

Research Interests

Software Verification, Satisfiability Modulo Theories (SMT), Bit-Vectors, Arrays, Boolean Satisfiability (SAT), Boolean Optimization, Parallel Constraint Solving

Education

Sep 2013 **Ph.D. in Information Systems and Computer Engineering**, *University of Lisbon*, Portugal, Graduated with honors.

- Developed new algorithms for Maximum Satisfiability (MaxSAT).
- Implemented state-of-the-art single-threaded and multi-threaded MaxSAT solvers.
- MaxSAT has many practical applications, such as software package upgrades (e.g. used in the Eclipse platform to manage plug-in dependencies), fault localization in C code, debugging of hardware designs, timetabling, etc.

Jan 2008 **M.Sc. in Mathematics and Applications**, *University of Lisbon*, Portugal.

Jan 2008 **B.Sc. in Applied Mathematics and Computation**, *University of Lisbon*, Portugal.

Employment

Jan 2014-Current **Postdoctoral Research Assistant**, *University of Oxford*, UK.

- Improved the Satisfiability Modulo Theories (SMT) of Bit-Vectors and Arrays that are used in CBMC. CBMC is a bounded model checker for ANSI-C programs (around 0.5 million lines of C++) and is used by several companies, such as Toyota, ABB, BTC Embedded Systems, etc.
- Improved CBMC performance on software from automotive origin used by BTC Embedded Systems by extending CBMC with an incremental approach.
- Validated and verified the translation from AgentSpeak to C code that is used to operate Unmanned Aerial Vehicles (UAVs).

Sep 2013-Dec 2013 **Visiting Researcher**, *University of Lisbon*, Portugal.

- Worked on incomplete algorithms for Boolean optimization and Mixed Integer Linear Programming (MILP) and its integration with CPLEX.

May 2012-Jul 2012 **Research Intern**, *Microsoft Research*, Cambridge, UK.

- Implemented a lock-free unit propagation algorithm on top of MiniSAT.
- Implemented a parallel unit propagation algorithm with OpenMP on top of MiniSAT.

Nov 2012-Jan 2013 **Research Intern**, *Microsoft Research*, Cambridge, UK.

- Implemented a distributed SAT solver with MIP on top of MiniSAT.

Publications

Book Chapters:

- [B1] "Boolean Satisfiability and Optimization: Games, Puzzles and Genetics (in Portuguese)." Ruben Martins, Ana Graça. In *Números, Cirurgias e Nós de Gravata*, 252-270, IST Press, 2012.

Journals:

- [J5] “On Using Incremental Encodings in Unsatisfiability-based MaxSAT Solving.” Ruben Martins, Saurabh Joshi, Vasco Manquinho, Inês Lynce. In *Journal on Satisfiability, Boolean Modeling and Computation*, IOS Press, 2015 (Submitted).
- [J4] “Deterministic Parallel MaxSAT Solving.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Journal on Artificial Intelligence Tools*, World Scientific, 2014 (In Press).
- [J3] “Improving Linear Search Algorithms with Model-based Approaches for MaxSAT Solving.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *Journal of Experimental & Theoretical Artificial Intelligence*, Taylor and Francis 2014 (In Press).
- [J2] “Parallel Search for Maximum Satisfiability.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *AI Communications* 25(2): 75-95, IOS Press, 2012.
- [J1] “An Overview of Parallel SAT Solving.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *Constraints* 17(3): 304-347, Springer, 2012.

Conferences:

- [C10] “Stronger, Better, Faster: Optimally Propagating SAT Encodings.” Martin Brain, Liana Hadarean, Daniel Kroening, and Ruben Martins. In *International Conference on Automated Deduction (CADE’15)*, Springer, 2015 (Submitted).
- [C9] “Successful Use of Incremental BMC in Automotive Industry.” Peter Schrammel, Daniel Kroening, Martin Brain, Ruben Martins, Tino Teige, and Tom Bienmüller. In *Formal Methods for Industrial Critical Systems (FMICS’15)*, Springer, 2015.
- [C8] “Incremental Cardinality Constraints for MaxSAT.” Ruben Martins, Saurabh Joshi, Vasco Manquinho, Inês Lynce. In *Principles and Practice of Constraint Programming (CP’14)*, 531-548, Springer, 2014.
- [C7] “Open-WBO: A Modular MaxSAT Solver.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Conference on Theory and Applications of Satisfiability Testing (SAT’14)*, 438-445, Springer, 2014.
- [C6] “Community-based Partitioning for MaxSAT Solving.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Conference on Theory and Applications of Satisfiability Testing (SAT’13)*, 182-191, Springer, 2013.
- [C5] “On Partitioning for Maximum Satisfiability.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *European Conference on Artificial Intelligence (ECAI’12)*, 913-914, IOS Press, 2012.
- [C4] “Clause Sharing in Parallel MaxSAT.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *Learning and Intelligent Optimization (LION’12)*, 455-460, Springer, 12.
- [C3] “Exploiting Cardinality Encodings in Parallel Maximum Satisfiability.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Conference on Tools with Artificial Intelligence (ICTAI’11)*, 313-320, IEEE, 2011.
- [C2] “Improving Unsatisfiability-based Algorithms for Boolean Optimization.” Vasco Manquinho, Ruben Martins, Inês Lynce. In *International Conference on Theory and Applications of Satisfiability Testing (SAT’10)*, 181-193, Springer, 2010.
- [C1] “Improving Search Space Splitting for Parallel SAT Solving.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Conference on Tools with Artificial Intelligence (ICTAI’10)*, 336-343, IEEE, 2010.

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Workshops:

- [W6] “Model-based Partitioning for MaxSAT Solving.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *RCRA International Workshop on Experimental Evaluation of Algorithms for Solving Problems with Combinatorial Explosion (RCRA’13)*, 2013.
- [W5] “Clause Sharing in Deterministic Parallel Maximum Satisfiability.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *RCRA International Workshop on Experimental Evaluation of Algorithms for Solving Problems with Combinatorial Explosion (RCRA’12)*, 2012.
- [W4] “Parallel Search for Boolean Optimization.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *RCRA International Workshop on Experimental Evaluation of Algorithms for Solving Problems with Combinatorial Explosion (RCRA’12)*, 2011.
- [W3] “Preprocessing in Pseudo-Boolean Optimization: An Experimental Evaluation.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Workshop on Constraint Modelling and Reformulation (ModRef’09)*, 2009.
- [W2] “Effective CNF Encodings of the Towers of Hanoi.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *International Conference on Logic for Programming Artificial Intelligence and Reasoning (LPAR’08)*, 2008.
- [W1] “Breaking Local Symmetries in Quasigroup Completion Problems.” Ruben Martins, Vasco Manquinho, Inês Lynce. In *RCRA International Workshop on Experimental Evaluation of Algorithms for Solving Problems with Combinatorial Explosion (RCRA’07)*, 2007.

Technical Reports:

- [R1] “Effective CNF Encodings of the Towers of Hanoi.” Ruben Martins, Inês Lynce. In *Technical Report: 47, INESC-ID*, 2008.

Theses:

- [Th2] “Parallel Search for Maximum Satisfiability.” Ruben Martins. PhD Thesis, IST, University of Lisbon, Portugal, 2013.
- [Th1] “The Impact of Modeling in SAT Problem Solving (in Portuguese).” Master Thesis, IST, University of Lisbon, Portugal, 2007.

Posters:

- [P1] “On Partitioning for Maximum Satisfiability.” Ruben Martins, Vasco Manquinho, Inês Lynce. Poster at *European Conference on Artificial Intelligence (ECAI’12)*, 2012.

Talks:

- [T5] “MaxSAT Evaluation 2014.” Ruben Martins. Talk at FLoC Olympic Games, Award Ceremony for the MaxSAT Evaluation, July 17, 2014.
- [T4] “SATisfiability Solving: How to solve problems with SAT?” Ruben Martins. Talk at University of Oxford, Verification Seminar, February 13, 2014.
- [T3] “SATisfiability Solving: How do SAT solvers work?” Ruben Martins. Talk at University of Oxford, Verification Seminar, February 6, 2014.
- [T2] “Maximum Satisfiability: Beyond Decision Problems.” Ruben Martins. Talk at University of Oxford, Verification Seminar, September 5, 2013.
- [T1] “SAT & Sudoku (in Portuguese).” Ruben Martins. Talk at University of Lisbon, Math Seminar, April 26, 2006.

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Software

Developed three constraint solvers (Open-WBO, WBO, PWBO) for Boolean optimization (around 30 thousand lines of C++ code). These solvers are used in:

- Academia: for teaching and research purposes.
- Onera (French Aerospace Lab): for complex design space exploration in critical embedded systems.

2013-Current **Open-WBO**, sat.inesc-id.pt/open-wbo.

- Open-source MaxSAT solver that can be easily modified and extended.

Awards:

- MaxSAT FLoC Olympic Games 2014: 2 gold medals
- MaxSAT Evaluation 2014: 1 gold medal, 1 silver medal

2010-2013 **WBO**, sat.inesc-id.pt/wbo.

- Boolean optimization solver that can solve Weighted Boolean Optimization, Pseudo-Boolean optimization, 0-1 Integer Linear Programming, and MaxSAT problems.

Awards:

- MaxSAT Evaluation 2012: 1 gold medal, 1 bronze medal
- MaxSAT Evaluation 2011: 1 silver medal, 1 bronze medal

2010-2013 **PWBO**, sat.inesc-id.pt/pwbo.

- Parallel Boolean optimization solver based on WBO.

Awards:

- MaxSAT Evaluation 2012: 1 gold medal, 1 silver medal
- MaxSAT Evaluation 2011: 1 silver medal
- PB Evaluation 2011: 1 bronze medal

Skills

Programming C, C++, Java, Shell Scripting, CPLEX
Parallelism POSIX Threads, OpenMP, MPI
Development eclipse, Visual Studio, git, SVN

Other Professional Activities



Teaching • Lecturer for a week of tutorials on software verification at the University of Lleida, Spain: 3 two-hours theoretical lectures, 1 one-hour practical lecture, May 2015.

Program Committee IJCAI-2015

Reviewer CAV-2015; JSAT-2015; AAI-2015; TACAS-2015; SAT-2010,2011,2012,2013,2014; CP-2012,2014; FMCAD-2012,2014; IJCAI-2013; LPAR-2013; CPAIOR-2012; LION-2012; POS-2011,2012,2013,2014; RCRA-2012

Management • Co-supervised Eliot Ball, an undergraduate student at the University of Oxford, for a third year project on using extended resolution to improve the performance of SAT solvers (2014-2015).
• Organized the weekly seminars for the Systems Verification Group at the University of Oxford (2014-2015).

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