





Manuel López-Ibáñez

 manuel.lopez-ibanez@ulb.ac.be
 <http://iridia.ulb.ac.be/~manuel>
 +32 (0) 2650 2745
 Université Libre de Bruxelles, CoDE, IRIDIA, CP 194/6
50 Av. F. Roosevelt B-1050 Brussels, Belgium

LAST NAME, FIRST NAME **López-Ibáñez, Manuel**
DATE, PLACE OF BIRTH May 16, 1980 in El Puerto de Santa María, Spain
LANGUAGES Spanish (native), English (fluent), German (basic: 1 year)

ACADEMIC DEGREES

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

RESEARCH EXPERIENCE

Full time researcher since November, 2004: 6 years of research experience.

01-07-2009 – Present

Postdoctoral researcher at IRIDIA, Université Libre de Bruxelles, Brussels, Belgium.

01-03-2009 – 31-06-2009

Doctoral researcher at IRIDIA, Université Libre de Bruxelles, Brussels, Belgium.

15-10-2008 – 30-11-2008

Research Assistant at the research group ALBCOM, Departament Llenguatges i Sistemes Informàtics, Universitat Politècnica de Catalunya, Barcelona, Spain.

Supervisor: Dr. Christian Blum.

29-10-2007 – 31-12-2007

Project “High Performance Ant Colony Optimisation of the Pump Scheduling Problem” carried out at the Barcelona Supercomputing Centre, Barcelona, Spain.

December 2005

Collaboration with Prof. Carlos M. Fonseca at the University of Algarve, Faro, Portugal.

01-11-2004 – 26-06-2009

Full-time PhD student at Edinburgh Napier University, United Kingdom.

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

October 2003 – July 2004

MS Thesis (Diplomarbeit) at the Technische Universität Darmstadt, Germany, through the financial support of an Erasmus scholarship.

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

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 combinatorial, multi-objective and real-world optimization 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.

Programming Languages:

- High level: C, C++, Perl, R (statistical programming language).
- Basic level: Java, Bourne Again Shell (Bash), SQL, Flex, Yacc, x86 and Pentium assembler.

Mathematical Tools:

- R (statistical computing), Mathematica, Matlab, Gnuplot

Operating Systems:

- GNU/Linux (high user level, high administrator level)
- Windows 98/XP (high user level, medium administrator level)
- MS-DOS (high level)

Additionally, I have practiced:

- concurrent programming using threads and semaphores in C and Java,
- parallel programming using MPI,
- CGI programming using Perl,
- GUI design using Borland C++ Builder,
- software engineering using UML,
- Database Management using Oracle,
- Emacs, OpenOffice.org, LaTeX.

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* [IC5], 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* [IC6], 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* [IC7], co-authored with Thomas Stützle, received the 3rd best paper award of the 9th international conference on Artificial Evolution (EA'09), Strasbourg, France, 2009.

OTHER MERITS AND AWARDS

- HPC-EUROPA grant for the project “*High Performance Ant Colony Optimisation of the Pump Scheduling Problem*” carried out at the Barcelona Supercomputing Centre (November – December, 2007).
- 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

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

INTERESTS AND HOBBIES

- | | |
|-----------------------------------------------|----------------------------------------------|
| • Free Software and GNU/Linux | • Languages |
| • Artificial Intelligence | • Traveling |
| • Graphic novels, particularly Alan Moore | • Capoeira (Brazilian dance and martial art) |
| • Spanish poetry, particularly Angel González | |

Theses

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

International Journals

- [IJ1] 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*, 2011. In Press.
(2009 ISI impact factor: 3.103; ranking: 4/92)
- [IJ2] 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.
(2009 ISI impact factor: 2.116; ranking: 19/95)
- [IJ3] Manuel López-Ibáñez and Christian Blum. **Beam-ACO for the travelling salesman problem with time windows**. *Computers & Operations Research*, 37(9):1570–1583, 2010.
(2009 ISI impact factor: 2.116; ranking: 19/95)
(5 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 impact factor: 4.589; ranking: 2/103)
(23 citations according to the Google Scholar database)
- [IJ5] 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 impact factor: 2.116; ranking: 19/95)
(5 citations according to the Google Scholar database)
- [IJ6] 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 impact factor: 1.275; ranking: 12/91)
(9 citations according to the Google Scholar database)
- [IJ7] 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.
(36 citations according to the Google Scholar database)

★ Some of these publications are available at <http://iridia.ulb.ac.be/~manuel/publications>

Book Chapters

- [BC1] Thomas Stützle, Manuel López-Ibáñez, P. 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*. Springer, Berlin, Germany, 2011. To appear.
- [BC2] 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.
- [BC4] 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, Berlin, Germany, 2010.
(18 citations according to the Google Scholar database)
- [BC5] 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.

International Conferences

- [IC1] 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, Heidelberg, Germany, 2011.
- [IC2] 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, Heidelberg, Germany, 2011.
- [IC3] Manuel López-Ibáñez and Thomas Stützle. **Automatic Configuration of Multi-Objective ACO Algorithms**. In M. Dorigo et al., editors, *Ant Colony Optimization and Swarm Intelligence, 7th International Conference, ANTS 2010*, volume 6234 of *Lecture Notes in Computer Science*, pages 95–106. Springer, Heidelberg, Germany, 2010.
- [IC4] 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, Piscataway, NJ, 2010.

- [IC5] 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, New York, NY, 2010. ★ *Best paper award*
- [IC6] 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, Heidelberg, Germany, 2010. ★ *Best paper award*
- [IC7] Manuel López-Ibáñez and Thomas Stützle. **An Analysis of Algorithmic Components for Multi-objective Ant Colony Optimization: A Case Study on the Biobjective TSP.** In P. Collet et al., editors, *Artificial Evolution*, volume 5975 of *Lecture Notes in Computer Science*, pages 134–145. Springer, Heidelberg, Germany, 2010. ★ *3rd best paper award*
- [IC8] 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, Heidelberg, Germany, 2009.
- [IC9] 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 Evolutionary Computation in Combinatorial Optimization*, volume 5482 of *Lecture Notes in Computer Science*, pages 97–108. Springer, Heidelberg, Germany, 2009.
- [IC10] 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, Heidelberg, Germany, 2009.
- [IC11] 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.
- [IC12] 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, Piscataway, NJ, July 2006. (61 citations according to the Google Scholar database)
- [IC13] 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, Piscataway, NJ, September 2005.
- [IC14] 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.

- [IC15] Luís Paquete, Thomas Stützle, and Manuel López-Ibáñez. **Towards the Empirical Analysis of SLS Algorithms for Multiobjective Combinatorial Optimization Problems through Experimental Design**. In K. F. Doerner, M. Gendreau, P. Greistorfer, W. J. Gutjahr, R. F. Hartl, and M. Reimann, editors, *6th Metaheuristics International Conference (MIC 2005)*, pages 739–746, Vienna, Austria, 2005.
- [IC16] 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, Heidelberg, Germany, 2004.

Software publicly available

- [SW1] **Graphical tools for the exploratory analysis of bi-objective optimisation algorithms** developed in collaboration with Thomas Stützle and Luís Paquete [BC4]. The eaf R package is available from <http://iridia.ulb.ac.be/~manuel/eaftools>
- [SW2] Implementation of the **algorithm for computing the hypervolume indicator** co-authored with Carlos M. Fonseca and Luís Paquete [IC12], and available from <http://iridia.ulb.ac.be/~manuel/hypervolume> (1060 unique visitors).
This software has been incorporated into the 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>.
- [SW3] **EPANET for GNU/Linux**. A version of the hydraulic simulator library EPANET Toolkit, modified and improved by me for using it in optimisation algorithms. Available from <http://iridia.ulb.ac.be/~manuel/epanetlinux> (729 unique visitors)
- [SW4] **A Thread-Safe Variant of the EPANET Toolkit for Parallel Applications**. An extensive modification of the EPANET Toolkit developed by me for parallel optimisation algorithms [IC11]. Available from <http://iridia.ulb.ac.be/~manuel/epanet-thread-safe> (64 unique visitors)

Oral presentations and posters during conferences with scientific selection committee

- [OP1] 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.
- [OP2] Manuel López-Ibáñez. **Tutorial on Ant colony optimization**. In *Genetic and Evolutionary Computation Conference, GECCO 2010*, Portland, Oregon, USA, July 7-11, 2010.
- [OP3] 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.
- [OP4] 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, New York, NY, 2007. (Poster)

Conference Program Committee Membership

- Genetic and Evolutionary Computation Conference (GECCO), Dublin, Ireland (2011).
- Twenty-second International Joint Conference on Artificial Intelligence (IJCAI), Barcelona, Spain (2011).
- Learning and Intelligent Optimization (LION5), Rome, Italy (2011).
- Seventh International Conference on Swarm Intelligence (ANTS), Brussels, Belgium (2010).
- Genetic and Evolutionary Computation Conference (GECCO), Portland, Oregon, USA (2010).
- Learning and Intelligent Optimization (LION4), Venice, Italy (2010).
- Hybrid Metaheuristics, Udine, Italy (2009).
- Genetic and Evolutionary Computation Conference (GECCO), Seattle, WA, USA (2006).

Book Chapters

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

International Journals

- *Evolutionary Computation Journal*, MIT Press, 2006, 2007, 2008, 2009, 2010, 2011.
- *IEEE Transactions on Evolutionary Computation*, 2006, 2009, 2010.
- *Swarm Intelligence*, Springer New York, 2008 (Special issue on “Ant Colony Optimization”), 2009, 2011.
- *Computers & Operations Research*, 2008 (Special issue on “Hybrid Metaheuristics”), 2009.
- *Engineering Optimization*, Taylor & Francis, 2011
- *IEEE Transactions on Systems, Man, and Cybernetics–Part B: Cybernetics*, 2010.
- *International Journal of Information Technology & Decision Making*, 2010.
- *Journal of Heuristics*, Springer, 2010, 2011.
- *Natural Computing*, Springer, 2011.
- *Expert Systems*, Wiley, 2010.
- *Adaptive Behavior*, 2010.
- *Journal of Hydroinformatics*, 2010.
- *Soft Computing*, Springer, 2011.
- *Journal of Systems and Software*, Elsevier, 2010.
- *Integrated Computer-Aided Engineering*, 2010.
- *BRAIN: Broad Research in Artificial Intelligence and Neuroscience*, 2010.

- *Computers & Industrial Engineering*, 2009, 2010.
- *Journal of Aerospace Computing, Information, and Communication*, AIAA, 2009.
- *Computational Intelligence*, Wiley, 2009.
- Special issue of *Journal of Industrial and Management Optimization*, AIMS, 2007.
- 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.
- *Journal of Computational Optimization and Applications*, 2006.

Reviews for Conferences

- 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.

REFERENCES

References are available upon request.