Aurélien DECELLE

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Researcher in theoretical physics at UCM, "Atraccion de Talentos program"
Keywords : spin glasses, Bayesian inference, inverse Ising, Belief-Propagation, random graph, cavity method, sampling algorithms, machine learning, Markov random field, Boltzmann Machine, restricted Boltzmann Machine, learning

Formation

2008/2011 University of Paris-Sud XI (Orsay)/LPTMS, France. **PhD thesis** in theoretical physics, obtained with high honors in October 2011. Supervisor: Pr. Silvio Franz.

2007/2008 University of Paris-Sud XI (Orsay)/ENS, France. **Master: Spécialité Concepts Fondamentaux de la Physique**, theoretical physics.

Research experience

July 2020-	**Researcher** in theoretical physics at Universidad Complutense Madrid
Sept. 14-June 2020	**Associate Professor** in Computer Science at Université Paris Sud
October 2011-2014	**Post-Doc** at La Sapienza with Dr. F. Ricci-Tersenghi (Rome)
October 2008-2011	**PhD thesis** in statistical physics at Laboratoire de Physique Théorique et Modèles Statistiques (LPTMS) at Orsay.
April-Mai 2008	Bibliographical study: « An exact renormalization group approach on hierarchical lattices ». Supervisors: S. Franz et F. van Wijland.
Jan-March 2008	Project of three months supervised by Y. Couder at MSC Paris VII on *bouncing droplets.*
Mai-July 2007	Project of three months supervised by J. Stalker at Trinity College (Dublin, Ireland), on *numerical work linked to General Relativity.*
June-July 2006	Project of two months supervised by M. Langer at IAS, Orsay *dynamic of the universe and Dark Energy.*

List of publications

Articles

(i) *Archimedean lattices in the bound states of wave interacting particles*, A. Eddi, A. Decelle, E. Fort and Y. Couder; EPL **87** 56002.

(ii) *Message passing for optimization and control of a power grid: model of a distribution system with redundancy*, L. Zdeborova, A. Decelle, M. Chertkov; PRE 80, 046112 09.

(iii) *Hierarchical Random Energy Model of a Spin Glass*, M. Castellana, A. Decelle, S. Franz, M. Mézard, G. Parisi; PRL **104**, 127206 (2010)

(iv) *Phase transition in the detection of modules in sparse networks*, A. Decelle, F. Krzakala, C. Moore, L. Zdeborova; PRL **107**, 065701 (2011).

(v) *Asymptotic analysis of the stochastic block model for modular networks and its algorithmic applications*, A. Decelle, F. Krzakala, C. Moore, L. Zdeborova; PRE 84, 066106 (2011).

(vi) *Extreme Value Statistics Distribution in Spin Glasses*, M. Castellana, A. Decelle, E. Zarinelli; PRL **107**, 275701 (2011)

(vii) **PhD thesis**: *Statistical physics of disordered networks – Spin Glasses on hierarchical lattices and community inference on random graphs*

(viii) *Pseudolikelihood decimation algorithm improving the inference of the interaction network in a general class of ising models*, A. Decelle and F. Ricci-Tersenghi; PRL **112(7)**, 070603 (2014),
(ix) *Belief-Propagation Guided Monte-Carlo Sampling*, A. Decelle and F. Krzakala; PRB **89(21)**, 214421 (2014)
(x) *Ensemble renormalization group for the random field hierarchical model*, A. Decelle, G. Parisi and J. Rocchi ; PRE **89(3)**, 032132 (2014)
(xi) *Solving the inverse Ising problem by mean-field methods in a clustered phase space with many states*, A. Decelle, F. Ricci-Tersenghi; PRE **94(1)**, 012112 (2016)
(xii) *Inference of the sparse kinetic Ising model using the decimation method*, A. Decelle, P. Zhang ; PRE **91(5)**; 052136 (2015)
(xiii) *Detection of cheating by decimation algorithm*, S. Yamanaka, M. Ohzeki, A. Decelle ; J. of the Physical society of Japan; **84(2)**, p024801 (2015)
(xiv) *Cycle-Based Cluster Variational Method for Direct and Inverse Inference*, C. Furtlehner, A. Decelle ; J. of Stat. Phys. **164(3)**, 531-574 (2016)
(xv) *Data quality for the inverse lsing problem*, A. Decelle, F. Ricci-Tersenghi, P. Zhang ; J. of Phys. A: Math. and Theoretical **49(38)**, 384001 (2016)
(xvi) *Spectral Dynamics of Learning Restricted Boltzmann Machines*, European Physics Letter 119(6), 60001 (2017)
(xvii) *Themodynamics of Restrictued Boltzmann Machines and related learning dynamics*, A. Decelle, G. Fissore, C. Furtlehner, Journal of Statistical Physics **172 (6)**, 1576-1608 (2018)
(xviii) *Creating Artificial Human Genomes Using Generative Models*, B. Yelmen, A. Decelle, L. Ongaro, D. Marnetto, C. Tallec, F. Montinaro, C. Furtlehener, L. Pagani, F. Jay, bioRxiv, 769091 (2019)
(xix) *Inverse problems for structured datasets using parallel TAP equations and RBM*, A. Decelle, S. Hwang, J. Rocchi, D. Tantari, arXiv preprint arXiv:1906.11988 (2019)
(xx) *Learning a local symmetry with neural networks*, A. Decelle, V. Martin-Mayor, B. Seoane, PRE **100(5)**, 050102 (2019)
(xxi) *Robust Multi-Output Learning with Highly Incomplete Data via Restricted Boltzmann Machines*, G. Fissore, A. Decelle, C. Furtlehner, Y. Han, arXiv:1912.09382 (2019)
(xxii) Gaussian-Spherical Restricted Boltzmann Machines, A. Decelle, C. Furtlehner; Journal of Physics A: Mathematical and Theoretical **53 (18)**, 184002 (2020)
(xxiii) *T-ReX: a graph-based filament detection method*, T. Bonnaire, N. Aghanim, A. Decelle, M. Doupsis; Astronomy & Astrophysics 637, A18 (2020)

Chapter of a book (lecture note of Pr. C. Moore)
Computational Complexity, Phase Transitions, and Message-Passing for Community Detection, to appear in Statistical Physics, Optimization, Inference, and Message-Passing Algorithms, edited by Oxford University Press

Research projects

Machine Learning for space weather: I'm part of a research project between the INRIA and the CWI (Amsterdam) that aims to detect solar storms (amongst with other goals) by means of machine learning methods (https://projects.cwi.nl/mlspaceweather/pages/team) (2016-2019)
Byopic: This research project (ERC of Pr. Aghanim IAS) focuses on the missing baryon of the universe. My role is to develop new statistical/ML tools to help characterizing cosmological object. (2018-)
Myndblue: Consulting activities for Myndblue (health-tech business), (2017-2019)

Teaching activities

Teaching assistant at Paris-Sud XI (Orsay) from October 2008 to October 2011:
2008-2010: math. for undergraduate students (third grade).
2008-2010: mathematical tools for physicists (third grade).

2010-2011: physics for first year students.

PhD course at the university of Rome - La Sapienza

April-May 2013: Introduction to Bayesian inference (20h)

Teaching assistant at the university of Rome - La Sapienza

October-Decembre 2013: C++ programming (30h)

Lecturer at University Paris Sud (2014-2020)

Service of 192h each year.

Lecturer in

- Computer Architecture (L2)
- Machine Learning (L2,M1,M1Pro)
- Statistics and probability (M1Pro)
- Information Theory (M1)
- Machine Learning for Physicist (M2)

Miscellaneous

Referee for

« Journal of Statistical Mechanics: theory and experiment »,
« Physical Review Letter »,
« Physical Review E »,
« Physical Review B »,
« Journal of Statistical Physics »
« NIPS »
« ECAI »
...

Phd Advisor:

G. Fisorre, thesis on "Statistical physics of generative models" started in 2017
T. Bonnaire, thesis on "reconstruction of the cosmic web", started in 2018
M. Ullmo, thesis on "Detection and classification of the cosmic web elements" started in 2018

Mentoring:

PhD student, J. Rocchi, in his thesis with G. Parisi
Undergraduate student, C. Tallec during his master (2015), internship
Undergraduate student, R. Saiseau during his master (2015), internship
Undergraduate student, G. Fissore during his master (2017), internship
Undergraduate student, C. Leroy during his master (2017), internship
Undergraduate student, M. Ullmos during his master (2018), internship
Undergraudate student, I. Diarra, L3 student (2018), internship
Undergraudate student, A. Gardille, L3 student (2020), internship

Other:

Fête des sciences 2016

Skills

Languages: French (mother tongue)
English (fluent)
Italian (fluent)
Spanish (proficient)

Computer: Programming language: C/C++, Fortran, Mathematica, Python, Matlab, Julia
OS: GNU/Linux, Windows, Mac
Software: Latex, Office, Gnuplot