

Georgios Is. Detorakis (GID), PhD

Contact Information

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Research Interests

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

Professional Experience

adNomus Inc., Santa Clara, CA, USA

Data Science Architect

August 2019–Now

- Develop NLP algorithms with applications in context analysis.
- Analyze behavioral data.
- Use 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	<ul style="list-style-type: none"> - Supervised two undergraduate students in Engineering, CentraleSupélec, Gif-sur-Yvette, France. Primary adviser: Prof. Antoine Chaillet. - Supervised a postgraduate (M.Sc.) internship student in INRIA Nancy Grand-Est, Lorraine, France. Primary adviser: Dr. Nicolas P. Rougier.
Teaching Experience	<p>Supélec, Gif-sur-Yvette, France</p> <p>Guest Instructor for a crash course in Python. March 2014 – April 2014</p> <ul style="list-style-type: none"> - Introduction to the Python Programming Language, Numpy, Scipy, and Matplotlib packages. <p>The University of Crete, Heraklion, Hellas</p> <p>Teaching Assistant Spring Semester 2006</p> <ul style="list-style-type: none"> - TEM 202: Undergraduate Algorithms' Theory. - Instructor: Prof. M. Karavelas. - Course tutoring.
Professional Service	<p>Workshop Service</p> <ul style="list-style-type: none"> - Co-organizer (with Prof. Antoine Chaillet) of a workshop on: "Neural Population Dynamics", Supélec, Gif-sur-Yvette, February 2015. <p>Editorial Service</p> <ul style="list-style-type: none"> - The ReScience journal
Research Experience	<p>INRIA - Nancy Grand Est, Nancy, France CORTEX Team</p> <p>Research Assistant in Computational Neuroscience October 2010 – October 2013</p> <ul style="list-style-type: none"> - 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 <i>in vivo</i> experiment <i>in silico</i> to study self-organization in the brain. <p>FORTH, Heraklion, Hellas Computational Vision and Robotics Laboratory</p> <p>Research Intern in Robotics May 2008 – October 2008</p> <ul style="list-style-type: none"> - Configuration and calibration of a HOAP3 humanoid robot. - Applied biped locomotion algorithms on a HOAP3 robotic platform. <p>The University of Crete - Faculty of Medicine, Heraklion, Hellas Laboratory of Systems Physiology and Computational Neuroscience</p> <p>Research Intern in Systems Neuroscience October 2007 – April 2008</p> <ul style="list-style-type: none"> - 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	<p>General Participant</p> <ul style="list-style-type: none"> - Workshop on <i>Neuromorphic Cognition Engineering</i>, Telluride, Colorado (USA), 2017. - Summer school on <i>Neural Dynamics Approach to Cognitive Robotics III - A Hands-on</i>, Bochum (Germany), 2012.
Software	<p>Software with applications in Neuromorphic Systems:</p> <ul style="list-style-type: none"> - NSAT A C/Python simulator for the Neural and Synaptic Array Transceiver (NSAT) neuromorphic framework (https://github.com/nmi-lab/NSAT). - NSATcarl A C++ interface of CARLsim (http://www.socsci.uci.edu/~jkrichtma/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, 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.

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, \LaTeX (\LaTeX , Bib \TeX , 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, Linear Algebra, Probabilities Theory, Theory of Systems and Signals, Information Theory, Optimization, and Empirical Dynamic Modeling.

Computer Science:

- Deep Learning, Machine Learning, Natural Language Processing, Neural Networks, Neuromorphic Computing, Software Development, Evolutionary Computing, Theory of Algorithms.

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] **G. Detorakis**, and Andrew Burton, *GAIM: A C++ library for Genetic Algorithms and Island Models*, The Journal of Open Source Software, 4(44), 1839, 2019.
- [7] 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.
- [8] **G. Detorakis**, T. Bartley and E. Neftci, *Contrastive Hebbian Learning with Feedback Random Weights*, Neural Networks, 114, 2019.
- [9] **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.
- [10] N.P. Rougier, K. Hinsén, [et al., including **Georgios Detorakis**], *Sustainable computational science: the ReScience initiative*, PeerJ Computer Science 3, 2017.
- [11] E. Neftci, S. Paul, C. Augustine, **G. Detorakis**, *Event-Driven Random Back-Propagation: Enabling Neuromorphic Deep Learning Machines*, Frontiers in Neuroscience 11, 2017.
- [12] A. Chaillet, **G. Is. Detorakis**, S. Palfi and S. Senova, *Robust stabilization of delayed neural fields with partial measurement and actuation*, Automatica 83, 2017.
- [13] **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.
- [14] **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.
- [15] **G. Is. Detorakis** *Cortical plasticity, dynamic neural fields, and self-organization*, University of Lorraine (Thesis), 2013.
- [16] **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)

- [17] **G. Detorakis**, [Re] *A generalized linear Integrate-and-Fire neural model produces diverse spiking behaviors*, The ReScience Journal, 3:1, 2017.
- [18] **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)

- [19] **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.
- [20] 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.
- [21] **G. Detorakis** and A. Chaillet, *Incremental stability of spatiotemporal delayed dynamics and application to neural fields*, CDC, Melbourne, Australia, 2017.
- [22] E. Neftci, C. Augustine, S. Paul, **G. Detorakis**, *Event-Driven Random Backpropagation: Enabling Neuromorphic Deep Learning Machines*, IEEE ISCAS, Baltimore (MD, USA), 2017.
- [23] 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.
- [24] 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.
- [25] N.P. Rougier and **G. Is. Detorakis**, *Self-Organizing Dynamic Neural Fields*, Advances in Cognitive Neurodynamics III, 2012.

Book Chapters

- [26] 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

- [27] 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.
- [28] **G. Detorakis**, T. Bartley, E. Neftci, *Random Contrastive Hebbian Learning as a Biologically Plausible Learning Scheme*, OCNS, Seattle (WA, USA), 2018.
- [29] **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.
- [30] **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.
- [31] **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.
- [32] **G. Detorakis**, D. Barsever, E. Neftci *NeuroLachesis: A Neuromorphic Framework*, Scipy 2017, Austin (TX, USA).
- [33] 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.
- [34] **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).

- [35] **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).
- [36] **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).
- [37] **G. Is. Detorakis** and A. Chaillet and I. Haidar, *A global stability analysis for delayed neural fields*, BCCN 2014, Göttingen (Germany).
- [38] **G. Is. Detorakis** and N. P. Rougier, *A computational view of the primary somatosensory cortex*, CNS 2013, Paris (France).
- [39] **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.
- [40] **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.
- [41] 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.
- [42] C. Pouzat and **G. Is. Detorakis**, *SPySort*, GDR Multielectrode systems and signal processing for Neuroscience, Gif-sur-Yvette (France), 2014.
- [43] **G. Is. Detorakis** and N. P. Rougier, *Skin Topographic Maps in SI*, Progress in Neural Field Theory, Reading (UK), 2012.
- [44] **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.
- [45] 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.

Minor
Conferences

Popular
Science