 793-829, 2010.
- 13.G. Gnecco, M. Sanguineti, "*Accuracy of suboptimal solutions to kernel principal component analysis*", **Computational Optimization and Applications**, vol. 42, pp. 265-287, 2009.

- 14.G. Gnecco, M. Sanguineti, "Error bounds for suboptimal solutions to kernel principal component analysis", **Optimization Letters**, vol. 4, pp. 197-210, 2010.
- 15.G. Gnecco, M. Sanguineti, "On spectral windows in supervised learning from data", **Information Processing Letters**, vol. 110, no. 23, pp. 1031-1036, 2010.
- 16.G. Gnecco, M. Sanguineti, "Team optimization problems with Lipschitz continuous strategies", **Optimization Letters**, vol. 5, no. 2, pp. 333-346, 2011.
- 17.G. Gnecco, M. Sanguineti, "The weight-decay technique in learning from data: An optimization point of view", **Computational Management Science**, vol. 6, pp. 53-79, 2009.
- 18.G. Gnecco, M. Sanguineti, "Estimates of the approximation error using Rademacher's complexity: Learning vector-valued functions". **Journal of Inequalities and Applications**, vol. 2008, article ID, 640758, 16 pages, 2008.
- 19.G. Gnecco, "Functional optimization by variable-basis approximation schemes", Summary of the PhD Thesis, **4OR: A Quarterly Journal of the Operations Research**, vol. 9, pp. 103-106, 2011.
- 20.G. Gnecco, M. Sanguineti, *Editorial for the special issue: "Mathematical problems in engineering, aerospace and sciences"*, **Applied Mathematical Sciences**, vol. 4, no. 73, pp. 3621-3624, 2010.
- 21.G. Gnecco, M. Sanguineti, "Information complexity of functional optimization problems and their approximation schemes", **Mathematics in Engineering, Science and Aerospace**, vol. 1, no. 3, pp. 303-317, 2010.
- 22.A. Alessandri, G. Gnecco, M. Sanguineti, "Computationally efficient approximation Schemes for functional optimization". **International Journal of Computer Research**, vol. 17, no. 1/2, pp. 153-189, 2008 (cross-published in "**Computational Optimization: New Research Developments**", R. F. Linton and T. B. Carroll Jr. (Eds.), Nova Science Publishers, 2010).
- 23.G. Gnecco, M. Sanguineti, "Value and policy function approximations in infinite-horizon optimization problems", **Journal of Dynamical Systems and Geometric Theories**, vol. 6, no. 2, pp. 123-147, 2008.
- 24.G. Gnecco, M. Sanguineti, "Approximation error bounds via Rademacher's complexity", **Applied Mathematical Sciences**, vol. 2, n. 4, pp. 153-176, 2008.

Book chapters and contributions in monograph

- 24.G. Gnecco, V. Kůrková, M. Sanguineti, "Bounds for approximate solutions of Fredholm integral equations using kernel networks". In "**Lecture Notes in Computer Science**", Springer, Berlin Heidelberg, 2011, to appear.

25. G. Gnecco, V. Kůrková, M. Sanguineti, "Some comparisons of model complexity in linear and neural-network approximation". In "**Lecture Notes in Computer Science**", vol. 6354, pp. 358-367, Springer, Berlin Heidelberg, 2010.
26. G. Gnecco, M. Sanguineti, "Smooth optimal decision strategies for static team optimization problems and their approximations". In "**Lecture Notes in Computer Science**", vol. 5901, pp. 440-451, Springer, Berlin Heidelberg, 2010.
27. G. Gnecco, M. Sanguineti, "Regularization and suboptimal solutions in learning from data". In "**Innovations in Neural Information Paradigms and Applications**", M. Bianchini, M. Maggini, F. Scarselli (Eds.), Springer, 2010.
28. A. Alessandri, G. Gnecco, M. Sanguineti, "Computationally efficient approximation schemes for functional optimization". In "**Computational Optimization: New Research Developments**", R. F. Linton and T. B. Carroll Jr. (Eds.), Nova Science Publishers, 2010 (cross-published in **International Journal of Computer Research**, vol. 17, no. 1/2, pp. 153-189, 2008).

Conferences

29. M. Degiorgis, G. Gnecco, S. Gorni, G. Roth, M. Sanguineti, A.C. Taramasso, "Classifiers for the detection of flood prone areas from remote sensed elevation data", **5th CNR-Princeton workshop**, Miami, 2012.
30. M. Cello, G. Gnecco, M. Marchese, M. Sanguineti, "A stochastic knapsack problem with nonlinear capacity constraint", **AIRO 2011**, September 2011.
31. G. Gnecco, M. Sanguineti, R. Zoppoli, "Functional optimization in OR problems with very large numbers of variables", **AIRO 2011**, September 2011.
32. M. Cello, G. Gnecco, M. Marchese, M. Sanguineti, "A generalized stochastic knapsack problem with application in call admission control", **10th Cologne-Twente Workshop**, Frascati, June 14th-16th, 2011.
33. G. Gnecco, V. Kůrková, M. Sanguineti, "Bounds for approximate solutions of Fredholm integral equations using kernel networks", **ICANN 2011**, Espoo, Finland, June 14th-17th, 2011.
34. M. Marchese, M. Cello, G. Gnecco, M. Sanguineti, "Structural properties of optimal coordinate-convex policies for CAC with nonlinearly-constrained feasibility regions", **IEEE INFOCOM (Mini-Conference) 2011**, Shanghai, China, April 2011.
35. G. Gnecco, M. Sanguineti, M. Gaggero, "Approximate dynamic programming by variable-basis schemes: Error analysis and numerical results", **AIRO WINTER 2011**, Cortina d'Ampezzo, February 2011.

- 36.G. Gnecco, V. Kůrková, M. Sanguineti, "*Some comparisons of model complexity in linear and neural-network approximation*", **ICANN 2010**, Thessaloniki, Greece, 2010.
- 37.M. Gaggero, G. Gnecco, M. Sanguineti, "*Decentralized optimization problems with cooperating decision makers*", **AIRO 2010**, Villa San Giovanni, Italy, 2010.
- 38.M. Cello, G. Gnecco, M. Marchese, M. Sanguineti, "*On call admission control with nonlinearly constrained feasibility regions*", **EURO 2010**, Lisbon, Portugal, 2010.
- 39.M. Gaggero, G. Gnecco, M. Sanguineti, "*Suboptimal solutions to team optimization problems with statistical information structure*", **EURO 2010**, Lisbon, Portugal, 2010.
- 40.G. Gnecco, M. Sanguineti, "*Smooth optimal decision strategies for static team optimization problems and their approximations*", **SOFSEM 2010**, Špindlerův Mlýn, Czech Republic, january 2010.
- 41.G. Gnecco, M. Sanguineti, "*Lipschitz continuity of the solutions to team optimization problems revisited*", **Proceedings of the International Conf. on Mathematical Science and Engineering (ICMSE 09)**, Venice, Italy, 2009.
- 42.G. Gnecco, M. Sanguineti, "*Suboptimal solutions to network team optimization problems*", **Proceedings of the International Network Optimization Conference (INOC 2009)** Pisa, Italy, 2009.
- 43.G. Gnecco, M. Sanguineti, "*Approximate dynamic programming by value-function approximation via variable-basis schemes*", **AIRO 2009**, Siena, Italy, 2009.
- 44.G. Gnecco, M. Sanguineti, "*Smoothness and approximation of optimal decision strategies in team optimization problems*", **AIRO 2009**, Siena, Italy, 2009.
- 45.G. Gnecco, M. Sanguineti, "*Functional optimization by variable-basis approximation schemes*", **AIRO 2009**, Siena, Italy, 2009.
- 46.G. Gnecco, M. Sanguineti, "*Structural properties of stochastic dynamic concave optimization problems and approximations of the value and optimal policy*", **AIRO 2008**, Ischia, Italy, 2008.
- 47.G. Gnecco, M. Sanguineti, "*Deriving approximation error bounds via Rademacher's complexity and learning theory*", **AIRO 2007**, Genoa, Italy, 2007.
- 48.G. Gnecco, M. Sanguineti, R. Zoppoli, "*Suboptimal solutions to dynamic optimization problems: Extended Ritz method versus approximate dynamic programming*", **AIRO 2007**, Genoa, Italy, 2007.
- 49.G. Gnecco, M. Sanguineti, R. Zoppoli, "*Exploiting structural results in approximate dynamic programming*", **EURO 2007**, Prague, Czech Republic, 2007.

50.G. Gnecco, M. Sanguineti, "*Accuracy of suboptimal solutions to kernel principal component analysis*", **AIRO 2005**, Camerino, Italy, 2005.

Ph.D. Thesis

51.G. Gnecco, "*Functional Optimization by Variable-Basis Approximation Schemes*".
Dept. of Mathematics, University of Genoa, Italy, 2009.

Laurea Thesis (5 years)

52.G. Gnecco, "*Application of Support Vector Machines to Optimal Control Problems*".
Dept. of Communications, Computer, and System Sciences (DIST), University of Genoa, 2004.

Technical Reports

53.G. Gnecco, M. Sanguineti, M. Gaggero, "*Dynamic programming and value-function approximation in sequential decision problems: Error analysis and numerical results*".

54.G. Gnecco, M. Sanguineti, M. Gaggero, "*Stochastic N-stage optimization via approximations of value and policy functions*".

55.G. Gnecco, M. Gori, M. Sanguineti, "*Learning with Boundary Conditions*".

56.M. Cello, G. Gnecco, M. Marchese, M. Sanguineti, "*Congestion Control in Intermittently Connected Networks*".

57.G. Gnecco, V. Kůrková, M. Sanguineti, "*Accuracy of Approximations of Solutions to Fredholm Equations by Kernel Methods*".

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