

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 and brain-machine interfaces with applications in neurodegenerative disorders (Parkinson's disease). Cortical plasticity, memory and learning. **Evo-
lutionary 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

- Developing NLP algorithms with applications on context analysis.
- Deep learning algorithms for time-series forecasting.

Academic Appointments

Postdoctoral Researcher

January 2016 – July 2019

Neuromorphic Machine Intelligence Lab, University of California Irvine

- Binary stochastic deep neural networks.
- Developed a neuromorphic framework and its simulator (<https://github.com/nmi-lab/NSAT>).
- Developed machine learning algorithms.
- Co-developed algorithms for Brain-Machine Interface using machine learning and neuromorphic devices.
- Developed applications using neuromorphic sensors (DVS camera).

Postdoctoral Researcher

December 2013 – December 2015

Laboratoire des signaux et systèmes, Supélec, University Paris Sud

- Developed a neural model (nonlinear, delayed, neural field) 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 using 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 and 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

- Undergraduate students in Engineering, CentraleSupélec, Gif-sur-Yvette, France.
Primary adviser: Prof. Antoine Chaillet.
- Graduate (master) internship student in 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

Workshop Service

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

Referee Service

- [The ReScience journal](#)

Research
Experience

Supélec, Gif-sur-Yvette, France and **Université Paris Sud**, Orsay, France
[Laboratoire des signaux et systèmes](#)

Postdoc Researcher in Neuroscience & Control Theory December 2013 – December 2015

- Developed a neural model (nonlinear, delayed, neural field) 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 using a Plexon recording device.

INRIA - Nancy Grand Est, Nancy, France
CORTEX Team

Research Assistant in Computational Neuroscience

October 2010 – October 2013

- Developed a computational model for self-organizing maps.
- Developed a mathematical model for the development of the somatosensory cortex.
- Developed an attention mechanism for the self-organizing map.
- 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

- Configured and calibrated a humanoid robot (HOAP3).
- Applied biped locomotion algorithms on the robotic platform HOAP3.
- Developed demo simulations for the aforementioned 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

- Conducting EMG and EEG experiments for studying human tremor.
- Developed software on Matlab for EMG signal processing and analysis.
- Analyzing EMG and EEG data.
- Developed 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), September 2012.

Software

Software with applications in Neuromorphic Systems:

- **NSATsim** A neuromorphic framework simulator written in C. The user interface is written in Python.
- **NSATcarl** A C++ interface of CARLsim (<http://www.socsci.uci.edu/~jkrichma/CARLsim/>) for a neuromorphic framework.

Software with applications in Neuroscience:

- **Crebral** A simple simulator for conductance-based neural networks written mainly in C. All the accompanied tools are written in Python. The source code is available at github: <https://github.com/gdetor/Crebral>.
- **SPySort** A Python package for spike sorting. The source code can be found at github: <https://github.com/gdetor/spysort>.
- **SI-RF-Structure** A collection of Python scripts that implements algorithms and experimental protocols relative to somatotopy of area 3b of primary somatosensory cortex. The source code is hosted at github: <https://github.com/gdetor/SI-RF-Structure>.
- **SITopMaps** A Python/C implementation of self-organizing maps with application on the somatotopy of area 3b of primary somatosensory cortex. The source code can be found at github: <https://github.com/gdetor/SITopMaps>.

Software with applications in Optimization:

- **GAIM** A C++ library for Genetic Algorithms and Island Models. The source code can be found at gitlab: https://gitlab.com/gdetor/genetic_alg.

Communication
Skills

Languages:

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

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, 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 , 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) – Operation of portable EEG device consisting of 18 electrodes.

Invasive:

- Extracellular recordings – Set up, calibration and software development for extracellular recordings using a Plexon Recording Device.
- Electromyography (EMG) – Conducting 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.

Computational Neuroscience:

- Spiking Neural Networks, Neural Population Models, Mathematical Modeling of Neural Systems.

Natural and Social Sciences:

- Neuroanatomy, Neurophysiology, Cognitive Neuroscience, Philosophy of Mind.

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”**, CenraleSupélec, 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*, to be published in *Advances on Delays and Dynamics* at Springer.

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**, Stephan Palfi and Suhan 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