

Manuel López-Ibáñez

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☎	+44 (0) 16130 66598	NATIONALITY	Spanish
✉	University of Manchester, Decision and Cognitive Sciences Research Centre Alliance Manchester Business School Booth St East, Manchester M13 9SS, UK	LANGUAGES	Spanish (native) English (fluent) French (basic, 2 years) German (basic, 1 year)

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KNOWLEDGE BACKGROUND

My main expertise is the application of **computational intelligence** techniques, such as **stochastic local search** algorithms and **metaheuristics**, including **evolutionary algorithms** and **ant colony optimization**, to optimization problems, including **continuous**, **combinatorial**, and **multi-objective** problems. I have made significant contributions on theoretical and practical aspects of the empirical analysis of multi-objective optimization algorithms. I have also a track record of working on problems relevant in practice, both well-known academic problems with important practical applications, such as the **longest common subsequence problem**, and real-world optimization problems, such as the **scheduling of pump operations** in water distribution networks in order to save energy and reduce operating costs.

I am interested in improving the **understanding of optimization algorithms** by means of experimentation, and I am particularly interested in **difficult multidisciplinary problems**. These interests have led me to study the recent advances on **automatic configuration** and **tuning of algorithms** and how to extend and improve existing methods for more complex optimization problems, such as those with multiple objectives.

ACADEMIC DEGREES

- November 2009 **PhD award**, Edinburgh Napier University, United Kingdom.
Viva-voice defense successfully passed on 26th June, 2009.
Supervisors: Dr. T. Devi Prasad and Prof. Ben Paechter.
Examination Panel: Prof. David W. Corne, Prof. Emma Hart, and Prof. Dragan Savic.
- September 2004 *Ingeniero en Informática* (Spanish equivalent of **MS degree in Computer Science**, minimum 5 years), University of Granada, Spain.

PUBLICATION TRACK-RECORD AND CITATIONS

I have published **19 journal papers**, **7 book chapters**, and **38 papers in peer-reviewed proceedings** of international conferences, and edited **3 books**. In addition to the presentations associated to peer-reviewed conference papers, I have personally given **21 presentations** during conferences with scientific selection committee, including **five tutorials** and **five invited talks**. I have also made available several **software tools** that are widely used by the research community. According to the Google Scholar database (or SCOPUS and excluding self-citations):

- My **h-index** is 22 (SCOPUS: 16).
- The **total number of citations** to my papers are more than 2 295 (SCOPUS: 882).
- My five **most-cited** peer-reviewed publications have more than 50 citations each. In addition, the technical report [TR1] describing the **irace** automatic configuration tool [SW6] has been cited more than 100 times, which shows it is widely used by the research community.

PROFESSIONAL EXPERIENCE

Full time researcher since November, 2004: More than **12 years of research experience**.

Lecturer (Assistant Professor) October 2015 – Present
at the Decision and Cognitive Sciences Research Centre,
Alliance Manchester Business School, University of Manchester, UK.

Postdoctoral researcher October 2011 – September 2015
of the Belgian Fund for Scientific Research (Chargé de recherches des Fonds de la Recherche Scientifique-FNRS) at IRIDIA, the artificial intelligence laboratory of the Université Libre de Bruxelles, Brussels, Belgium.

Postdoctoral researcher July 2009 – September 2011
at IRIDIA, Université Libre de Bruxelles, Brussels, Belgium.

Doctoral researcher March 2009 – June 2009
at IRIDIA, Université Libre de Bruxelles, Brussels, Belgium.

Research Assistant October 2008 – November 2008
at the research group ALBCOM, Departament Llenguatges i Sistemes Informàtics, Universitat Politècnica de Catalunya, Barcelona, Spain. Supervisor: Dr. Christian Blum.

Doctoral researcher

October 2007 – December 2007

at Barcelona Supercomputing Centre, Spain, funded by HPC-Europa Transnational Access Programme.

Fully funded PhD position

November 2004 – November 2007

at Edinburgh Napier University, United Kingdom.

Supervisors: Dr. T. Devi Prasad and Prof. Ben Paechter.

MS Thesis (Diplomarbeit)

October 2003 – July 2004

at the Technische Universität Darmstadt, Germany, with financial support of an Erasmus scholarship.

Supervisors: Dr. Thomas Stützle and Dr. Luís Paquete.

SKILLS

Programming languages:	C, C++, Perl, R (statistical programming language), Bourne Again Shell (Bash)
Mathematical tools:	R (statistical computing), Mathematica, Matlab, Gnuplot
Operating systems:	GNU/Linux, Windows 98/XP, MS-DOS
Parallel programming:	Threads and semaphores, MPI
Various:	LaTeX, Emacs, Subversion, Git, LibreOffice/OpenOffice

BEST PAPER AWARDS

GECCO 2010 The paper “*The Impact of Design Choices of Multiobjective Ant Colony Optimization Algorithms on Performance: An Experimental Study on the Biobjective TSP*” [IC11], co-authored with Thomas Stützle, received the best paper award of the Ant Colony Optimization and Swarm Intelligence track at the Genetic and Evolutionary Computation Conference (GECCO 2010), Portland, Oregon, 2010.

LION 4 2010 The paper “*Adaptive Anytime Two-Phase Local Search*” [IC10], co-authored with Jérémie Dubois-Lacoste and Thomas Stützle, received the best paper award of the Learning and Intelligent Optimization conference (LION 4), Venice, Italy, 2010.

EA 2009 The paper “*An Analysis of Algorithmic Components for Multiobjective Ant Colony Optimization: A Case Study on the Biobjective TSP*” [IC9], co-authored with Thomas Stützle, received the 3rd best paper award of the 9th international conference on Artificial Evolution (EA'09), Strasbourg, France, 2009.

SCIENTIFIC COLLABORATIONS

Invited visiting researcher hosted by Dr. Arnaud Liefoghe

12/6/2017 – 16/6/2017

at the University of Lille, France.

Invited visiting researcher hosted by Dr. Thomas Stützle

19/6/2017 – 23/6/2017

at the Université libre de Bruxelles (ULB), Belgium.

- UScore2: City to city local level peer review on Disaster Risk Reduction** 1/1/2017 – 31/12/2018
EU Project. Role: Participant researcher. Budget: £1 010 186.
- Dagstuhl Seminar on Automated Algorithm Selection and Configuration** 9/10/2016 – 14/10/2016
Schloss Dagstuhl - Leibniz Center for Informatics, Germany
- 43rd CREST Open Workshop** 26/10/2015 – 27/10/2015
on Hyper-Heuristics for Software Engineering, University College London (UCL), UK
- Visiting researcher hosted by Prof. Enrique Alba** 1/5/2015 – 31/7/2015
at the University of Málaga (UMA), Spain. Funded by a grant (2 710 €) by the UMA (Estancias Tipo B, Fondos Propios UMA 2014)
- Dagstuhl Seminar on Understanding Complexity in Multiobjective Optimization** 11/1/2015 – 16/1/2015
Schloss Dagstuhl - Leibniz Center for Informatics, Germany
- Honorary Postdoctoral Fellow hosted by Prof. Holger H. Hoos** 25/10/2013 – 1/12/2013
at the University of British Columbia, Vancouver, Canada. Funded by F.R.S.-FNRS Crédit bref séjour à l'étranger
- Lorent Center Workshop (SIMCO – Set-Oriented and Indicator-Based Multi-Criteria Optimization)** 2/9/2013 – 6/9/2013
Lorentz Center, Leiden, The Netherlands
- COMEX: Combinatorial Optimization: Metaheuristics and EXact methods** 1/10/2012 – 30/9/2017
Project (P7-36) funded by the Inter-university Attraction Poles Programme of the Belgian Federal Science Policy Office (BELSPO). Role: Participant researcher. Budget: 500 000 €.
- Invited visit hosted by Prof. Juergen Branke** 23/3/2012 – 30/3/2012
at the University of Warwick, Coventry, United Kingdom. COST (European Cooperation in Science and Technology) Action IC0702
- Dagstuhl Seminar on Learning in Multi-Objective Optimization** 22/1/2012 – 27/1/2012
Schloss Dagstuhl - Leibniz Center for Informatics, Germany
- Invited visit hosted by Dr. Oliver Korb** 17/10/2011 – 18/10/2011
at the Cambridge Crystallographic Data Centre, Cambridge, United Kingdom.
- Invited visit hosted by Dr. Oscar Cordón** 21/6/2011 – 30/6/2011
at the European Centre for Soft Computing, Mieres, Spain. COST (European Cooperation in Science and Technology) Action IC0702
- Hybrid Search Methods for Complex Problems** 1/1/2010 – 1/12/2013
Joint FRFC (“Fonds de la recherche fondamentale collective”) research project with the *BeCool* research group at Université catholique de Louvain. Role: Participant researcher. Budget: 109 000 €.
- Meta-X: Metaheuristics for Complex Optimization Problems** 1/10/2008 – 30/9/2013
ARC Project (“Action de Recherche Concertée”) funded by the Scientific Research Directorate of the French Community of Belgium. Role: Participant researcher. Budget: 650 000 €.

Invited visit hosted by Prof. Carlos M. Fonseca
at the University of Algarve, Faro, Portugal.

1/12/2005 – 20/12/2005

FUNDING OBTAINED

Belgian F.R.S.-FNRS: “ <i>Crédit bref séjour à l'étranger</i> ” Grant for a research visit at University of British Columbia, Vancouver.	October 2013 – December 2013 1 900 €
NCP Wallonie, Belgium: “ <i>Prime Horizon</i> ” Grant for the elaboration as a partner of a project proposal for the European Union FET-Open-Xtrack.	September 2013 1 925 €
Belgian F.R.S.-FNRS: “ <i>Chargé de recherches</i> ” Postdoctoral Fellowship.	October 2011 – September 2015 approx. 360 000 €
HPC-Europa Transnational Access Programme: “ <i>High Performance Ant Colony Optimisation of the Pump Scheduling Problem</i> ” Grant for a research project on parallel optimization at the Barcelona Supercomputing Centre, Spain.	October 2007 – December 2007 4 500 €

OTHER MERITS AND AWARDS

- Ayuda Ramón y Cajal (5-years postdoctoral fellowship of the Spanish National Government, approx. 208 600 €), awarded and declined in 2015.
- Successfully completed *Google Summer of Code* program. 10% acceptance rate (May 2006 – August 2006).
- Erasmus scholarship at the Technische Universität Darmstadt, Germany (October 2003 – June 2004).

RESIDENCE IN FOREIGN COUNTRIES

- Manchester, United Kingdom (October 2015 – Present).
- Brussels, Belgium (March 2009 – September 2015).
- Edinburgh, United Kingdom (November 2004 – November 2007).
- Darmstadt, Germany (October 2003 – August 2004).

INTERESTS AND HOBBIES

- Free/Open Source Software. I have contributed code to the GNU Compiler Collection (GCC), the R project, and other software projects
- Graphic novels, particularly Alan Moore
- Spanish poetry, particularly Angel González
- Languages
- Traveling
- Capoeira, a Brazilian dance and martial art

- Manuel López-Ibáñez and Thomas Stützle. **The Automatic Design of Multi-Objective Ant Colony Optimization Algorithms**. *IEEE Transactions on Evolutionary Computation*, 16(6):861–875, 2012. (2012 ISI-JCR impact factor: 4.810, 1/100 in COMPUTER SCIENCE, THEORY & METHODS) (101 citations according to the Google Scholar database) (39 citations according to SCOPUS)

Abstract: Multi-objective optimization problems are problems with several, typically conflicting, criteria for evaluating solutions. Without any a priori preference information, the Pareto optimality principle establishes a partial order among solutions, and the output of the algorithm becomes a set of nondominated solutions rather than a single one. Various ant colony optimization (ACO) algorithms have been proposed in recent years for solving such problems. These multi-objective ACO (MOACO) algorithms exhibit different design choices for dealing with the particularities of the multi-objective context. This paper proposes a formulation of algorithmic components that suffices to describe most MOACO algorithms proposed so far. This formulation also shows that existing MOACO algorithms often share equivalent design choices, but they are described in different terms. Moreover, this formulation is synthesized into a flexible algorithmic framework, from which not only existing MOACO algorithms may be instantiated, but also combinations of components that were never studied in the literature. In this sense, this paper goes beyond proposing a new MOACO algorithm, but it rather introduces a family of MOACO algorithms. The flexibility of the proposed MOACO framework facilitates the application of automatic algorithm configuration techniques. The experimental results presented in this paper show that the automatically configured MOACO framework outperforms the MOACO algorithms that inspired the framework itself. This paper is also among the first to apply automatic algorithm configuration techniques to multi-objective algorithms.

Commentary: This paper is notable for being the most profound critical survey of MOACO algorithms to date, while at the same time proposing a novel way to automatically design MOACO algorithms using automatic configuration tools. The Editor-in-Chief of *IEEE Transactions on Evolutionary Computation* highlighted this paper in the CIS Publication Spotlight of the *IEEE Computational Intelligence Magazine*, 8(2), 2013. *IEEE Transactions on Evolutionary Computation* is among the top five journals in both Theoretical Computer Science and Artificial Intelligence.

- Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **A Hybrid TP+PLS Algorithm for Bi-objective Flow-Shop Scheduling Problems**. *Computers & Operations Research*, 38(8):1219–1236, 2011. (2011 ISI-JCR impact factor: 1.720, 10/77 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE) (76 citations according to the Google Scholar database)

Abstract: This paper presents a new, carefully designed algorithm for five bi-objective permutation flow shop scheduling problems that arise from the pairwise combinations of the objectives (i) makespan, (ii) the sum of the completion times of the jobs, and (iii) both, the weighted and non-weighted total tardiness of all jobs. The proposed algorithm combines two search methods, two-phase local search and Pareto local search, which are representative of two different, but complementary, paradigms for multi-objective optimization in terms of Pareto-optimality. The design of the hybrid algorithm is based on a careful experimental

analysis of crucial algorithmic components of these two search methods. We compared our algorithm to the two best algorithms identified, among a set of 23 candidate algorithms, in a recent review of the bi-objective permutation flow-shop scheduling problem. We have reimplemented carefully these two algorithms in order to assess the quality of our algorithm. The experimental comparison in this paper shows that the proposed algorithm obtains results that often dominate the output of the two best algorithms from the literature. Therefore, our analysis shows without ambiguity that the proposed algorithm is a new state-of-the-art algorithm for the bi-objective permutation flow-shop problems studied in this paper.

Commentary: This work presents results from the thesis of my PhD student, Dr. Dubois-Lacoste. In this work, we put in practice the methods for the analysis of multi-objective optimization algorithms that I had previously developed. Moreover, the results presented in this paper were later further improved by applying the method for automatic configuration of multi-objective algorithms developed by me in a different paper.

- Manuel López-Ibáñez and Thomas Stützle. **Automatically Improving the Anytime Behaviour of Optimisation Algorithms**. *European Journal of Operational Research*, 235(3):569–582, 2014. (2014 ISI-JCR impact factor: 2.358, 10/81 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)

Abstract: Optimisation algorithms with good anytime behaviour try to return as high-quality solutions as possible independently of the computation time allowed. Designing algorithms with good anytime behaviour is a difficult task, because performance is often evaluated subjectively, by plotting the trade-off curve between computation time and solution quality. Yet, the trade-off curve may be modelled also as a set of mutually nondominated, bi-objective points. Using this model, we propose to combine an automatic configuration tool and the hypervolume measure, which assigns a single quality measure to a nondominated set. This allows us to improve the anytime behaviour of optimisation algorithms by means of automatically finding algorithmic configurations that produce the best nondominated sets. Moreover, the recently proposed weighted hypervolume measure is used here to incorporate the decision-maker's preferences into the automatic tuning procedure. We report on the improvements reached when applying the proposed method to two relevant scenarios: (i) the design of parameter variation strategies for MAX-MIN Ant System and (ii) the tuning of the anytime behaviour of SCIP, an open-source mixed integer programming solver with more than 200 parameters.

Commentary: This is one of my most recent papers. It combines ideas from automatic configuration and multi-objective optimization in a novel way in order to improve the quality of the results obtained by non-exact algorithms for various computation time limits. EJOR is one of the top journals in the fields of Optimization and Operations Research.

- Nicola Beume, Carlos M. Fonseca, Manuel López-Ibáñez, Luís Paquete, and Jan Vahrenhold. **On the complexity of computing the hypervolume indicator**. *IEEE Transactions on Evolutionary Computation*, 13(5):1075–1082, 2009. (2009 ISI-JCR impact factor: 4.589, 3/92 in COMPUTER SCIENCE, THEORY & METHODS) (157 citations according to the Google Scholar database) (55 citations according to SCOPUS)

Abstract: The goal of multi-objective optimization is to find a set of best compromise solutions for typically conflicting objectives. Due to the complex nature of most real-life problems, only an approximation to such an optimal set can be obtained within reasonable (computing) time. To compare such approximations, and thereby the performance of multi-objective optimizers providing them, unary quality measures are usually applied. Among these, the *hypervolume indicator* (or *S-metric*) is of particular relevance due to its favorable properties. Moreover, this indicator has been successfully integrated into stochastic optimizers, such as evolutionary algorithms, where it serves as a guidance criterion for finding good approximations to the Pareto front. Recent results show that computing the hypervolume indicator can be seen as solving a specialized version of Klee's Measure Problem. In general, Klee's Measure Problem can be solved with $O(n \log n + n^{d/2} \log n)$ comparisons for an input instance of size n in d dimensions; as of this writing, it is unknown whether a lower bound higher than $\Omega(n \log n)$ can be proven. In this article, we derive a lower bound of $\Omega(n \log n)$ for the complexity of computing the hypervolume indicator in any number of dimensions $d > 1$ by reducing the so-called UNIFORMGAP problem to it. For the three dimensional case, we also present a matching upper bound of $O(n \log n)$ comparisons that is obtained by extending an algorithm for finding the maxima of a point set.

Commentary: This paper was the first to prove that the computation of the hypervolume indicator is $O(n \log n)$ in three dimensions and to derive upper and lower bounds for higher number of dimensions. An optimal algorithm for the three-dimensional case is presented here, although a preliminary version was already proposed on a previous conference paper ([IC4] in my list of publications). The publicly available implementation ([SW3] in my list of publications) was released together with the conference paper and, thus, the conference paper is often cited (more than 195 times, so far) instead of this journal paper. IEEE Transactions on Evolutionary Computation is among the top five journals in Theoretical Computer Science and Artificial Intelligence.

- Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Ant Colony Optimisation for the Optimal Control of Pumps in Water Distribution Networks.** *Journal of Water Resources Planning and Management, ASCE*, 134(4):337–346, 2008.
(2008 ISI-JCR impact factor: 1.275, 12/91 in ENGINEERING, CIVIL)
(138 citations according to the Google Scholar database)

Abstract: Reducing energy consumption of water distribution networks has never had more significance than today. The greatest energy savings can be obtained by careful scheduling of operation of pumps. Schedules can be defined either implicitly, in terms of other elements of the network such as tank levels, or explicitly by specifying the time during which each pump is on/off. The traditional representation of explicit schedules is a string of binary values with each bit representing pump on/off status during a particular time interval. In this paper a new explicit representation is presented. It is based on time controlled triggers, where the maximum number of pump switches is specified beforehand. In this representation a pump schedule is divided into a series of integers with each integer representing the number of hours for which a pump is active/inactive. This reduces the number of potential schedules (search space) compared to the binary representation. Ant colony optimization (ACO) is a stochastic meta-heuristic for combinatorial optimization problems that is inspired by the foraging behavior of some species of ants. In this paper, an application of the ACO

framework was developed for the optimal scheduling of pumps. The proposed representation was adapted to an ant colony optimization framework and solved for the optimal pump schedules. Minimization of electrical cost was considered as the objective, while satisfying system constraints. Instead of using a penalty function approach for constraint violations, constraint violations were ordered according to their importance and solutions were ranked based on this order. The proposed approach was tested on a small test network and on a large real-world network. Results are compared with those obtained using a simple genetic algorithm based on binary representation and a hybrid genetic algorithm that uses level-based triggers.

Commentary: This paper presented results from my PhD thesis. It demonstrates my capacity to work on multidisciplinary subjects and real-world applications. At the moment of publication, the results presented were state-of-the-art for this particular problem, thus later methods are often compared to this one. The paper was published in the top journal in water resources engineering and it has been highly cited since then.

Theses

- [TS2] Manuel López-Ibáñez. *Operational Optimisation of Water Distribution Networks*. PhD thesis, School of Engineering and the Built Environment, Edinburgh Napier University, UK, 2009.
- [TS1] Manuel López-Ibáñez. *Multi-objective Ant Colony Optimization*. Diploma thesis, Intellectics Group, Computer Science Department, Technische Universität Darmstadt, Germany, 2004.

Papers in peer-reviewed international journals

- [IJ19] Manuel López-Ibáñez, Jérémie Dubois-Lacoste, Leslie Pérez Cáceres, Thomas Stützle, and Mauro Birattari. **The irace package: Iterated Racing for Automatic Algorithm Configuration**. *Operations Research Perspectives*, 3:43–58, 2016.
- [IJ18] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **Automatic Component-Wise Design of Multi-Objective Evolutionary Algorithms**. *IEEE Transactions on Evolutionary Computation*, 20(3):403–417, 2016.
(2015 ISI-JCR impact factor: 5.908, Q1: 1/105 in COMPUTER SCIENCE, THEORY & METHODS)
- [IJ17] Christian Blum, Pedro Pinacho, Manuel López-Ibáñez, and José A. Lozano. **Construct, Merge, Solve & Adapt: A New General Algorithm for Combinatorial Optimization**. *Computers & Operations Research*, 68:75–88, 2016.
(2015 ISI-JCR impact factor: 1.988, Q1: 19/82 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
- [IJ16] Vito Trianni and Manuel López-Ibáñez. **Advantages of Task-Specific Multi-Objective Optimisation in Evolutionary Robotics**. *PLoS One*, 10(8):e0136406, 2015.
(2015 ISI-JCR impact factor: 3.057, Q1: 11/63 in MULTIDISCIPLINARY SCIENCES)
- [IJ15] Leslie Pérez Cáceres, Manuel López-Ibáñez, and Thomas Stützle. **Ant colony optimization on a limited budget of evaluations**. *Swarm Intelligence*, 9(2-3):103–124, 2015.
(2015 ISI-JCR impact factor: 2.577, Q1: 26/130 in COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE)
- [IJ14] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Anytime Pareto Local Search**. *European Journal of Operational Research*, 243(2):369–385, 2015.
(2015 ISI-JCR impact factor: 2.679, Q1: 9/82 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
- [IJ13] Franco Mascia, Manuel López-Ibáñez, Jérémie Dubois-Lacoste, and Thomas Stützle. **Grammar-based generation of stochastic local search heuristics through automatic algorithm configuration tools**. *Computers & Operations Research*, 51:190–199, 2014.
(2014 ISI-JCR impact factor: 1.861, Q1: 19/81 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
- [IJ12] Manuel López-Ibáñez and Thomas Stützle. **Automatically Improving the Anytime Behaviour of Optimisation Algorithms**. *European Journal of Operational Research*, 235(3):569–582, 2014.
(2014 ISI-JCR impact factor: 2.358, Q1: 10/81 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
- (27 citations according to the Google Scholar database)
- [IJ11] Manuel López-Ibáñez, Christian Blum, Jeffrey W. Ohlmann, and Barrett W. Thomas. **The Travelling Salesman Problem with Time Windows: Adapting Algorithms from Travel-time to Makespan**

★These publications are available at <http://lopez-ibanez.eu/publications>

- Optimization.** *Applied Soft Computing*, 13(9):3806–3815, 2013.
(2013 ISI-JCR impact factor: 2.679, Q1: 20/121 in COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE)
- [IJ10] Manuel López-Ibáñez and Thomas Stützle. **An experimental analysis of design choices of multi-objective ant colony optimization algorithms.** *Swarm Intelligence*, 6(3):207–232, 2012.
(2012 ISI-JCR impact factor: 0.640, Q4: 89/115 in COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE)
- [IJ9] Manuel López-Ibáñez and Thomas Stützle. **The Automatic Design of Multi-Objective Ant Colony Optimization Algorithms.** *IEEE Transactions on Evolutionary Computation*, 16(6):861–875, 2012.
(2012 ISI-JCR impact factor: 4.810, Q1: 1/100 in COMPUTER SCIENCE, THEORY & METHODS)
(101 citations according to the Google Scholar database)
- [IJ8] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Improving the Anytime Behavior of Two-Phase Local Search.** *Annals of Mathematics and Artificial Intelligence*, 61(2):125–154, 2011.
(2011 ISI-JCR impact factor: 0.358, Q4: 98/111 in COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE)
(23 citations according to the Google Scholar database)
- [IJ7] Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Representations and Evolutionary Operators for the Scheduling of Pump Operations in Water Distribution Networks.** *Evolutionary Computation*, 19(3):429–467, 2011.
(2011 ISI-JCR impact factor: 1.061, Q2: 31/99 in COMPUTER SCIENCE, THEORY & METHODS)
(22 citations according to the Google Scholar database)
- [IJ6] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **A Hybrid TP+PLS Algorithm for Bi-objective Flow-Shop Scheduling Problems.** *Computers & Operations Research*, 38(8):1219–1236, 2011.
(2011 ISI-JCR impact factor: 1.720, Q1: 10/77 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
(76 citations according to the Google Scholar database)
- [IJ5] Manuel López-Ibáñez and Christian Blum. **Beam-ACO for the travelling salesman problem with time windows.** *Computers & Operations Research*, 37(9):1570–1583, 2010.
(2010 ISI-JCR impact factor: 1.769, Q1: 19/75 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
(96 citations according to the Google Scholar database)
- [IJ4] Nicola Beume, Carlos M. Fonseca, Manuel López-Ibáñez, Luís Paquete, and Jan Vahrenhold. **On the complexity of computing the hypervolume indicator.** *IEEE Transactions on Evolutionary Computation*, 13(5):1075–1082, 2009.
(2009 ISI-JCR impact factor: 4.589, Q1: 3/92 in COMPUTER SCIENCE, THEORY & METHODS)
(157 citations according to the Google Scholar database)
- [IJ3] Christian Blum, María J. Blesa, and Manuel López-Ibáñez. **Beam search for the longest common subsequence problem.** *Computers & Operations Research*, 36(12):3178–3186, 2009.
(2009 ISI-JCR impact factor: 2.116, Q1: 9/73 in OPERATIONS RESEARCH & MANAGEMENT SCIENCE)
(38 citations according to the Google Scholar database)
- [IJ2] Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Ant Colony Optimisation for the Optimal Control of Pumps in Water Distribution Networks.** *Journal of Water Resources Planning and Management, ASCE*, 134(4):337–346, 2008.
(2008 ISI-JCR impact factor: 1.275, Q1: 12/91 in ENGINEERING, CIVIL)
(138 citations according to the Google Scholar database)

- [IJ1] Manuel López-Ibáñez, Luís Paquete, and Thomas Stützle. **Hybrid Population-based Algorithms for the Bi-objective Quadratic Assignment Problem**. *Journal of Mathematical Modelling and Algorithms*, 5(1):111–137, 2006.
(2005 SJR impact factor: 0.419, 64/139 in MODELING AND SIMULATION)
(65 citations according to the Google Scholar database)

Edited books

- [ED3] B. Hu and M. López-Ibáñez, editors. *Evolutionary Computation in Combinatorial Optimization - 17th European Conference, EvoCOP 2017, Amstardam, The Netherlands, April 19-21, 2017. Proceedings*, volume 10197 of *Lecture Notes in Computer Science*. Springer, 2017.
- [ED2] M. Dorigo, M. Birattari, X. Li, M. López-Ibáñez, K. Ohkura, C. Pinciroli, and T. Stützle, editors. *Swarm Intelligence, 10th International Conference, ANTS 2016, Brussels, Belgium, September 7-9, 2016, Proceedings*, volume 9882 of *Lecture Notes in Computer Science*. Springer, 2016.
- [ED1] J. Handl, E. Hart, P. R. Lewis, M. López-Ibáñez, G. Ochoa, and B. Paechter, editors. *Parallel Problem Solving from Nature – PPSN XIV 14th International Conference, Edinburgh, UK, September 17-21, 2016, Proceedings*, volume 9921 of *Lecture Notes in Computer Science*. Springer, 2016.

Book chapters

- [BC7] Manuel López-Ibáñez, Thomas Stützle, and Marco Dorigo. **Ant Colony Optimization: A Component-Wise Overview**. In R. Martí, P. M. Pardalos, and M. G. C. Resende, editors, *Handbook of Heuristics*, pages 1–37. Springer International Publishing, 2017.
- [BC6] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Combining Two Search Paradigms for Multi-objective Optimization: Two-Phase and Pareto Local Search**. In E.-G. Talbi, editor, *Hybrid Metaheuristics*, volume 434 of *Studies in Computational Intelligence*, pages 97–117. Springer Verlag, 2013.
- [BC5] Thomas Stützle, Manuel López-Ibáñez, Paola Pellegrini, Michael Maur, Marco A. Montes de Oca, Mauro Birattari, and Marco Dorigo. **Parameter Adaptation in Ant Colony Optimization**. In Y. Hamadi, E. Monfroy, and F. Saubion, editors, *Autonomous Search*, pages 191–215. Springer, 2012.
(96 citations according to the Google Scholar database)
- [BC4] Christian Blum and Manuel López-Ibáñez. **Ant Colony Optimization**. In *The Industrial Electronics Handbook: Intelligent Systems*. CRC Press, second edition, 2011.
- [BC3] Thomas Stützle, Manuel López-Ibáñez, and Marco Dorigo. **A Concise Overview of Applications of Ant Colony Optimization**. In J. J. Cochran, editor, *Wiley Encyclopedia of Operations Research and Management Science*, volume 2, pages 896–911. John Wiley & Sons, 2011.
- [BC2] Manuel López-Ibáñez, Luís Paquete, and Thomas Stützle. **Exploratory Analysis of Stochastic Local Search Algorithms in Biobjective Optimization**. In T. Bartz-Beielstein, M. Chiarandini, L. Paquete, and M. Preuss, editors, *Experimental Methods for the Analysis of Optimization Algorithms*, pages 209–222. Springer, 2010.
(75 citations according to the Google Scholar database)

- [BC1] Luís Paquete, Thomas Stützle, and Manuel López-Ibáñez. **Using experimental design to analyze stochastic local search algorithms for multiobjective problems.** In K. F. Doerner, M. Gendreau, P. Greistorfer, W. J. Gutjahr, R. F. Hartl, and M. Reimann, editors, *Metaheuristics: Progress in Complex Systems Optimization*, volume 39 of *Operations Research / Computer Science Interfaces*, pages 325–344. Springer, New York, NY, 2007.

Papers in peer-reviewed international conference proceedings

- [IC38] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **An empirical assessment of the properties of inverted generational distance indicators on multi- and many-objective optimization.** In H. Trautmann, G. Rudolph, K. Klamroth, O. Schütze, M. M. Wiecek, Y. Jin, and C. Grimme, editors, *Evolutionary Multi-criterion Optimization, EMO 2017*, Lecture Notes in Computer Science, pages 31–45. Springer, 2017.
- [IC37] Manuel López-Ibáñez and Joshua D. Knowles. **Machine Decision Makers as a Laboratory for Interactive EMO.** In A. Gaspar-Cunha, C. H. Antunes, and C. A. Coello Coello, editors, *Evolutionary Multi-criterion Optimization, EMO 2015 Part II*, volume 9019 of *Lecture Notes in Computer Science*, pages 295–309. Springer, 2015.
- [IC36] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **Comparing Decomposition-Based and Automatically Component-Wise Designed Multi-Objective Evolutionary Algorithms.** In A. Gaspar-Cunha, C. H. Antunes, and C. A. Coello Coello, editors, *Evolutionary Multi-criterion Optimization, EMO 2015 Part I*, volume 9018 of *Lecture Notes in Computer Science*, pages 396–410. Springer, 2015.
- [IC35] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **To DE or Not to DE? Multi-objective Differential Evolution Revisited from a Component-Wise Perspective.** In A. Gaspar-Cunha, C. H. Antunes, and C. A. Coello Coello, editors, *Evolutionary Multi-criterion Optimization, EMO 2015 Part I*, volume 9018 of *Lecture Notes in Computer Science*, pages 48–63. Springer, 2015.
- [IC34] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **Automatic Design of Evolutionary Algorithms for Multi-Objective Combinatorial Optimization.** In T. Bartz-Beielstein, J. Branke, B. Filipič, and J. Smith, editors, *PPSN 2014*, volume 8672 of *Lecture Notes in Computer Science*, pages 508–517. Springer, 2014.
- [IC33] Manuel López-Ibáñez, Arnaud Liefooghe, and Sébastien Verel. **Local Optimal Sets and Bounded Archiving on Multi-objective NK-Landscapes with Correlated Objectives.** In T. Bartz-Beielstein, J. Branke, B. Filipič, and J. Smith, editors, *PPSN 2014*, volume 8672 of *Lecture Notes in Computer Science*, pages 621–630. Springer, 2014.
- [IC32] Leslie Pérez Cáceres, Manuel López-Ibáñez, and Thomas Stützle. **Ant Colony Optimization on a Budget of 1000.** In M. Dorigo et al., editors, *Swarm Intelligence, 9th International Conference, ANTS 2014*, volume 8667 of *Lecture Notes in Computer Science*, pages 50–61. Springer, 2014.
- [IC31] Leslie Pérez Cáceres, Manuel López-Ibáñez, and Thomas Stützle. **An Analysis of Parameters of irace.** In C. Blum and G. Ochoa, editors, *Proceedings of EvoCOP 2014 – 14th European Conference on Evolutionary Computation in Combinatorial Optimization*, volume 8600 of *Lecture Notes in Computer Science*, pages 37–48. Springer, 2014.
- [IC30] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **Deconstructing Multi-Objective Evolutionary Algorithms: An Iterative Analysis on the Permutation Flowshop.** In

- P. M. Pardalos, M. G. C. Resende, C. Vogiatzis, and J. L. Walteros, editors, *Learning and Intelligent Optimization, 8th International Conference, LION 8*, volume 8426 of *Lecture Notes in Computer Science*, pages 57–172. Springer, 2014.
- [IC29] Frank Hutter, Manuel López-Ibáñez, Chris Fawcett, Marius Thomas Lindauer, Holger H. Hoos, Kevin Leyton-Brown, and Thomas Stützle. **AClib: a Benchmark Library for Algorithm Configuration**. In P. M. Pardalos, M. G. C. Resende, C. Vogiatzis, and J. L. Walteros, editors, *Learning and Intelligent Optimization, 8th International Conference, LION 8*, volume 8426 of *Lecture Notes in Computer Science*, pages 36–40. Springer, 2014.
- [IC28] Franco Mascia, Manuel López-Ibáñez, Jérémie Dubois-Lacoste, Marie-Eléonore Marmion, and Thomas Stützle. **Algorithm Comparison by Automatically Configurable Stochastic Local Search Frameworks: A Case Study Using Flow-Shop Scheduling Problems**. In M. J. Blesa, C. Blum, and S. Voß, editors, *Hybrid Metaheuristics*, volume 8457 of *Lecture Notes in Computer Science*, pages 30–44. Springer, 2014.
- [IC27] Marie-Eléonore Marmion, Franco Mascia, Manuel López-Ibáñez, and Thomas Stützle. **Automatic Design of Hybrid Stochastic Local Search Algorithms**. In M. J. Blesa, C. Blum, P. Festa, A. Roli, and M. Sampels, editors, *Hybrid Metaheuristics*, volume 7919 of *Lecture Notes in Computer Science*, pages 144–158. Springer, 2013.
- [IC26] Florence Massen, Manuel López-Ibáñez, Thomas Stützle, and Yves Deville. **Experimental Analysis of Pheromone-Based Heuristic Column Generation Using irace**. In M. J. Blesa, C. Blum, P. Festa, A. Roli, and M. Sampels, editors, *Hybrid Metaheuristics*, volume 7919 of *Lecture Notes in Computer Science*, pages 92–106. Springer, 2013.
- [IC25] Andreea Radulescu, Manuel López-Ibáñez, and Thomas Stützle. **Automatically Improving the Anytime Behaviour of Multiobjective Evolutionary Algorithms**. In R. C. Purshouse, P. J. Fleming, C. M. Fonseca, S. Greco, and J. Shaw, editors, *Evolutionary Multi-criterion Optimization, EMO 2013*, volume 7811 of *Lecture Notes in Computer Science*, pages 825–840. Springer, 2013.
- [IC24] Franco Mascia, Manuel López-Ibáñez, Jérémie Dubois-Lacoste, and Thomas Stützle. **From Grammars to Parameters: Automatic Iterated Greedy Design for the Permutation Flow-shop Problem with Weighted Tardiness**. In P. M. Pardalos and G. Nicosia, editors, *Learning and Intelligent Optimization, 7th International Conference, LION 7*, volume 7997 of *Lecture Notes in Computer Science*, pages 321–334. Springer, 2013.
- [IC23] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **An Analysis of Local Search for the Bi-objective Bidimensional Knapsack Problem**. In M. Middendorf and C. Blum, editors, *Proceedings of EvoCOP 2013 – 13th European Conference on Evolutionary Computation in Combinatorial Optimization*, volume 7832 of *Lecture Notes in Computer Science*, pages 85–96. Springer, 2013.
- [IC22] Manuel López-Ibáñez, Franco Mascia, Marie-Eléonore Marmion, and Thomas Stützle. **Automatic Design of a Hybrid Iterated Local Search for the Multi-Mode Resource-Constrained Multi-Project Scheduling Problem**. In G. Kendall, G. V. Berghe, and B. McCollum, editors, *Multidisciplinary International Conference on Scheduling: Theory and Applications (MISTA 2013)*, pages 1–6, Gent, Belgium, 2013.
- [IC21] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **Automatic Generation of Multi-objective ACO Algorithms for the Biobjective Knapsack**. In M. Dorigo et al., editors,

Swarm Intelligence, 8th International Conference, ANTS 2012, volume 7461 of *Lecture Notes in Computer Science*, pages 37–48. Springer, 2012.

- [IC20] Manuel López-Ibáñez, Tianjun Liao, and Thomas Stützle. **On the anytime behavior of IPOP-CMA-ES**. In C. A. Coello Coello et al., editors, *Parallel Problem Solving from Nature, PPSN XII*, volume 7491 of *Lecture Notes in Computer Science*, pages 357–366. Springer, 2012.
- [IC19] Dimo Brockhoff, Manuel López-Ibáñez, Boris Naujoks, and Günther Rudolph. **Runtime Analysis of Simple Interactive Evolutionary Biobjective Optimization Algorithms**. In C. A. Coello Coello et al., editors, *Parallel Problem Solving from Nature, PPSN XII*, volume 7491 of *Lecture Notes in Computer Science*, pages 123–132. Springer, 2012.
- [IC18] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Pareto Local Search Algorithms for Anytime Bi-objective Optimization**. In J.-K. Hao and M. Middendorf, editors, *Proceedings of EvoCOP 2012 – 12th European Conference on Evolutionary Computation in Combinatorial Optimization*, volume 7245 of *Lecture Notes in Computer Science*, pages 206–217. Springer, 2012.
- [IC17] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Automatic Configuration of State-of-the-art Multi-objective Optimizers Using the TP+PLS Framework**. In N. Krasnogor and P. L. Lanzi, editors, *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO 2011*, pages 2019–2026. ACM Press, 2011. ★ *Nominated for the best paper award of the Self-* track*
- [IC16] Stefan Eppe, Manuel López-Ibáñez, Thomas Stützle, and Yves De Smet. **An Experimental Study of Preference Model Integration into Multi-Objective Optimization Heuristics**. In *Proceedings of the 2011 Congress on Evolutionary Computation (CEC 2011)*, pages 2751–2758. IEEE Press, 2011.
- [IC15] Manuel López-Ibáñez, Joshua D. Knowles, and Marco Laumanns. **On Sequential Online Archiving of Objective Vectors**. In R. H. C. Takahashi et al., editors, *Evolutionary Multi-criterion Optimization, EMO 2011*, volume 6576 of *Lecture Notes in Computer Science*, pages 46–60. Springer, 2011. (42 citations according to the Google Scholar database)
- [IC14] Carlos M. Fonseca, Andreia P. Guerreiro, Manuel López-Ibáñez, and Luís Paquete. **On the Computation of the Empirical Attainment Function**. In R. H. C. Takahashi et al., editors, *Evolutionary Multi-criterion Optimization, EMO 2011*, volume 6576 of *Lecture Notes in Computer Science*, pages 106–120. Springer, 2011.
- [IC13] Manuel López-Ibáñez and Thomas Stützle. **Automatic Configuration of Multi-Objective ACO Algorithms**. In M. Dorigo et al., editors, *Swarm Intelligence, 7th International Conference, ANTS 2010*, volume 6234 of *Lecture Notes in Computer Science*, pages 95–106. Springer, 2010.
- [IC12] Michael Maur, Manuel López-Ibáñez, and Thomas Stützle. **Pre-scheduled and adaptive parameter variation in Max-Min Ant System**. In H. Ishibuchi et al., editors, *Proceedings of the 2010 Congress on Evolutionary Computation (CEC 2010)*, pages 3823–3830. IEEE Press, 2010.
- [IC11] Manuel López-Ibáñez and Thomas Stützle. **The impact of design choices of multi-objective ant colony optimization algorithms on performance: An experimental study on the biobjective TSP**. In M. Pelikan and J. Branke, editors, *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO 2010*, pages 71–78. ACM Press, 2010. ★ *Best paper award*
- [IC10] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Adaptive “Anytime” Two-Phase Local Search**. In C. Blum and R. Battiti, editors, *Learning and Intelligent Optimization, 4th*

- International Conference, LION 4*, volume 6073 of *Lecture Notes in Computer Science*, pages 52–67. Springer, 2010. ★ *Best paper award*
- [IC9] Manuel López-Ibáñez and Thomas Stützle. **An Analysis of Algorithmic Components for Multiobjective Ant Colony Optimization: A Case Study on the Biobjective TSP**. In P. Collet, N. Monmarché, P. Legrand, M. Schoenauer, and E. Lutton, editors, *Artificial Evolution: 9th International Conference, Evolution Artificielle, EA, 2009*, volume 5975 of *Lecture Notes in Computer Science*, pages 134–145. Springer, 2010. ★ *3rd best paper award*
- [IC8] Manuel López-Ibáñez, Christian Blum, Dhananjay Thiruvady, Andreas T. Ernst, and Bernd Meyer. **Beam-ACO based on stochastic sampling for makespan optimization concerning the TSP with time windows**. In C. Cotta and P. Cowling, editors, *Proceedings of EvoCOP 2009 – 9th European Conference on Evolutionary Computation in Combinatorial Optimization*, volume 5482 of *Lecture Notes in Computer Science*, pages 97–108. Springer, 2009.
- [IC7] Manuel López-Ibáñez and Christian Blum. **Beam-ACO Based on Stochastic Sampling: A Case Study on the TSP with Time Windows**. In T. Stützle, editor, *Learning and Intelligent Optimization, Third International Conference, LION 3*, volume 5851 of *Lecture Notes in Computer Science*, pages 59–73. Springer, 2009.
- [IC6] Jérémie Dubois-Lacoste, Manuel López-Ibáñez, and Thomas Stützle. **Effective Hybrid Stochastic Local Search Algorithms for Biobjective Permutation Flowshop Scheduling**. In M. J. Blesa, C. Blum, L. Di Gaspero, A. Roli, M. Sampels, and A. Schaerf, editors, *Hybrid Metaheuristics*, volume 5818 of *Lecture Notes in Computer Science*, pages 100–114. Springer, 2009.
- [IC5] Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Parallel Optimisation Of Pump Schedules With A Thread-Safe Variant Of EPANET Toolkit**. In J. E. van Zyl, A. A. Ilemobade, and H. E. Jacobs, editors, *Proceedings of the 10th Annual Water Distribution Systems Analysis Conference (WDSA 2008)*. ASCE, August 2008.
- [IC4] Carlos M. Fonseca, Luís Paquete, and Manuel López-Ibáñez. **An improved dimension-sweep algorithm for the hypervolume indicator**. In *Proceedings of the 2006 Congress on Evolutionary Computation (CEC 2006)*, pages 1157–1163. IEEE Press, July 2006.
(272 citations according to the Google Scholar database)
- [IC3] Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Multi-objective Optimisation of the Pump Scheduling Problem using SPEA2**. In *Proceedings of the 2005 Congress on Evolutionary Computation (CEC 2005)*, volume 1, pages 435–442. IEEE Press, September 2005.
(44 citations according to the Google Scholar database)
- [IC2] Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Optimal Pump Scheduling: Representation and Multiple Objectives**. In D. A. Savic, G. A. Walters, R. King, and S. Thiam-Khu, editors, *Proceedings of the Eighth International Conference on Computing and Control for the Water Industry (CCWI 2005)*, volume 1, pages 117–122, University of Exeter, UK, September 2005.
- [IC1] Manuel López-Ibáñez, Luís Paquete, and Thomas Stützle. **On the Design of ACO for the Biobjective Quadratic Assignment Problem**. In M. Dorigo et al., editors, *Ant Colony Optimization and Swarm Intelligence, 4th International Workshop, ANTS 2004*, volume 3172 of *Lecture Notes in Computer Science*, pages 214–225. Springer, 2004.
(60 citations according to the Google Scholar database)

Software publicly available

- [SW7] **MOACO framework.** The multi-objective ant colony optimization (MOACO) framework is able to instantiate most MOACO algorithms from the literature, and also combine components that were never studied in the literature. This is the software originally proposed in [IJ9], and used later in [IJ10][IC21]. [<http://lopez-ibanez.eu/moaco>]
- [SW6] **irace R package.** Implements the Iterated F-Race procedure for automatic configuration (offline tuning) of parametric optimization algorithms. Lead developer and co-maintainer. The irace package is described in [TR1][IJ19]. Close to one-hundred papers have made use of irace, as evidenced by the high number of citations of the TR.
[<http://iridia.ulb.ac.be/irace>] (More than 17,000 total downloads by January 2017)
- [SW5] **Multi-objective Archivers.** This software implements most of the currently available archiving algorithms (archivers) in a common framework for simplifying their comparison and analysis. Developed in collaboration with Joshua Knowles and Marco Laumanns [IC15].
[<http://lopez-ibanez.eu/archivers>]
- [SW4] **Graphical tools for the exploratory analysis of bi-objective optimisation algorithms** (eaf R package). Developed in collaboration with Thomas Stützle and Luís Paquete [BC2]. Lead developer and current maintainer. [<http://lopez-ibanez.eu/eaftools>] (More than 9,442 total downloads by February 2015)
- [SW3] **Software for computing the hypervolume indicator.** Implementation of our $O(n^{d-2} \log n)$ algorithm [IC4]. Co-authored with Carlos M. Fonseca and Luís Paquete.
[<http://lopez-ibanez.eu/hypervolume>]
This software has been incorporated into two R packages, mco (multi criteria optimization algorithms and related functions) [<http://cran.r-project.org/web/packages/mco>] and emoa (evolutionary multiobjective optimization algorithms) [<http://cran.r-project.org/web/packages/emoa>], and it is used by the project “desiRe” [<http://r-forge.r-project.org/projects/desire>].
- [SW2] **EPANET for GNU/Linux.** A version of the hydraulic simulator library EPANET Toolkit, improved for using it in optimisation algorithms. Sole developer.
[<http://lopez-ibanez.eu/epanetlinux>]
- [SW1] **A Thread-Safe Variant of the EPANET Toolkit for Parallel Applications.** An extensive modification of the EPANET Toolkit for parallel optimisation algorithms [IC5]. Sole developer.
[<http://lopez-ibanez.eu/epanet-thread-safe>]

Presentations and posters during conferences with scientific selection committee

(Only those presented by myself and excluding presentations associated to peer-reviewed conference papers, which are listed above)

- [OP21] Manuel López-Ibáñez and Thomas Stützle. **Tutorial on Automatic Offline Design of Algorithms.** In *Genetic and Evolutionary Computation Conference, GECCO*, Berlin, Germany, July 15-19, 2017.
- [OP20] Manuel López-Ibáñez. **Challenges in Automated Algorithm Design: Representativeness, One-Shot Expensive Scenarios, Parameter Importance and Sensitivity, and Human-in-the-Loop.** In *Dagstuhl Seminar on Automated Algorithm Selection and Configuration*, Schloss Dagstuhl - Leibniz-Center for Informatics, Wadern, Germany, October 9-14, 2016. Invited Talk.

- [OP19] Manuel López-Ibáñez. **How to Design a New State-of-the-Art Multi-objective Evolutionary Algorithm Every Weekend.** In *28th European Conference on Operational Research, EURO 2016*, Poznan, Poland, July 3–6, 2016.
- [OP18] Manuel López-Ibáñez. **Automatic Configuration and Design of Optimization Algorithms.** In *43rd CREST Open Workshop*, University College London, UK, October 26-27, 2015. Invited Talk.
- [OP17] Thomas Stützle and Manuel López-Ibáñez. **Tutorial on Automatic (Offline) Configuration of Algorithms.** In *Genetic and Evolutionary Computation Conference, GECCO*, Madrid, Spain, July 11-15, 2015.
- [OP16] Manuel López-Ibáñez. **Machine Decision Makers: from Modeling Preferences to Modeling Decision Makers.** In *Dagstuhl Seminar on Understanding Complexity in Multiobjective Optimization*, Schloss Dagstuhl - Leibniz-Center for Informatics, Wadern, Germany, January 12-16, 2015. Invited Talk.
- [OP15] Manuel López-Ibáñez, Franco Mascia, Marie-Eléonore Marmion, and Thomas Stützle. **A Template for Designing Single-Solution Hybrid Metaheuristics.** In *Workshop on Metaheuristic Design Patterns (MetaDeeP), Genetic and Evolutionary Computation Conference, GECCO*, Vancouver, Canada, July 12-16, 2014.
- [OP14] Manuel López-Ibáñez and Thomas Stützle. **Tutorial on Automatic (Offline) Configuration of Algorithms.** In *Genetic and Evolutionary Computation Conference, GECCO*, Vancouver, Canada, July 12-16, 2014.
- [OP13] Leonardo C. T. Bezerra, Manuel López-Ibáñez, and Thomas Stützle. **Deconstructing Multi-objective Evolutionary Algorithms.** In *28th Annual Conference of the Belgian Operations Research Society, ORBEL 28*, Mons, Belgium, January 30-31, 2014.
- [OP12] Manuel López-Ibáñez and Thomas Stützle. **Tutorial on Automatic (Offline) Configuration of Algorithms.** In *Genetic and Evolutionary Computation Conference, GECCO 2013*, Amsterdam, The Netherlands, July 6-10, 2013.
- [OP11] Franco Mascia, Manuel López-Ibáñez, Jérémie Dubois-Lacoste, and Thomas Stützle. **From Grammars to Parameters: Automatic Design of Iterated Greedy Algorithms.** In *27th Annual Conference of the Belgian Operations Research Society, ORBEL 27*, Kortrijk, Belgium, February 7-8, 2013.
- [OP10] Manuel López-Ibáñez, Jérémie Dubois-Lacoste, Thomas Stützle, and Mauro Birattari. **Automatic Configuration of Optimization Algorithms.** In *Fourth International Workshop on Model-based Metaheuristics, Matheuristics 2012*, Angra dos Reis, Brazil, September 17-20, 2012.
- [OP9] Manuel López-Ibáñez. **Automatic Design of Algorithms with iRace for Multi-Objective Optimization and Anytime Optimization.** In *12th International Conference on Parallel Problem Solving From Nature, PPSN XII*, Taormina, Italy, September 1-5, 2012. Invited Talk.
- [OP8] Manuel López-Ibáñez and Thomas Stützle. **Automatic Design of Multi-Objective Algorithms.** In *25th European Conference on Operational Research, EURO 2012*, Vilnius, Lithuania, July 8-11, 2012.
- [OP7] Manuel López-Ibáñez and Thomas Stützle. **Automatically Improving the Anytime Behavior of Optimisation Algorithms.** In *26th Annual Conference of the Belgian Operations Research Society, ORBEL 26*, Brussels, Belgium, February 2-3, 2012.

- [OP6] Manuel López-Ibáñez and Thomas Stützle. **Offline Learning in Multi-Objective Optimization.** In *Dagstuhl Seminar on Learning in Multiobjective Optimization*, Schloss Dagstuhl - Leibniz-Center for Informatics, Wadern, Germany, January 22-27, 2012. Invited Talk.
- [OP5] Manuel López-Ibáñez and Thomas Stützle. **Improving the Anytime Behaviour of Optimisation Algorithms by Automatic Algorithm Configuration Tools.** In *Metaheuristics International Conference, MIC 2011*, Udine, Italy, July 25-28, 2011.
- [OP4] Manuel López-Ibáñez and Thomas Stützle. **Automatic Design of Ant Colony Optimization Algorithms for Bi-objective Problems.** In *25th Annual Conference of the Belgian Operations Research Society, ORBEL 25*, Ghent, Belgium, February 10-11, 2011.
- [OP3] Manuel López-Ibáñez. **Tutorial on Ant Colony Optimization.** In *Genetic and Evolutionary Computation Conference, GECCO 2010*, Portland, Oregon, USA, July 7-11, 2010.
- [OP2] Manuel López-Ibáñez, Thomas Stützle, and Luis Paquete. **Graphical tools for the analysis of bi-objective optimization algorithms.** In *Workshop on Theoretical Aspects of Evolutionary Multiobjective Optimization, Genetic and Evolutionary Computation Conference, GECCO 2010*, Portland, Oregon, USA, July 7-11, 2010.
- [OP1] Manuel López-Ibáñez, T. Devi Prasad, and Ben Paechter. **Solving Optimal Pump Control Problem using Max-Min Ant System.** In D. Thierens et al., editors, *Proceedings of the Genetic and Evolutionary Computation Conference, GECCO 2007*, volume 1, page 176. ACM Press, 2007. (Poster)

Notable Technical Reports

(These technical reports are notable for various reasons and are either pending or not suitable for peer-reviewed publication)

- [TR4] Jürgen Branke, Salvatore Corrente, Salvatore Greco, Milosz Kadzinski, Manuel López-Ibáñez, Vincent Mousseau, Mauro Munerato, and Roman Słowiński. **Behavior-Realistic Artificial Decision-Makers to Test Preference-Based Multi-objective Optimization Method (Working Group “Machine Decision-Making”).** In S. Greco, K. Klamroth, J. D. Knowles, and G. Rudolph, editors, *Understanding Complexity in Multiobjective Optimization (Dagstuhl Seminar 15031)*, volume 5(1) of *Dagstuhl Reports*, pages 110–116. Schloss Dagstuhl–Leibniz-Zentrum für Informatik, Germany, 2015.
- [TR3] Vito Trianni and Manuel López-Ibáñez. **Advantages of Multi-Objective Optimisation in Evolutionary Robotics: Survey and Case Studies.** Technical Report TR/IRIDIA/2014-014, IRIDIA, Université Libre de Bruxelles, Belgium, 2014.
- [TR2] Anne Auger, Dimo Brockhoff, Manuel López-Ibáñez, Kaisa Miettinen, Boris Naujoks, and Günther Rudolph. **Which questions should be asked to find the most appropriate method for decision making and problem solving? (Working Group “Algorithm Design Methods”).** In S. Greco, J. D. Knowles, K. Miettinen, and E. Zitzler, editors, *Learning in Multiobjective Optimization (Dagstuhl Seminar 12041)*, volume 2(1) of *Dagstuhl Reports*, pages 92–93. Schloss Dagstuhl–Leibniz-Zentrum für Informatik, Germany, 2012.
- [TR1] Manuel López-Ibáñez, Jérémie Dubois-Lacoste, Thomas Stützle, and Mauro Birattari. **The irace package, Iterated Race for Automatic Algorithm Configuration.** Technical Report TR/IRIDIA/2011-004, IRIDIA, Université Libre de Bruxelles, Belgium, 2011.
(265 citations according to the Google Scholar database)

Other invited talks

- 27/10/2016 *“Let the Cloud design your next multi-objective optimiser”*.
Computer Science Department, University of Exeter, UK.
- 4/5/2016 *“How (not) to design the new best optimisation algorithm every weekend”*.
Department of Automatic Control & Systems Engineering (ACSE), University of
Sheffield, UK.
- 17/10/2011 *“The irace Package: Iterated Race for Automatic Algorithm Configuration and Scoring
Function Parameterisation”*.
at Cambridge Crystallographic Data Centre, Cambridge, United Kingdom. Invited
by Oliver Korb.

Conference Organization

- Programme Co-Chair, with Arnaud Liefooghe, of the “18th European Conference on Evolutionary Computation in Combinatorial Optimisation” (EvoCOP), Parma, Italy (2018).
- Co-Chair, with John Woodward and Daniel Tauritz, of the “Workshop on Evolutionary Computation for the Automated Design of Algorithms (ECADA)”, at GECCO (2017, 2016, 2015).
- Programme Co-Chair, with Bin Hu, of the “17th European Conference on Evolutionary Computation in Combinatorial Optimisation” (EvoCOP), Amsterdam, The Netherlands (2017).
- Programme Co-Chair, with Xiaodong Li and Kazuhiro Ohkura, of the “Tenth International Conference on Swarm Intelligence” (ANTS), Brussels, Belgium (2016).
- Programme Co-Chair, with Gabriela Ochoa and Julia Handl, of the “14th International Conference on Parallel Problem Solving from Nature” (PPSN), Edinburgh, UK (2016).
- Co-Chair, with Holger H. Hoos, of the “Evolutionary Combinatorial Optimization and Metaheuristics Track” at the Genetic and Evolutionary Computation Conference (GECCO), Denver, USA (2016).
- Chair and Organizer of the session “Algorithmic Components of Evolutionary Multi-objective Optimization” at the 28th European Conference on Operational Research, EURO 2016, Poznan, Poland, 2016.
- Co-Chair, with Sanaz Mostaghim, of the “Ant Colony Optimization and Swarm Intelligence Track” at the Genetic and Evolutionary Computation Conference (GECCO), Madrid, Spain (2015).
- Co-organizer, with Franco Mascia, of the “COMEX Workshop on Practical Automatic Algorithm Configuration”, Brussels, Belgium (25th November, 2014).
- Co-Chair, with Thomas Stützle, of the “Evolutionary Combinatorial Optimization and Metaheuristics Track” at the Genetic and Evolutionary Computation Conference (GECCO), Amsterdam, The Netherlands (2013).

Editorial Activity

- *Swarm Intelligence*, Springer, Associate Editor since October 2015. (2015 Impact Factor: 2.577)
- *Operations Research Perspectives*, Elsevier, editorial board member since July 2016.

Reviews of Project Proposals

- Engineering and Physical Sciences Research Council, United Kingdom, 2012.
- Romanian National Council for Development and Innovation, Romania. Evaluation of project proposals for 2011 funding call.

Conference Program Committee Membership

- International Workshop on Machine Learning, Optimization and Big Data (MOD): Volterra, Italy (2016).
- Learning and Intelligent Optimization (LION): LION9, Lille, France (2015); LION8, Florida, USA (2014); LION7, Catania, Italy (2013); LION6, Paris, France (2012); LION5, Rome, Italy (2011); LION4, Venice, Italy (2010) .
- IEEE Congress on Evolutionary Computation (CEC): Donostia - San Sebastián, Spain (2017); Vancouver, Canada, (2016); Sendai, Japan (2015); Beijing, China (2014); Cancun, Mexico (2013) .
- Genetic and Evolutionary Computation Conference (GECCO): Berlin, Germany (2017); (*Evolutionary Multi-objective Optimization track*), Denver, USA (2016); Vancouver, Canada (2014); Philadelphia, USA (2012); Dublin, Ireland (2011); Portland, Oregon, USA (2010); Seattle, WA, USA (2006) .
- International Joint Conference on Artificial Intelligence (IJCAI): Buenos Aires, Argentina (2015); Beijing, China (2013); Barcelona, Spain (2011) .
- Artificial Evolution (EA 2015), Lyon, France (2015).
- Evolutionary Multiobjective Optimization Session, 22nd International Conference on Multiple Criteria Decision Making, Málaga, Spain (2013).
- Hybrid Metaheuristics: Plymouth, United Kingdom (2016); Hamburg, Germany (2014); Viena, Austria (2010); Udine, Italy (2009) .
- International Conference on Evolutionary Multi-Criterion Optimization (EMO): Munster, Germany (2017); Guimarães, Portugal (2015); Sheffield, UK (2013) .
- International Conference on Swarm Intelligence (ANTS): Brussels, Belgium (2014, 2012, 2010).
- International Conference on Operations Research and Enterprise Systems (ICORES): Porto, Portugal (2017); Roma, Italy (2016).
- International Conference on Agents and Artificial Intelligence (ICAART): Porto, Portugal (2017); Roma, Italy (2016).
- International Conference on Medical Imaging using Bio-inspired and Soft Computing (MIBISOC), Brussels, Belgium (2013).
- International Conference on Parallel Problem Solving From Nature (PPSN): Ljubljana, Slovenia (2014); Taormina, Italy (2012) .
- Twenty-Ninth AAI Conference on Artificial Intelligence, AAI-15, Austin, Texas (2014).
- European Conference on Artificial Intelligence (ECAI), Prague, Czech Republic (2014).

Reviews for International Journals

- *Operations Research Perspectives*, 2017.
- *European Journal of Operational Research*, 2013, 2014, 2016.
- *IEEE Transactions on Evolutionary Computation*, 2006, 2009–2011, 2013–2017.

- *Evolutionary Computation Journal*, MIT Press, 2006–2016.
- *Computers & Operations Research*, 2008 (Special issue on “Hybrid Metaheuristics”), 2009, 2011, 2014–2016.
- *Journal of Heuristics*, Springer, 2010–2016.
- *Swarm Intelligence*, Springer New York, 2008 (Special issue on “Ant Colony Optimization”), 2009, 2011, 2012, 2015–2017.
- *Applied Soft Computing*, Elsevier, 2012, 2013, 2014, 2016.
- *Theoretical Computer Science*, 2016.
- *IEEE Transactions on Cybernetics*, 2016.
(formerly known as *IEEE Transactions on Systems, Man, and Cybernetics–Part B: Cybernetics*, 2010, 2012, 2013).
- *Information Sciences*, 2016.
- *Computers & Industrial Engineering*, 2009, 2010, 2016, 2017.
- *International Journal of Automation & Computing*, 2017.
- *Transactions on Computational Collective Intelligence*, Springer, 2016.
- *The R Journal*, 2016.
- *AI Communications*, IOS Press, 2011, 2016.
- *Mathematical Problems in Engineering*, 2015.
- *Annals of Operations Research*, 2015.
- *Artificial Intelligence*, Elsevier, 2015.
- *Artificial Intelligence Review*, Springer, 2015.
- *International Transactions in Operational Research*, 2015.
- *Knowledge-Based Systems*, Elsevier, 2015.
- *Journal of Water Resources Planning and Management*, ASCE, 2014.
- *IEEE Computational Intelligence Magazine*, 2014 (Special Issue on “Computational Intelligence in Production and Logistics Systems”), 2017.
- *Journal of Industrial and Management Optimization*, AIMS, 2007 (Special issue), 2014.
- *Communications of the ACM*, 2013.
- *Journal of Hydroinformatics*, 2010, 2013.
- *IEEE Transactions on Parallel and Distributed Systems*, 2013.
- *PLoS ONE*, Public Library of Science, 2012.

- *Journal of Global Optimization*, Springer, 2011, 2012.
- *European Journal of Industrial Engineering*, 2012.
- *Fundamenta Informaticae*, IOS Press, 2012.
- *Journal of Computational Optimization and Applications*, 2006, 2012.
- *International Journal of Production Economics*, 2012.
- *Journal of Computer Science and Technology*, 2011.
- *Journal of Multi-Criteria Decision Analysis*, Wiley, 2011.
- *Engineering Optimization*, Taylor & Francis, 2011
- *Engineering Applications of Artificial Intelligence*, Elsevier, 2011.
- *Natural Computing*, Springer, 2011.
- *Soft Computing*, Springer, 2011, 2017.
- *International Journal of Information Technology & Decision Making*, 2010.
- *Expert Systems*, Wiley, 2010.
- *Adaptive Behavior*, 2010.
- *Journal of Systems and Software*, Elsevier, 2010.
- *Integrated Computer-Aided Engineering*, 2010.
- *BRAIN: Broad Research in Artificial Intelligence and Neuroscience*, 2010.
- *Journal of Aerospace Computing, Information, and Communication*, AIAA, 2009.
- *Computational Intelligence*, Wiley, 2009.
- Special issue “Nature Inspired Cooperative Strategies for Optimization” of the *International Journal of Intelligence Systems*, 2007.
- *Journal of Mathematics and Computers in Simulation (MATCOM)*, Elsevier, 2007.

Reviews of Book Chapters

- Chapter of the book “*Handbook of Heuristics*”, Springer (201?).
- Chapter of the book “*Optimization Techniques for Solving Complex Problems*”, Wiley (2008).

Reviews for Conferences

- 18th International Conference on Theory and Applications of Satisfiability Testing (SAT 2015), Austin, Texas, USA, 2015.
- 17th IEEE International Conferences on High Performance Computing and Communications (HPCC), New York, USA, 2015.
- Metaheuristics International Conference (MIC), Udine, Italy, 2011.
- 2nd Doctoral Symposium on Computing, York, UK, 2008.
- IEEE World Congress on Computational Intelligence (WCCI), Hong Kong, 2008.
- 14th Annual European Symposium on Algorithms (ESA), Zürich, Switzerland, 2006.
- Fifth International Workshop on Ant Colony Optimization and Swarm Intelligence (ANTS), Brussels, Belgium, 2006.

Panel Membership

- Expert panel member of the *Student Workshop* at the Genetic and Evolutionary Computation Conference, GECCO 2014.

Co-promoter (adviser and supervisor role) of PhD students:

- Lucia Rivadeneira Barreiro (2015 – Present)
- Leslie Pérez (2012 – Present)
- Leonardo C. T. Bezerra (2012 – 2016). *A Component-wise Approach to Multi-objective Evolutionary Algorithms*, Université libre de Bruxelles.
- Jérémie Dubois-Lacoste (2009 – 2014). *Anytime Local Search for Multi-Objective Combinatorial Optimization: Design, Analysis and Automatic Configuration*, Université libre de Bruxelles.

(Co-)Supervisor role of Master's (Ms) thesis

- Jindan Li (2016), *Forecasting Retail Sales of Walmart's Stores*, University of Manchester.
- Xuan Du (2016), *Multiple Objective Parameter Selection for Classifiers*, University of Manchester.
- Akshay Saxena (2016), *Prediction of Prices using Machine Learning Techniques*, University of Manchester.
- Shengian Li (2016), *Open Data Sources in the City of Manchester*, University of Manchester.
- Xiaoyan Yuan (2016), *Prices Forecast for Raw Materials and Final Products*, University of Manchester.
- Yurui Cui (2016), *GP Practice Assessments and Recommendations in Manchester Based on Customer Satisfaction*, University of Manchester.
- Aurelien Marion (2015), *Fast heuristics for the longest common subsequence problem*, Université libre de Bruxelles, Belgium.
- Javier Pérez (2014), *A framework of ant colony optimization for the automatic design on permutation problems*, Universidad Politécnica de Madrid, Spain.
- Luc Coene (2013), *Two-Phase and Pareto Local Search for multi-objective continuous optimization*, Université libre de Bruxelles, Belgium.
- Andreea Radulescu (2012), *Automatically Improving the Anytime Behaviour of Multiobjective Evolutionary Algorithms*, Université Nantes, France. Related publications: [IC25]
- Michael Maur (2010), *Adaptive Ant Colony Optimization for the Traveling Salesman Problem*, Technical University of Darmstadt, Germany. Related publications: [IC12] [BC5]

PARTICIPATION IN PHD DEFENSE JURY

- Jun 2016 **Leonardo C. T. Bezerra.** *A Component-wise Approach to Multi-objective Evolutionary Algorithms*, Université libre de Bruxelles, Belgium. (Co-promoter).
- Apr 2016 **Annelies De Corte.** *Optimization of water distribution networks using metaheuristics*, Faculty of Applied Economics, University of Antwerp, Belgium.
- Dec 2015 **Mohamed Saifullah Hussin.** *Stochastic Local Search Algorithms for Single and Bi-objective Quadratic Assignment Problems*, Université libre de Bruxelles, Belgium.
- May 2015 **Leticia Hernando.** *Instances of Combinatorial Optimization Problems: Complexity and Generation*, University of the Basque Country, Spain.
- Apr 2014 **Jérémie Dubois-Lacoste.** *Anytime Local Search for Multi-Objective Combinatorial Optimization: Design, Analysis and Automatic Configuration*, Université libre de Bruxelles, Belgium. (Co-promoter).
- Jun 2013 **Tianjun Liao.** *Population-based Heuristic Algorithms for Continuous and Mixed Discrete-Continuous Optimization Problems*, Université libre de Bruxelles, Belgium.

EVALUATION OF PHD THESES

- Dec 2015 **Fernando Alvarruiz Bermejo.** *Reducción del Tiempo de Simulación de Redes de Distribución de Agua mediante el Método de Mallas y la Computación de Altas Prestaciones*, Universitat Politècnica de València, València, Spain.

PARTICIPATION IN EXAMINATION PANELS

- January 2016 **Nicolás Emilio Rojas Morales.** *PhD thesis proposal*, Universidad Técnica Federico Santa María, Valparaiso, Chile.
- January 2016 **Alan Juan Toledo Vargas.** Ms. Thesis (Tesis de Magister en Ciencias de la Ingeniería Informática), *Una Hiperheurística para resolver Orienteering Problem with Hotel Selection and Time Windows*, Universidad Técnica Federico Santa María, Valparaiso, Chile.

TEACHING EXPERIENCE

At Alliance Manchester Business School, UK:

- | | |
|--|------------------|
| Programming in Python for Business Analytics
Course coordinator, lectures, seminars. | SS/2017 |
| Decision Analysis for Business & Management
Lecturer. | SS/2016, SS/2017 |
| Quantitative Methods for Business & Management
Course coordinator, lecturer. | SS/2017 |
| Academic and Career Development
Seminar leader. | 2016/7 |
| Data Visualisation and Statistical Programming
Full-day workshop, DBA (Doctor of Business Administration) Research Conference. | 16/6/2016 |
| Quantitative Methods for Business & Management 2
Lecturer, Coordinator. | SS/2016 |

Risk, Performance and Decision Analysis

SS/2016

Lecturer, Seminars.

Human Computer Interaction

WS/2015

Seminars.

At Université libre de Bruxelles, Brussels, Belgium:

Heuristic Optimization

SS/2011 and SS/2013

Seminars, design of coursework.

REFERENCES

References are available upon request.