

Curriculum Vitae

Lucian Buşoniu

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Education and work experience

- Jan. 2009 – ongoing: Postdoctoral fellow, DCSC, TU Delft, the Netherlands.
Topic: *Data-Efficient and Online Reinforcement Learning*.
Research and dissemination, drafting grant proposals, developing and coordinating lectures, course assignments, and exams, advising PhD, MSc, and BSc, students.
- Jan. 2005 – Jan. 2009: PhD candidate, DCSC, TU Delft, the Netherlands.
Topic: *Reinforcement Learning in Continuous State and Action Spaces*.
PhD degree obtained *cum laude*. Advisors: Prof. B. De Schutter and Prof. R. Babuška.
Research and dissemination, interaction and reporting within a large research project, developing and coordinating course assignments and exams, advising MSc and BSc students.
- Mar. 2005 – Mar. 2007: Completed course program of *Dutch Institute for Systems and Control*.
- Oct. 2003 – Jan. 2005: Teaching assistant, Automation Dept., TU Cluj-Napoca, Romania.
Teaching practical classes, exams for MSc and postgraduate courses.
- Spring 2004 – Dec. 2004: Freelance programmer, member of a team of programmers.
Designing, developing, and maintaining software in a team; interacting with clients.
- Oct. 2003 – Jun. 2004: Postgraduate degree in *Modern Control*, TU Cluj-Napoca, Romania.
Thesis: *MicroJava Agents in Testing*.
Graduated with maximum grade. Advisor: Prof. L. Miclea.
- Oct. 1998 – Jun. 2003: MSc in *Automation and Control*, TU Cluj-Napoca, Romania.
Thesis: *Multi-Agent Systems in Distributed Built-In Self-Testing and Distributed Testing*.
Graduated valedictorian. Advisor: Prof. L. Miclea.

Achievements and distinctions

- Author of book *Reinforcement Learning and Dynamic Programming Using Function Approximators*, published with Taylor & Francis CRC Press; as well as of 5 journal papers, 3 book chapters, and 18 conference papers.
- Co-advisor of 1 PhD student, 6 MSc students (2 graduated *cum laude*), and 6 BSc students.
- Invited member of the IEEE Technical Committee on *Adaptive Dynamic Programming and Reinforcement Learning*, 2010. Member in the task forces *Reinforcement Learning and Function Approximation* and *Robot Reinforcement Learning*
- 2009 Andrew P. Sage Award for the best paper published annually in the IEEE Transactions on Systems, Man and Cybernetics. Received for the paper “A Comprehensive Survey of Multi-Agent Reinforcement Learning”. *IEEE Transactions on Systems, Man, and Cybernetics—Part C: Application and Reviews*, vol. 38, no. 2, pages 156–172, 2008.

- *Cum laude* distinction for the PhD thesis and defense (January 2009).
- Best presentation in session, double award received at the *2004 IEEE-TTTC International Conference on Automation, Quality and Testing, Robotics (AQTR-04)*.
- Graduated postgraduate studies and dissertation with maximum grade, TU Cluj-Napoca, Romania, 2004.
- Graduated valedictorian (first among more than 120 students) MSc studies and thesis, TU Cluj-Napoca, Romania, 2003.
- Study scholarship throughout MSc and postgraduate studies (1998-2004).

International activities

Extended research visits

- Sept. – Dec. 2010: INRIA SequeL Lille, France, Dr. R. Munos.
Topic: *Optimal control for stochastic systems*.
- May – Jun. 2007: Supélec Rennes, France, Dr. D. Ernst.
Topic: *Dynamic programming and policy search with adaptive approximation*.

International academic cooperations

- 2009 – ongoing: Dr. R. Munos and dr. M. Ghavamzadeh, at INRIA SequeL Lille, France.
Multiple topics in *Approximate reinforcement learning and dynamic programming*.
- 2007 – ongoing: E. Schuitema and Prof.dr. P. Jonker, TU Delft, the Netherlands.
Topic: *Reinforcement learning for robotics*.
- 2006 – ongoing: Dr. D. Ernst, FRS-FNRS and University of Liège, Belgium.
Multiple topics in *Approximate reinforcement learning and dynamic programming*.
- 2006: Dr. M. Jitea, Univ. of Agricultural Sciences and Veterinary Medicine Cluj, Romania.
Topic: *Optimizing technological changes in farms*.
- 2005: Dr. X. Meng, Changchun Institute of Technology, China.
Topic: *Multi-agent reinforcement learning*.

Invited talks

- 1 Oct. 2010: *Approximate Dynamic Programming and Reinforcement Learning*, team SequeL, INRIA Lille, France.
- 24 Sept. 2010: *Efficient Reinforcement Learning for Control*, Systems and Modeling group, University of Liège, Belgium.
- 27 May 2010: *Reinforcement Learning for Control*, invited tutorial at the 2010 IEEE International Conference on Automation, Quality and Testing, Robotics, Cluj-Napoca, Romania.
- 26 Jan. 2010: *Fast Online Reinforcement Learning*, Interactive Collaborative Information Systems “Final Event”, Delft, the Netherlands.
- 2 May 2007: *Fuzzy Approximation for Continuous-State Reinforcement Learning*, Supélec Rennes, France.

L. Buşoniu has attended more than 15 scientific conferences, has given more than 25 presentations at scientific conferences and meetings (see also the List of publications), and has coauthored several colloquia and lectures.

Teaching and advising activities

Teaching

- 2005 – ongoing: Assistant and co-lecturer, DCSC, TU Delft, the Netherlands.
MSc course *Knowledge-Based Control Systems*.
Principal developer and coordinator of MATLAB and literature assignments, developing and coordinating lectures on reinforcement learning and exams, guiding students.
- 2003 – 2005: Teaching assistant, Automation Dept., TU Cluj-Napoca, Romania.
MSc courses *Computer-Aided Design in Control Engineering* and *Reliability and Diagnosis*.
Postgraduate course *Visual C++. Programming the Interface of Windows Applications*.
Developing and teaching practical classes; assisting exams.
- 2002: High-school lectures in *Electronics*, during MSc studies, part of a teaching module that also included taking courses on Teaching Methods, Pedagogy, and Educational Psychology.
Lecture planning and development; lecturing.

PhD, MSc, and BSc projects advising

L. Buşoniu has or is co-advising 1 PhD student, 6 MSc students (2 graduated *cum laude*), and 6 BSc students, see www.dcsc.tudelft.nl/~lbusoniu/projects.php for details. He has also served on 6 MSc defense committees.

Project involvement

- 2005 – 2010: *Interactive Collaborative Information Systems (ICIS)*, a major project funded by the BSIK program of the Dutch government and comprising a consortium of academic, research, and industrial institutions. See www.icis.decis.nl.
Research and executive reporting, actively participating and presenting progress in project meetings and public project events, interacting with the project team.
- 2004: *Intelligent Agents and Multi-Agent Systems in the Teleoperation and Control of a Cascade of Hydroelectric Power Plants (AGENTEL)*, funded by the Informational Society program of the Romanian Ministry of Education and Research.
Contributing to the grant proposal and project planning; project meetings.

Academic service

- Organizer of special session *Active reinforcement learning*, within the 2011 IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning.
- Program Committee member for:
 - 2011 IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning
 - 2011 International Joint Conference on Autonomous Agents and Multiagent Systems
 - 2010 IEEE International Conference on Automation, Quality and Testing, Robotics
- Chair of the *Control Systems* session, 2010 IEEE International Conference on Automation, Quality and Testing, Robotics.
- Reviewer for leading scientific journals and magazines, including *Automatica*; *Control Engineering Practice*; *Journal of Artificial Intelligence Research*; *Machine Learning*; *IEEE Transactions on Fuzzy Systems*, on *Systems, Man, and Cybernetics*, on *Vehicular Technology*; *Neurocomputing*; *IEEE Communications Magazine*; etc.

- Reviewed papers for more than 10 prestigious international conferences, including IFAC World Congress, IEEE World Congress on Computational Intelligence, International Conference on Adaptive Agents and Multi-Agent Systems, etc.
- Made freely available Matlab toolboxes for *Approximate Reinforcement Learning and Dynamic Programming*, and *Multi-Agent Reinforcement Learning*.
See www.dcsc.tudelft.nl/~lbusoniu/repository.php.
- Participated in the *Multi-agent systems* working group, DCSC, TU Delft.
- Served on interview and selection committees for PhD and postdoctoral candidates.
- Attracted a research visit of a foreign PhD student to DCSC, TU Delft.

Special courses attended

- 2009, 2010: Courses on obtaining research funding, including FP7 Marie Curie grants, FP7 ERC Starting grants, and Netherlands Organisation for Scientific Research (NWO) grants.
- Apr. 2010: *Education Techniques of the Theater*, a course on presentation techniques for academic content, within the *Basic Teaching Qualification* program of TU Delft.
- 29 Aug. – 1 Sept. 2005: *Advanced Issues in Neurocomputing*, a course of the *Advanced School for Computing and Imaging*, the Netherlands.

Other skills and interests

- Foreign languages: French (good comprehension, basic speaking), fluent English.
- English language score C2 (maximum, “Proficient”) on the Common European Framework of Reference scale, granted by TU Delft on 12 Jun. 2007.
- Programming, professionally and also as a hobby: knowledge of MATLAB, Java, C/C++, client- and server-side web scripting and markup languages (HTML, CSS, JavaScript, PHP), as well as basic knowledge of a number of other programming languages.
- Computer skill highlights: knowledge of Windows, Linux operating systems, LaTeX document preparation system, Corel graphics suite.
- Hobbies: reading, cinema, mountain hiking, technology (particularly mobile computing).

References

Available upon request.

List of publications

Books

1. L. Buşoniu, R. Babuška, B. De Schutter, and D. Ernst, “Reinforcement Learning and Dynamic Programming Using Function Approximators”. Taylor & Francis CRC Press, *Automation and Control Engineering Series*. April 2010, 280 pages, ISBN 978-1439821084.

Journal papers

5. Sander Adam, L. Buşoniu, and R. Babuška, “Experience Replay for Real-Time Reinforcement Learning Control”, provisionally accepted for *IEEE Transactions on Systems, Man, and Cybernetics—Part C: Applications and Reviews*, 2011.
4. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Cross-Entropy Optimization of Control Policies with Adaptive Basis Functions”, published online, to appear in *IEEE Transactions on Systems, Man, and Cybernetics—Part B: Cybernetics*, 2010.
3. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Approximate Dynamic Programming with a Fuzzy Parametrization”, *Automatica*, vol. 46, no. 5, pages 804–814, 2010.
2. L. Buşoniu, R. Babuška, and B. De Schutter, “A Comprehensive Survey of Multi-Agent Reinforcement Learning”. *IEEE Transactions on Systems, Man, and Cybernetics—Part C: Application and Reviews*, vol. 38, no. 2, pages 156–172, 2008. **Recipient of the 2009 Andrew P. Sage Award for the best paper published annually in the IEEE Transactions on Systems, Man and Cybernetics.**
1. X. Meng, R. Babuška, Y. Chen, and L. Buşoniu, “Multiagent Reinforcement Learning Algorithm Research Based on Non-Markov Environment”. *International Journal of Information Technology*, vol. 12, no. 6, pages 60–68, 2006.

Contributions to books

3. L. Buşoniu, R. Babuška, and B. De Schutter, “Multi-Agent Reinforcement Learning: An Overview”. In *Innovations in Multi-Agent Systems and Applications*, D. Srinivasan and L. Jain, Editors, series *Studies in Computational Intelligence*, vol. 310, pages 183–221. Springer, 2010.
2. L. Buşoniu, B. De Schutter, and R. Babuška, “Approximate Dynamic Programming and Reinforcement Learning”. In *Interactive Collaborative Information Systems*, R. Babuška and F.C.A. Groen, Editors, series *Studies in Computational Intelligence*, vol. 281, pages 3–44. Springer, 2010.
1. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Continuous-State Reinforcement Learning with Fuzzy Approximation”. In *Adaptive Agents and Multi-Agent Systems III*, K. Tuyls, A. Nowé, Z. Guessoum, D. Kudenko, Editors, series *Lecture Notes in Computer Science*, vol. 4865, pages 27–43. Springer, 2008.

Conference papers

17. E. Schuitema, L. Buşoniu, R. Babuška, P. Jonker, “Control Delay in Reinforcement Learning for Real-Time Dynamic Systems: A Memoryless Approach”. *Proceedings 2010 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS-10)*, pages 3226–3231, Taipei, Taiwan, 18–22 October 2010.
16. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Online Least-Squares Policy Iteration for Reinforcement Learning Control”. *Proceedings 2010 American Control Conference (ACC-10)*, pages 486–491, Baltimore, US, 30 June – 2 July 2010.
15. L. Buşoniu, B. De Schutter, R. Babuška, and D. Ernst, “Using Prior Knowledge to Accelerate Online Least-Squares Policy Iteration”. *Proceedings 2010 IEEE International Conference on*

- Automation, Quality and Testing, Robotics (AQTR-10)*, Cluj-Napoca, Romania, 28–30 May 2010.
14. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Policy Search with Cross-Entropy Optimization of Basis Functions”. *Proceedings 2009 IEEE International Symposium on Adaptive Dynamic Programming and Reinforcement Learning (ADPRL-09)*, pages 153–160, Nashville, US, 30 March – 2 April 2009.
 13. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Fuzzy Partition Optimization for Approximate Fuzzy Q-iteration”. *Proceedings 17th IFAC World Congress (IFAC-08)*, pages 5629–5634, Seoul, Korea, 6–11 July 2008.
 12. X. Yuan, L. Buşoniu, and R. Babuška, “Reinforcement Learning for Elevator Control”. *Proceedings 17th IFAC World Congress (IFAC-08)*, pages 2212–2217, Seoul, Korea, 6–11 July 2008.
 11. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Consistency of Fuzzy Model-Based Reinforcement Learning”. *Proceedings 2008 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE-08)*, pages 518–524, Hong Kong, 1–6 June 2008.
 10. M. Jitea, M. Valentin, and L. Buşoniu, “Calibrating Tools for Modeling the Technological Changes at the Farm Level”. In *Proceedings 5th International Conference on the Management of Technological Changes*, vol. 2, pages 3–36, Alexandroupolis, Greece, 25–26 August 2007.
 9. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Fuzzy Approximation for Convergent Model-Based Reinforcement Learning”. In *Proceedings 2007 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE-07)*, pages 968–973, London, UK, 23–26 July 2007.
 8. L. Buşoniu, D. Ernst, B. De Schutter, and R. Babuška, “Continuous-State Reinforcement Learning with Fuzzy Approximation”. In *Adaptive Learning Agents and Multi-Agent Systems Symposium (ALAMAS-07)*, pages 21–35, Maastricht, the Netherlands, 2–3 April 2007.
 7. L. Buşoniu, R. Babuška, and B. De Schutter, “Multi-Agent Reinforcement Learning: A Survey”. In *Proceedings 9th International Conference of Control, Automation, Robotics, and Vision (ICARCV-06)*, pages 527–532, Singapore, 5–8 December 2006.
 6. L. Buşoniu, B. De Schutter, and R. Babuška, “Decentralized Reinforcement Learning Control of a Robotic Manipulator”. In *Proceedings 9th International Conference of Control, Automation, Robotics, and Vision (ICARCV-06)*, pages 1347–1352, Singapore, 5–8 December 2006.
 5. L. Buşoniu, B. De Schutter, and R. Babuška, “Multiagent Reinforcement Learning with Adaptive State Focus”. In *Proceedings 17th Belgian-Dutch Conference of Artificial Intelligence (BNAIC-05)*, pages 35–42, Brussels, Belgium, 17–18 October 2005.
 4. X. Meng, R. Babuška, L. Buşoniu, Y. Chen, and W. Tan, “An Improved Multiagent Reinforcement Learning Algorithm”. In *Proceedings 2005 IEEE/WIC/ACM International Joint Conference on Web Intelligence and Intelligent Agent Technology*, pages 337–343, Compiègne, France, 19–22 September 2005.
 3. L. Miclea, L. Buşoniu, Sz. Enyedi, M. Abrudean, I. Stoian, A. Vancea, “Limited-Resource System Testing with Microagent Societies”. In *9th IEEE European Test Symposium (ETS-04)*, Ajaccio, Corsica, France, 23–26 May 2004.
 2. L. Miclea, L. Buşoniu, Sz. Enyedi, “Implementation of a Multiagent DBIST/Distributed Testing Solution”. In *Proceedings 2004 IEEE-TTTC International Conference on Automation, Quality and Testing, Robotics (AQTR-04)*, pages 267–272, Cluj-Napoca, Romania, 13–15 May 2004. Paper presentation received **best presentation in session award**.

1. L. Buşoniu, L. Miclea, Sz. Enyedi, “An Abstract Load-Balancing Architecture for Large Scale Multi-Agent Systems”. In *Proceedings 2004 IEEE-TTTC International Conference on Automation, Quality and Testing, Robotics (AQTR-04)*, pages 239–244, Cluj-Napoca, Romania, 13–15 May 2004. Paper presentation received **best presentation in session award**.

Theses and dissertations

3. L. Buşoniu, “Reinforcement Learning in Continuous State and Action Spaces”, PhD thesis, Delft University of Technology, 190 pages, ISBN 978-90-9023754-1, November 2008.
2. L. Buşoniu, “MicroJava Agents in Testing”, postgraduate studies dissertation, Technical University of Cluj-Napoca, Romania, June 2004.
1. L. Buşoniu, “Multi-Agent Systems in Distributed Built-In Self-testing and Distributed Testing”, MSc thesis, Technical University of Cluj-Napoca, Romania, June 2003.

Technical reports

1. L. Buşoniu, B. De Schutter, R. Babuška, “Learning and Coordination in Dynamic Multi-Agent Systems”. Technical report number 05-019, Delft Center for Systems and Control, Delft University of Technology, the Netherlands, October 2005.

Abstracts

3. M. Vaandrager, R. Babuška, L. Buşoniu, and G. Lopes, “Model-Based Imitation for Learning Control”. *Philips Conference on Applications of Control Technology (PACT-09)*, pages 83–87, 3–4 February 2009, Hilvarenbeek, the Netherlands.
2. L. Buşoniu, B. De Schutter, and R. Babuška, “Fuzzy Approximation in Continuous-Space Reinforcement Learning”, *26th Benelux Meeting on Systems and Control (Benelux-07)*, 13–15 March 2007, Lommel, Belgium.
1. L. Buşoniu, B. De Schutter, and R. Babuška, “Learning in Multi-Agent Systems: A Survey”, *25th Benelux Meeting on Systems and Control (Benelux-06)*, 13–15 March 2006, Heeze, the Netherlands.