

CURRICULUM VITAE

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Education

Doctor of Philosophy in Computer Science, University of Texas at Austin, 2003.

Bachelor of Arts in Geography, Clark University, Worcester, MA, 1991.

Professional Positions

Postdoctoral Researcher, Dalle Molle Institute for Artificial Intelligence, April 2004 - December 2007.

Researcher on the European project: “From Reactive to Anticipatory Cognitive Embodied Systems” (**Mind RACES**), 2004-2007.

Senior Researcher, Dalle Molle Institute for Artificial Intelligence, January 2007 - August 2014.

Co-Founder and CEO of NNAISENSE S.A. since September 2014.

Research Summary

My research has focused on using artificial evolution to automatically design recurrent neural network (RNN) controllers for reinforcement learning tasks. RNNs can implement a kind of short-term memory that allows controllers to take actions based on their entire history of inputs, not just the most recent ones. Evolving these networks avoids many of the problems associated with training them by conventional means, and allows them to be used in tasks where the correct output of the network at each point in time is not known in advance.

This general approach can potentially provide a way to solve complex real-world control problems in areas such as aerospace and autonomous robotics where it is often too difficult to design effective controllers by conventional engineering methods. In addition to developing algorithms that can solve such tasks, I am also interested in studying techniques for making evolved controllers robust so that they can successfully make the transition from simulation to the real world, and therefore actually be useful in industry.

Grants and Projects

Principal Investigator for Swiss National Science Foundation grant (120061): “Advanced Cooperative NeuroEvolution for Unsupervised Learning and Autonomous Control” (**EVOCMP**), starting March 2008, for one PhD Student.

Principal Investigator for Swiss National Science Foundation grant (137736): “Advanced Cooperative NeuroEvolution for Autonomous Control” (**ACNEAC**), starting October 2011, for one PhD Student.

Co-author for the Swiss National Science Foundation project (CRSIKO_122697/1): “State Representation in Reward-Based Learning - from Spiking Neuron Models to Psychophysics” (**Sinergia**). March 2009 - March 2012.

Co-author for the large-scale integrating European Project (231722): “Intrinsically Motivated Cumulative Learning Versatile Robots” (**IM-CLeVeR**). February 2009 - February 2013.

Co-author for the European STREP Project (2315760): “Enhancing Biomorphic Agility through Variable Stiffness” (**STIFF**). February 2009 - February 2012.

Co-author for the European STREP Project (231453): “Humanoids that Learn Socio-Communicative Skills by Observation” (**HUMANOBS**). February 2009 - February 2012.

Co-author for the European FET Project (317662): “NANoScale Engineering for Novel Computation using Evolution” (**NASCENCE**). November 2012 - February 2015.

Publications

1. Rupesh Kumar Srivastava, Jonathan Masci, Faustino Gomez, and Juergen Schmidhuber (2015). Understanding Locally Competitive Networks. In *Proceedings of Internatinoal Conference on Learning Representations (ICLR)*.
2. Marijn Stollenga, Jonathan Masci, Faustino Gomez, and Juergen Schmidhuber (2014). Deep Networks with Internal Selective Attention through Feedback Connections. In *Proceedings of Neural Information Processing Systems (NIPS)*.
3. Jan Koutnik, Juergen Schmidhuber and Faustino Gomez (2014). Online Evolution of Deep Convolutional Network for Vision-Based Reinforcement Learning. In *Proceedings of the Simulation of Adaptive Behavior Conference (SAB, Castellon, ES)*.
4. Marijn Stollenga, Juergen Schmidhuber, and Faustino Gomez (2014). Rapid Humanoid Motion Learning through Coordinated, Parallel Evolution. In *Proceedings of the Simulation of Adaptive Behavior Conference (SAB, Castellon, ES)*.
5. Jan Koutnik, Juergen Schmidhuber, and Faustino Gomez (2014). Evolving Deep/Recurrent Networks for Reinforcement Learning. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO, Vancouver, CA)*.
6. Jan Koutnik, Klaus Greff, Faustino Gomez, Juergen Schmidhuber (2014). A Clockwork RNN. In *Proceedings of the International Conference on Machine Learning (ICML, Beijing)*.

7. Rupesh Kumar Srivastava, Jonathan Masci, Sohrab Kazerounian, Faustino Gomez, and Juergen Schmidhuber (2013). Compete to Compute. In *Proceedings of Neural Information Processing Systems* (NIPS, Lake Tahoe).
8. Jan Koutnik, Giuseppe Cuccu, Juergen Schmidhuber, and Faustino Gomez (2013). Evolving Large-Scale Neural Networks for Vision-Based TORCS. In *Foundations of Digital Games* (FDG, Chania, Crete).
9. Yi Sun, Faustino Gomez, Tom Schaul, and Juergen Schmidhuber (2013). A Linear Time Natural Evolution Strategy for Non-Separable Functions. In *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO, Amsterdam),
10. Jan Koutnik, Giuseppe Cuccu, Juergen Schmidhuber, and Faustino Gomez (2013). Evolving Large-Scale Neural Networks for Vision-Based Reinforcement Learning. In *Proceedings of the Conference on Genetic and Evolutionary Computation* (GECCO, Amsterdam).
11. Jan Koutnik, Giuseppe Cuccu, Juergen Schmidhuber, and Faustino Gomez (2013). Evolving Large-Scale Neural Networks for Vision-Based TORCS. In *Proceedings Foundations of Digital Games* (FDG, Chania, Crete, GR).
12. Faustino Gomez (2012). Scalable Neuroevolution for Reinforcement Learning. Invited Talk. In *Proceedings 1st International Conference on the Theory and Practice of Natural Computing* (TPNC, Chania, Tarragona, Spain).
13. Faustino Gomez, Jan Koutnik, and Juergen Schmidhuber (2012). Compressed Network Complexity Search. In *Proceedings of the 12th International Conference on Parallel Problem Solving from Nature* (PPSN XII, Taormina, IT).
14. Rupesh Kumar Srivastava, Juergen Schmidhuber, and Faustino Gomez (2012). Generalized Compressed Network Search. In *Proceedings of the 12th International Conference on Parallel Problem Solving from Nature* (PPSN XII, Taormina, IT).
15. Giuseppe Cuccu and Faustino Gomez (2012). Block Diagonal Natural Evolution Strategies. In *Proceedings of the 12th International Conference on Parallel Problem Solving from Nature* (PPSN XII, Taormina, IT).
16. Yi Sun, Faustino Gomez, and Juergen Schmidhuber (2012). On the Size of the Online Kernel Sparsification Dictionary. In *Proceedings of the International Conference on Machine Learning* (ICML, Edinburgh).
17. Rupesh Kumar Srivastava, Juergen Schmidhuber, Faustino Gomez (2012). Generalized Compressed Network Search. In *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-12, Philadelphia).
18. Faustino Gomez, Jan Koutnik, and Juergen Schmidhuber (2012). Complexity Search for Compressed Neural Networks. In *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-12, Philadelphia).
19. Yi Sun, Faustino Gomez, and Juergen Schmidhuber (2011). Optimal Bayesian Exploration in Dynamic Environments. In *Proceedings of the Artificial General Intelligence* (AGI, Mountainview, CA).

20. Yi Sun, Faustino Gomez, Mark Ring, and Juergen Schmidhuber (2011). Incremental Basis Construction from Temporal Difference Error. In *Proceedings of the International Conference on Machine Learning (ICML, Bellevue, WA)*.
21. Leo Pape, Faustino Gomez, Mark Ring and Juergen Schmidhuber (2011). Modular Deep Belief Networks that do not Forget. In *Proceedings of the International Joint Conference on Neural Networks (IJCNN, San Jose, CA)*.
22. Tom Schaul, Yi Sun, Daan Wierstra, Faustino Gomez, and Juergen Schmidhuber (2011). Curiosity-Driven Optimization. In *Proceedings of the IEEE Congress on Evolutionary Computation (CEC, New Orleans)*.
23. Giuseppe Cuccu, Faustino Gomez, and Tobias Glasmachers (2011). Novelty Restarts for Evolutionary Strategies. In *Proceedings of the IEEE Congress on Evolutionary Computation (CEC, New Orleans)*.
24. Giuseppe Cuccu and Faustino Gomez (2011). When Novelty is Not Enough. In *Proceedings of Evostar 2011 (Turin, Italy)*.
25. Sun Yi, Faustino Gomez, and Juergen Schmidhuber (2010). Improving Asymptotic Performance of Markov Chain Monte-Carlo by Inserting Vortices. In *Advances in Neural Information Processing Systems (NIPS)*.
26. Jan Koutnik, Faustino Gomez, and Juergen Schmidhuber (2010). Evolving Neural Networks in Compressed Weight Space. In *Proceedings of the Conference on Genetic and Evolutionary Computation (GECCO-10, Portland, OR)*.
27. Jan Koutnik, Faustino Gomez, and Juergen Schmidhuber (2010). Searching for Minimal Neural Networks in Fourier Space. In *Proceedings of the Third Conference on Artificial General Intelligence (AGI-10, Lugano, Switzerland)*.
28. Faustino Gomez, Julian Togelius, and Juergen Schmidhuber (2009). Measuring and Optimizing Behavioral Complexity. In *Proceedings of the International Conference on Artificial Neural Networks (ICANN-09, Lamissol, Cyprus)*.
29. Faustino Gomez (2009). Sustaining Diversity using Behavioral Information Distance. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-09, Montreal)*. Nominated for Best Paper in Artificial Life, Evolutionary Robotics, Adaptive Behavior, and Evolvable Hardware.
30. Juergen Schmidhuber, Faustino Gomez, Alex Graves, and Sepp Hochreiter (to appear 2010). *Recurrent Neural Networks for Sequence Learning* (book). Cambridge University Press.
31. Assigned author for the Evolutionary Reinforcement Learning chapter of the Encyclopedia of Machine Learning project (<http://refworks.springer.com/ML/>).
32. Julian Togelius, Tom Schaul, Juergen Schmidhuber, and Faustino Gomez (2008). Countering Poisonous Inputs with Memetic Neuroevolution. In *Proceedings of the International Conference on Parallel Problem Solving From Nature (PPSN-08, Dortmund)*.
33. Hermann Mayer, Faustino Gomez, Daan Wierstra, Istvan Nagy, Alois Knoll, and Juergen Schmidhuber (2008). A System for Robotic Heart Surgery that Learns to Tie Knots using Recurrent Neural Networks. *Advanced Robotics*, 22(13-14), pp 1521-1537.

34. Faustino Gomez, Juergen Schmidhuber and Risto Miikkulainen (2008). Accelerated Neural Evolution through Cooperatively Coevolved Synapses. *Journal of Machine Learning Research*, 9(May), pp 937-965.
35. Julian Togelius, Faustino Gomez, and Juergen Schmidhuber (2008). Learning What to Ignore: Memetic Climbing in Topology and Weight Space. *Congress on Evolutionary Computation* (CEC-08, Hong Kong).
36. Faustino Gomez, Juergen Schmidhuber, and Risto Miikkulainen (2006). Efficient Non-Linear Control through Neuroevolution. In *Proceedings of the European Conference on Machine Learning* (ECML-06, Berlin).
37. Hermann Mayer, Faustino Gomez, Daan Wierstra, Istvan Nagy, Alois Knoll, and Juergen Schmidhuber (2006). A System for Robotic Heart Surgery that Learns to Tie Knots Using Recurrent Neural Networks. In *Proceedings of the International Conference on Intelligent Robotics and Systems* (IROS-06, Beijing). Best Paper Finalist.
38. Juergen Schmidhuber, Daan Wierstra, Matteo Gagliolo, and Faustino Gomez (2006). Training Recurrent Neural Networks by Evolino. In *Neural Computation* 19(3).
39. Alex Graves, Santiago Fernandez, Faustino Gomez, and Juergen Schmidhuber (2006). Connectionist Temporal Classification: Labeling Unsegmented Sequence Data with Recurrent Neural Networks. In *Proceedings of the International Conference on Machine Learning* (ICML-06, Pittsburgh).
40. Juergen Schmidhuber, Matteo Gagliolo, Daan Wierstra, and Faustino Gomez (2006). Evolino for Recurrent Support Vector Machines. In *Proceedings of the European Symposium on Artificial Neural Networks* (ESANN-06, Bruges).
41. Viktor Zhumatiy, Faustino Gomez, Marcus Hutter, and Juergen Schmidhuber (2006). Metric State Space Reinforcement Learning for a Vision-Capable Mobile Robot. In *Proceedings of the International Conference on Intelligent Autonomous Systems* (IAS-06, Tokyo).
42. Faustino Gomez and Juergen Schmidhuber (2005). Evolving Modular Fast-Weight Networks for Control. In *Proceedings of the International Conference on Artificial Neural Networks* (ICANN-05, Warsaw).
43. Faustino Gomez and Juergen Schmidhuber (2005). Co-Evolving Recurrent Neurons Learn Deep Memory POMDPs. In *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-05, Washington, D.C.). Nominated for Best Paper in Coevolution.
44. Daan Wierstra, Faustino Gomez, and Juergen Schmidhuber (2005). Modeling Systems with Internal State using Evolino. In *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-05, Washington, D.C.). **Winner of Best Paper Award in Learning Classifier Systems and Other Genetics-Based Machine Learning.**
45. Juergen Schmidhuber, Daan Wierstra, and Faustino Gomez (2005). Evolino: Hybrid Neuroevolution / Optimal Linear Search for Sequence Learning. In *Proceedings of the International Joint Conference on Artificial Intelligence* (IJCAI-05, Edinburgh).
46. Faustino Gomez and Risto Miikkulainen (2004). Transfer of Neuroevolved Controllers in Unstable Domains. In *Proceedings of the Genetic and Evolutionary Computation Conference* (GECCO-04, Seattle).

47. Faustino Gomez (2003). Robust Non-Linear Control through Neuroevolution. PhD Thesis. AI-TR-03-303, Department of Computer Sciences, University of Texas at Austin.
48. Faustino Gomez and Risto Miikkulainen (2003). Active Guidance for a Finless Rocket through Neuroevolution. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-03, Chicago)*. **Winner of Best Paper Award in Real World Applications.**
49. Faustino Gomez, Doug Burger, and Risto Miikkulainen (2001). A Neuroevolution Method For Dynamic Resource Allocation On A Chip Multiprocessor, In *Proceedings of the International Joint Conference on Neural Networks (IJCNN-01, Washington DC)*.
50. Faustino Gomez and Risto Miikkulainen (1999). Solving Non-Markovian Control Tasks with Neuroevolution. In *Proceedings of the International Joint Conference on Artificial Intelligence (IJCAI-99, Stockholm, Sweden)*, Denver: Morgan Kaufmann.
51. Faustino Gomez and Risto Miikkulainen (1998). 2-D Pole Balancing with Recurrent Evolutionary Networks. In *Proceedings of the International Conference on Artificial Neural Networks (ICANN-98, Skovde, Sweden)*, 425-430. Berlin, New York: Springer.
52. Faustino Gomez and Risto Miikkulainen (1997). Incremental Evolution of Complex General Behavior, *Adaptive Behavior*, 5:317-342.

Teaching

Intelligent Systems course for 6 years (Fall 2007, 2009–2013) as part of the Masters of Science program in Informatics at the University of Lugano (USI).

Co-supervised and mentored 13 PhD students (of which 5 have graduated so far), 9 post-doctoral research during my tenure at IDSIA.

Awards

Best Paper Finalist at the International Conference on Intelligent Robotics and Systems (IROS-06) for “A System for Robotic Heart Surgery that Learns to Tie Knots using Recurrent Neural Networks.”

Winner of Best Paper Award in Learning Classifier Systems and Other Genetics-Based Machine Learning at the Genetic and Evolutionary Computation Conference (GECCO-05) for “Modeling Systems with Internal State using Evolino.”

Winner of Best Paper in Real World Applications at the Genetic and Evolutionary Computation Conference (GECCO-03) for ”Active Guidance for a Finless Rocket through Neuroevolution.”

Journal Review

Neural Network (Action Editor)

Neural Computation

IEEE Systems, Man, and Cybernetics

IEEE Transactions on Evolutionary Computation

Swarm Intelligence

Evolutionary Computation

Journal of Machine Learning Research

Software

ESP C++ package. Implementation of the Enforced SubPopulations algorithm available at:
<http://nn.cs.utexas.edu/soft-list.php>

CoSyNE C++ package. Implementation of the Cooperative Synapse NeuroEvolution algorithm.