

CV : ALEXIS DUBREUIL

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Personal: Born 24th of February 1986, French, 2 children
Languages: French, English, Italian

ACADEMIC APPOINTMENTS

02/2018-07/2020 **Group for Neural Theory, Ecole Normale Supérieure, Paris**

(post-doc, supervisor: Srdjan Ostojic)

I have developed a new modeling methodology, based on deep-learning algorithms and neural network theory, that allows to extract network mechanisms for the implementation of various computations [1-5].

10/2016-10/2017 **Laboratory of Theoretical Physics, Ecole Normale Supérieure, Paris**

(1 year, post-doc, supervisors: Rémi Monasson and Alessandro Treves)

I have used statistical physics tools and numerical simulations to investigate the properties of neural maps involved in spatial navigation experiments [6].

10/2014-09/2016 **Laboratory of Theoretical Physics, Ecole Normale Supérieure, Paris & Jean-Perrin Laboratory, Sorbonne Université, Paris**

(2 years, post-doc, supervisors: Rémi Monasson and Georges Debrégeas)

I have analyzed large calcium imaging datasets (50,000 neurons recorded simultaneously) recorded in behaving animals (zebra-fish larvae). I have used numerical and dynamical system tools to understand how processes of sensory-motor transformations can be implemented in biological neural networks [8,9].

01/2013-08/2014 **Departments of Statistics and Neurobiology, University of Chicago, USA**

(1 year 6 months, PhD student, supervisor: Nicolas Brunel)

I have analyzed large-scale cortical connectivity measurements and compare them with connectivity properties of network models of memory [7,10].

09/2011-12/2012 **Neurophysics Laboratory, Paris Descartes University, Paris, France**

(1 year 6 months, PhD student, supervisor: Nicolas Brunel)

I have studied the memory properties of various kinds of neural networks, focusing on their synaptic properties, for instance studying slow and fast learning networks [11].

04/2009-08/2010 **OEB Department, Harvard University, USA**

(1 year 4 months, intern, supervisors: Yoram Burak and Bence P. Ölveczky)

I have analyzed single-cell recordings in behaving animals (singing zebra-finch) and modeled these data to understand the biological processes underlying learning of motor sequences.

EDUCATION

2014 **PhD in Theoretical Neurosciences, Paris Descartes University, Paris, France**

(supervisor: Nicolas Brunel ; head examiners: Peter Latham, Alessandro Treves)

Title of the thesis: 'Memory and Cortical Connectivity'.

2007-2011 **Ecole Normale Supérieure de Cachan, Physics Department, Cachan, France**

2011- Master « Theoretical Physics of Complex Systems »: from Master de Sciences et Technologies, mention Physique et Applications (Paris 6, 7, 11 and ENS Cachan).

2007- Bachelor in Physics

2004-2007 **Classe Préparatoire aux Grandes Ecole, MPSI-PSI, Clermont-Ferrand, France**

Intensive study of Mathematics and Physics.

Others: Machine learning classes

2018 Deep-learning-do-it-yourself, master level deep learning course at ENS.

2015 L'apprentissage profond, series of lectures by Yan LeCun at Collège de France.

2013 Summer school: Statistical Physics, Optimization, Inference, and Message-Passing Algorithms, in Les Houches.

TEACHING

2016 Paris Descartes University: Course of Computational Neuroscience for L3 undergraduate students majoring in mathematics or computer science (25h).

2011 and 2012 Ecole Normale Supérieure : TA for the course “Advanced Course in Theoretical Neuroscience” (Cogmaster, ENS/EHESS/P5) (40h).

2011 and 2012 Université Paris Descartes : TA in physics for first year medical students: fluid mechanics, electromagnetism, diffusion (80h).

2010 Harvard University: TA for the course “Computational Neuroscience” (30h).

SUPERVISION

2019 Supervision of a master student in computer science (6 months), on the project: « new models of working memory ».

PUBLICATIONS

[1] Complementary roles of dimensionality and population structure in neural computations
A.Dubreuil, A.Valente, M.Beiran, F.Mastrogiuseppe, S.Ostojic, bioRxiv, **under review**, *Nature Neuroscience*, 2020.

[2] Shaping dynamics with multiple populations in low-rank recurrent networks
M. Beiran, **A.Dubreuil**, S.Ostojic, bioRxiv, under review, *Neural Computation*, 2020.

[3] The interplay between randomness and structure during learning in RNNs
F. Schuessler, F.Mastrogiuseppe, **A.Dubreuil**, S.Ostojic, O.Barak, accepted, *NeurIPS*, 2020.

[4] Dynamics of random recurrent networks with correlated low-rank structure
F. Schuessler, **A.Dubreuil**, F.Mastrogiuseppe, S.Ostojic, O.Barak, *Physical Review Research*, 2020.

[5] Disentangling the roles of dimensionality and cell classes in neural computations
A.M.Dubreuil, A.Valente, F.Mastrogiuseppe, S.Ostojic, *NeurIPS workshop Neuro-AI*, 2019.

[6] Encoding of multiple spaces in grid-cell networks
D.Spalla*, **A.M.Dubreuil***, R.Monasson, A. Treves, *Neural Computation*, 2019.
* equal contributions

[7] Short-term memory properties of sensory neural architectures
A.M.Dubreuil, *Journal of Computational Neuroscience*, 2019.

[8] A sensori-motor hub driving phototaxis in zebrafish
S.Wolf*, **A.M.Dubreuil***, T.Bertoni, U.Lucas Böhm, V.Bormuth, R.Candelier, S.Karpenko, D.G.C. Hildebrand, I.Bianco, R.Monasson, G.Debrégeas, *Nature Communications*, 2017.
* equal contributions

[9] Rheotaxis of larval zebrafish: behavioral study of a multi-sensory process
R.Olive, S.Wolf, **A.Dubreuil**, V.Bormuth, G.Debrégeas, R.Candelier, *Frontiers in System Neuroscience*, 2016.

[10] Storing structured sparse memories in a large-scale multi-modular cortical network model
A.M.Dubreuil, N.Brunel, *Journal of Computational Neuroscience*, 2016.

[11] Memory capacity of networks with stochastic binary synapses
A.M.Dubreuil, Y.Amit, N.Brunel, *PLoS Computational Biology*, 2014.

TALKS IN INTERNATIONAL CONFERENCE

“Disentangling the role of dimensionality and cell classes in neural computations”, September 2020, Bernstein workshop, online conference.

“Disentangling the role of dimensionality and cell classes in neural computations”, October 2019, Statistical Physics and Neural Computation, Guangzhou, China.

“A sensori-motor hub driving phototaxis in zebrafish”, September 2017, Neural Coding, Computation and Dynamics, Capbreton, France.

SELECTED TALK IN NATIONAL CONFERENCE

“Disentangling the roles of dimensionality and cell classes in neural computations”, December 2019, GDR NeuralNet, Bordeaux.

“Minimal-dimensionality implementation of behavioral tasks in recurrent networks”, June 2019, NeuroCompDays, Sorbonne Université, Paris.

INVITED SEMINARS

“Disentangling the role of dimensionality and cell populations in neural computations”, January 2020, CoML team, INRIA, Paris.

“Disentangling the role of dimensionality and cell populations in neural computations”, January 2020, MNEMOSYNE team, INRIA, Bordeaux.

“Disentangling the role of dimensionality and cell populations in neural computations”, January 2020, NeuroSpin, Gif-sur-Yvette.

“Disentangling the role of dimensionality and cell classes in neural computations”, November 2019, Group for cortical dynamics, IDIBAPS, Barcelona, Spain.

“Mechanics of neural Computation”, November 2019, Centre d’Analyse et de Mathématiques Sociales, Paris.

“Mechanics of neural Computation”, November 2019, Institut des Neurosciences Paris-Saclay, Gif-sur-Yvette.

“Reverse-engineering recurrent neural networks”, March 2019, Team Apprentissage et optimisation, Laboratoire de Recherche en Informatique, Université Paris-Saclay.

“Reverse-engineering recurrent neural networks”, November 2018, Institut des Systèmes Intelligents et de Robotique, Sorbonnes Université.

“A sensori-motor hub driving phototaxis in zebrafish”, June 2017, Bernstein Center for Computational Neuroscience, Berlin, Germany.

“A sensori-motor hub driving phototaxis in zebrafish”, May 2017, Group for cortical dynamics, IDIBAPS, Barcelona, Spain.

“Modeling networks of head-direction cells with non-linear dendritic interactions”, January 2017, IBENS, ENS, Paris, France.

“Shaping effective connectivity via non-linear dendritic interactions allows precise network control”, December 2016, MNEMOSYNE, INRIA, Bordeaux, France.

“Memory and cortical connectivity”, June 2014, Unité de Neurosciences Information et Complexité, Gif-sur-Yvette, France.

“Neural mechanisms underlying the reduction in behavioral variability during trial-and-error learning”, May 2010, Laboratory of Neurophysics and Physiology, Paris Descartes University, Paris, France.

REVIEWING ACTIVITIES

Organization for Computational Neuroscience, NeurIPS, ICLR, Physical Review Letter, Physical review E

GRANTS and AWARDS

Elève Normalien (2007, 4 years, 80k€)

Prix international de l’ENS Cachan (2009, master internship grant, 2k€)

Allocation Spécifique Normalien (2011, PhD grant, 3 years, 90k€)

Post-doctoral fellowship from Fondation Pierre-Gilles de Gennes (2014, 1 year, 50k€)

Travel grant, COSYNE Conference, awarded to the 20/1000 best graded submissions (2019, 1,5k€)

Child care grant, COSYNE Conference (2019, 1k€)

POPULARIZATION

I gave a talk “Cerveau et Intelligence Artificielle“ at Université Populaire de la Dore, to provide an overview of research conducted in these two fields for a general audience.

COMPUTER SCIENCE SKILLS

Programming: Python, Matlab, Fortran ; Deep-learning: Keras, Pytorch ; Others: Mathematica, Webdesign