Georgios Is. Detorakis (GID), PhD

Contact Information

Machine Learning Engineer
Independent Researcher
Irvine, CA, USA

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Research Interests

Computational Neurosciences and Machine Learning: Machine learning algorithms with applications on time-series analysis and forecasting. Brain-machine interfaces with applications in neurodegenerative disorders (Parkinson's disease). Self-organization and attention mechanisms. Cortical plasticity, memory and learning. Neuromorphic computing. **Evolutionary Computing:** Genetic algorithms, island models and applications in the context of machine learning and neuroscience.

Professional Experience

Independent Contractor, Irvine (CA), USA

Machine Learning Engineer **December 2020–Now**

- Develop machine learning algorithms with applications on time series analysis and forecasting.
- Deploy time series forecasting machine learning algorithms.

adNomus Inc., Santa Clara, CA, USA

Data Science Architect **August 2019–Now**

- Developed NLP algorithms with applications in context analysis.
- Analyzed behavioral data.
- Used machine and deep Learning algorithms for time-series prediction.

Academic Appointments

Postdoctoral Researcher **January 2016 – July 2019**

Neuromorphic Machine Intelligence Lab, University of California Irvine

- Research in stochastic deep neural networks.
- Developed a neuromorphic framework (https://github.com/nmi-lab/NSAT).
- Developed machine learning algorithms for neuromorphic devices.
- Co-developed algorithms for Brain-Machine Interface using machine learning and neuromorphic devices.
- Integrated neuromorphic sensors (DVS camera) with neuromorphic frameworks.

Postdoctoral Researcher **December 2013 – December 2015**

Laboratoire des signaux et systèmes, Supélec, University Paris Sud

- Developed a mathematical model (neural fields with time delays) and a closed-loop simulation for Parkinson's disease treatment.
- Conducted theoretical work on non-linear retarded dynamical systems in a closed-loop setup.
- Co-developed software for spike-sorting (https://github.com/gdetor/SPySort).
- Developed Matlab software for on-line data processing on a Plexon recording device.

Education

The University of Lorraine, Lorraine, France

Ph.D., INRIA Nancy Grand-Est, **October 2010 – October 2013**

- Thesis Topic: *Cortical plasticity, dynamic neural fields and self-organization*.
- Adviser: Dr. Nicolas P. Rougier
- Area of Study: Computational Neuroscience.

The University of Crete, Heraklion, Hellas

M.Sc., Faculty of Medicine, **January 2007 – January 2009**

- Interdisciplinary two-years graduate program in "Brain & Mind Sciences".
- Area of Study: Neuroscience.

B.Sc., Department of Applied Mathematics, **September 2002 – September 2006**

- Four years undergraduate program.
- Specialization in mathematical methods and software development.

Travel Grants

- Federation of European Neuroscience Societies (FENS), Regional Meeting 2015, Thessaloniki, Greece (€500).
- Organization for Computational Neurosciences, CNS 2013 Annual Meeting, Paris, France ($ 200).

Student Advising

- Supervised undergraduate students' projects in Engineering on oculomotor control, Centrale-Supélec, Gif-sur-Yvette, France.
  Primary adviser: Prof. Antoine Chaillet.
- Supervised a postgraduate (M.Sc.) internship student working on sensorimotor integration at INRIA Nancy Grand-Est, Lorraine, France.
  Primary adviser: Dr. Nicolas P. Rougier.

Teaching Experience

Supélec, Gif-sur-Yvette, France

Guest Instructor for a crash course in Python. **March 2014 – April 2014**

- Introduction to the Python Programming Language, Numpy, Scipy, and Matplotlib packages.

The University of Crete, Heraklion, Hellas

Teaching Assistant **Spring Semester 2006**

- TEM 202: Undergraduate Algorithms' Theory.
- Instructor: Prof. M. Karavelas.
- Course tutoring.

Professional Service

Editorial Service

- The ReScience Journal
- Frontiers in Neuroscience–Neuromorphic Engineering

Workshop Service

- Co-organizer (with Prof. Antoine Chaillet) of a workshop on: "Neural Population Dynamics", Supélec, Gig-sur-Yvette, February 2015.

Research Experience

INRIA - Nancy Grand Est, Nancy, France
CORTEX Team

Research Assistant in Computational Neuroscience **October 2010 – October 2013**

- Developed algorithms for self-organizing maps.
- Developed a mathematical model for the development of the somatosensory cortex.
- Studied attention mechanisms in the somatosensory cortex.
- Reproduced an *in vivo* experiment *in silico* to study self-organization in the brain.

FORTH, Heraklion, Hellas
Computational Vision and Robotics Laboratory

Research Intern in Robotics **May 2008 – October 2008**

- Configuration and calibration of a HOAP3 humanoid robot.
- Applied biped locomotion algorithms on a HOAP3 robotic platform.

The University of Crete - Faculty of Medicine, Heraklion, Hellas
Laboratory of Systems Physiology and Computational Neuroscience

Research Intern in Systems Neuroscience **October 2007 – April 2008**

- Conducted EMG and EEG experiments for studying human tremor.
- EMG and EEG recordings, data processing and analysis.
- Software development for signal processing.
- Computational simulations of motor units.

Other Meeting Attendance

General Participant

- Workshop on *Neuromorphic Cognition Engineering*, Telluride, Colorado (USA), 2017.
- Summer school on *Neural Dynamics Approach to Cognitive Robotics III - A Hands–on*, Bochum (Germany), 2012.

Software

Software with applications in Neuromorphic Systems:

- **NSAT** A C/Python simulator for the Neural an Synaptic Array Transceiver (NSAT) neuromorphic framework (https://github.com/nmi-lab/NSAT).
- **NSATcarl** A C++ interface of CARLsim (http://www.socsci.uci.edu/~jkrichma/CARLsim/) with a neuromorphic framework (https://github.com/gdetor/CarlNsat).

Software with applications in Neuroscience:

- **Crebral** A simple C/Python simulator for conductance-based neural networks (https://github.com/gdetor/Crebral).
- **SPySort** A Python package for spike sorting (https://github.com/gdetor/spysort).
- **SI-RF-Structure** A collection of Python scripts that implement algorithms and experimental protocols for simulating area 3b of primary somatosensory cortex (https://github.com/gdetor/SI-RF-Structure).
- **SITopMaps** A Python/C implementation of self-organizing maps with applications on self-organization of area 3b of primary somatosensory cortex (https://github.com/gdetor/SITopMaps).

Software with applications in Optimization:

- **GAIM** A C++ library for Genetic Algorithms and Island Models (https://gitlab.com/gdetor/genetic_alg).

Communication Skills

Languages:

- Greek – native language,
- English – full professional proficiency,
- French – intermediate working proficiency,
- German – elementary proficiency.

Software Skills

Programming:

- C, C++, Python, Rust, Fortran, Java, Pascal, UNIX shell scripting, GNU make, SQL, Matlab/Octave, Maple, HTML.
- CSS, Bootstrap.
- Scikit-learn, LAPACK/BLAS, Sundials, OpenMP, OpenCV, Nvidia CUDA, MPI, FEniCS.

Deep Learning Frameworks:

- PyTorch, TensorFlow.

Natural Language Processing Frameworks:

- spaCy.

Simulators:

- Brian, Neuron (Python).

Version Control and Software Configuration Management:

- Git and SVN.

Devops:

- Gitlab CI/CD configuration.

Desktop Editing and Productivity Software:

- Vim, TEX (LATEX, BibTEX, Tikz), Microsoft Office, Graphviz, GIMP, Inkscape, Scribus.

Operating Systems:

- Linux and BSD, Microsoft Windows family, Apple OS X.

Recording Techniques

Noninvasive:

- Electroencephalography (EEG) – Conducted EEG recordings using an 18-electrodes portable EEG device.

Invasive:
- Extracellular recordings – Set up, calibration and software development on a Plexon Recording Device.
- Electromyography (EMG) – Conducted muscle force and motor units (MUs) activity recordings.

Expertise

Mathematics:
- Linear and Nonlinear Dynamical Systems, Control Theory, Numerical Analysis, Numerical Solutions of PDEs, Linear Algebra, Probabilities Theory, Theory of Systems and Signals, Information Theory, Optimization, and Empirical Dynamic Modeling (EDM).

Computer Science:
- Deep Learning, Machine Learning, Natural Language Processing, Neural Networks, Neuromorphic Computing, Software Development, Evolutionary Computing, Theory of Algorithms, and Topological Data Analysis (TDA).

Neuroscience:
- Systems Neuroscience, Computational Neuroscience, Cognitive Science.

Natural Sciences:
- Neuroanatomy and Neurophysiology.

Talks

[1] "**Biologically plausible contrastive divergence: Towards an abstract complementary learning system**", Hughes Research Laboratory (HRL), Malibu CA (USA), 2017.

[2] "**Closed-loop deep brain stimulation for Parkinson's disease: A computational study**", University of California Irvine, Irvine CA (USA), 2016.

[3] "**Neural Fields 101**", CentraleSupélec, Gif-sur-Yvette (France), 2015.

[4] "**The perception of touch: A computational approach**", Aix Marseille University, Marseille (France), 2014.

[5] "**Coherent 6–10 Hz rhythms in muscle activities-Humanoid Robot & Biped Locomotion-EEG & Time Series Analysis**" in Bernstein Center for Computational Neuroscience, Freiburg (Germany), 2008.

Refereed Journal Publications

[6] N. P. Rougier and **G. Is. Detorakis**, *Randomized Self-Organizing Map*, Neural Computation, 33(8), 2021.

[7] **G. Detorakis**, A. Chaillet, and N.P. Rougier, *Stability analysis of a neural field self-organizing map*, The Journal of Mathematical Neuroscience, 10 (20), 2020.

[8] **G. Detorakis**, and A. Burton, *GAIM: A C++ library for Genetic Algorithms and Island Models*, The Journal of Open Source Software, 4(44), 1839, 2019.

[9] B. U. Pedroni, S. Joshi, S. Deiss, S. Sheik, **G. Detorakis**, S. Paul, C. Augustine, E. Neftci, and G. Cauwenberghs, *Memory-efficient Synaptic Connectivity for Spike-Timing-Dependent Plasticity*, Frontiers in Neuroscience (Neuromorphic Section), 13, 2019.

[10] **G. Detorakis**, T. Bartley and E. Neftci, *Contrastive Hebbian Learning with Feedback Random Weights*, Neural Networks, 114, 2019.

[11] **G. Detorakis**, S. Sheik, C. Augustine, S. Paul, B.U. Pedroni, N. Dutt, J. Krichmar, G. Cauwenberghs, and E. Neftci, *Neural and Synaptic Array Transceiver: A Brain-Inspired Computing Framework for Embedded Learning*, Frontiers in Neuroscience (Neuromorphic section) 12, 2018.

[12] N.P. Rougier, K. Hinsen, [et al., including **Georgios Detorakis**], *Sustainable computational science: the ReScience initiative*, PeerJ Computer Science 3, 2017.

[13] E. Neftci, S. Paul, C. Augustine, **G. Detorakis**, *Event-Driven Random Back-Propagation: Enabling Neuromorphic Deep Learning Machines*, Frontiers in Neuroscience 11, 2017.

[14] A. Chaillet, **G. Is. Detorakis**, S. Palfi and S. Senova, *Robust stabilization of delayed neural fields with partial measurement and actuation*, Automatica 83, 2017.

[15] **G. Is. Detorakis**, A. Chaillet, S. Palfi, and S. Senova, *Closed-loop stimulation of a delayed neural fields model of parkinsonian STN-GPe network: a theoretical and computational study*, Frontiers in Neuroscience, 9:237, 2015.

[16] **G. Is. Detorakis** and N.P. Rougier, *Structure of Receptive Fields in a Computational Model of Area 3b of Primary Sensory Cortex*, Frontiers in Computational Neuroscience, 8(76), 2014.

[17] **G. Is. Detorakis** *Cortical plasticity, dynamic neural fields, and self-organization*, University of Lorraine (Thesis), 2013.

[18] **G. Is. Detorakis** and N.P. Rougier, *A Neural Field Model of the Somatosensory Cortex: Formation, Maintenance and Reorganization of Ordered Topographic Maps*, PLoS ONE 7(7): e40257, 2012.

Reproducible Science (peer-reviewed)

[19] **G. Detorakis**, *[Re] A generalized linear Integrate-and-Fire neural model produces diverse spiking behaviors*, The ReScience Journal, 3:1, 2017.

[20] **G. Is. Detorakis**, *[Re] Multiple dynamical modes of thalamic relay neurons: rhythmic bursting and intermittent phase-locking*, The ReScience Journal, 2:1, 2016.

Conference Publications (peer-reviewed)

[21] **G. Detorakis**, S. Dutta, A. Khanna, B. Grisafe, S. Datta, and E. Neftci, *Inherent Weight Normalization in Stochastic Neural Networks*, accepted for Poster Presentation in NeurIPS (NIPS) Conference, Vancouver, (Canada), 2019.

[22] H. Kashyap, **G. Detorakis**, N. Dutt, J. Krichmar,and E. Neftci, *A Recurrent Neural Network Based Model of Predictive Smooth Pursuit Eye Movement in Primates*, IJCNN, Rio de Janeiro (Brazil), 2018.

[23] **G. Detorakis** and A. Chaillet, *Incremental stability of spatiotemporal delayed dynamics and application to neural fields*, CDC, Melbourne, Australia, 2017.

[24] E. Neftci, C. Augustine, S. Paul, **G. Detorakis**, *Event-Driven Random Backpropagation: Enabling Neuromorphic Deep Learning Machines*, IEEE ISCAS, Baltimore (MD, USA), 2017.

[25] B. U. Pedroni, S. Sheik, S. Joshi, **G. Detorakis**, S. Paul, C. Augustine, E. Neftci, G. Cauwenberghs, *Forward Table-Based Presynaptic Event-Triggered Spike-Timing-Dependent Plasticity*, IEEE BioCAS 2016, Shanghai, China, 2016.

[26] C. Pouzat and **G. Is. Detorakis**, *SPySort: Neural spike sorting with Python*, Proc. of the 7th Eur. Conf. on Python in Science (Euroscipy 2014), Cambridge (UK), 2014.

[27] N.P. Rougier and **G. Is. Detorakis**, *Self-Organizing Dynamic Neural Fields*, Advances in Cognitive Neurodynamics III, 2012.

Book Chapters

[28] A. Chaillet, **G. Is. Detorakis**, S. Palfi, and S. Senova, *ISS-stabilization of delayed neural fields by small-gain arguments*, In: Valmorbida G., Seuret A., Boussaada I., Sipahi R. (eds) Delays and Interconnections: Methodology, Algorithms and Applications. Advances in Delays and Dynamics, 10, Springer, 2019.

International Conferences

[29] H.J. Kashyap, **G. Detorakis**, N. Dutt, J.L. Krichmar, E. Neftci *A neural network model of predictive smooth pursuit eye movement in primates*, SfN, San Diego (CA, USA), 2018.

[30] **G. Detorakis**, T. Bartley, E. Neftci, *Random Contrastive Hebbian Learning as a Biologically Plausible Learning Scheme*, OCNS, Seattle (WA, USA), 2018.

[31] **G. Detorakis**, T. Bartley, R. Parise, S. Sheik, C. Augustine, S. Paul, B. U. Pedroni, N. Dutt, J. Krichmar, G. Cauwenberghs, and E. Neftci, *Three-factor embedded learning on neuromorphic systems*, COSYNE, Denver (CO, USA), 2018.

[32] **G. Detorakis**, T. Bartley, R. Parise, S. Sheik, C. Augustine, S. Paul, B. Pedroni, N. Dutt, J. Krichmar, G. Cauwenberghs and E. Neftci, *Embedded Learning on Neuromorphic Systems: Towards a Unified Computing Framework*, NICE, Portland (OR, USA), 2018.

[33] **G. Detorakis**, T. Bartley, R. Parise, C. Augustine, S. Paul, E. Neftci, *Embedded learning on neuromorphic systems: Towards a unified computing framework*, IEED ICCAD HALO Workshop, 2017.

[34] **G. Detorakis**, D. Barsever, E. Neftci *NeuroLachesis: A Neuromorphic Framework*, Scipy 2017, Austin (TX, USA).

[35] A. Chaillet, **G. Is. Detorakis**, S. Palfi and S. Senova, *Robust stabilization of delayed neural fields by proportional feedback using input-to-state stability and small gain theorem*, ICMNS 2016, Juan-les-Pins, France.

[36] **G. Is. Detorakis** and A. Chaillet, *Closed-loop disruption of oscillations in a targeted frequency band for a delayed neural field STN-GPe model*, FENS Regional Meeting 2015, Thessaloniki (Greece).

[37] **G. Is. Detorakis** and A. Chaillet, *Incremental stability of delayed neural fields: a unifying framework for endogenous and exogenous sources of pathological oscillations*, CNS 2015, Prague (Czech Republic).

[38] **G. Is. Detorakis** and A. Chaillet, *Closed-loop regulation of the activity of delayed neural fields with only partial measurement and stimulation*, ICMNS 2015, Antibes - Juan les Pins (France).

[39] **G. Is. Detorakis** and A. Chaillet and I. Haidar, *A global stability analysis for delayed neural fields*, BCCN 2014, Göttingen (Germany).

[40] **G. Is. Detorakis** and N. P. Rougier, *A computational view of the primary somatosensory cortex*, CNS 2013, Paris (France).

[41] **G. Is. Detorakis**, N. P. Rougier, *Neural Fields and Cortical Plasticity*, Front. Comput. Neurosci. BCCN 2011: Computational Neuroscience and Neurotechnology Bernstein Conference & Neurex Annual Meeting, 2011.

Minor Conferences

[42] **G. Detorakis**, C. Augustine, S. Paul, E. Neftci, *Embedded learning on neuromorphic systems: Towards a unified computing framework*, 24th Joint Symposium on Neural Computation, San Diego (CA, USA), 2017.

[43] C. Pouzat and **G. Is. Detorakis**, *On the relation between neuronal size and extracellular spike amplitude and its consequence on extracellular recordings interpretation*, MathStat-Neuro Workshop, Nice (France), 2015.

[44] C. Pouzat and **G. Is. Detorakis**, *SPySort*, GDR Multielectrode systems and signal processing for Neuroscience, Gif-sur-Yvette (France), 2014.

[45] **G. Is. Detorakis** and N. P. Rougier, *Skin Topographic Maps in SI*, Progress in Neural Field Theory, Reading (UK), 2012.

[46] **G. Is. Detorakis**, N. P. Rougier, *Skin Topographic Maps in SI*, Workshop on Cognitive and Dynamics in Neural Systems: Mathematical and Computational Modeling (CONAS), Lyon (France), 2012.

Popular Science

[47] A. Chaillet, D. Da Silva, **G. Detorakis**, C. Pouzat, S. Senova., “Optogenetics to unravel the mechanisms of Parkinsonian symptoms and to optimize deep brain stimulation”, *ERCIM News, Special issue on cyber-physical systems*, Number 97, April 2014.