Nicolas P. Rougier

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Background

Professional History

2013 – today	Advanced Researcher at INRIA Bordeaux Sud-Ouest Member and vice-head of the MNEMOSYNE team-project Member of the Institute of Neurodegenerative Diseases Member of the LaBRI laboratory Member of the Labex Brain
2002–2012	Researcher at INRIA Nancy Grand-Est Member of the CORTEX team-project Member of the Loria laboratory
2000–2002	Associate Researcher at the Colorado University, Boulder, USA Member of the O'Reilly Cognitive Psychology laboratory

Education

May 2011	Habilitation, Université Nancy 2 *Fondements biologiques pour le calcul distribué, numérique et adaptatif* Jury: Guillaume Beslon (reviewer), Philippe Gaussier (reviewer), Gregor Schöner (reviewer), Axel Cleeremans (examiner), Anne Boyer (President), Frédéric Alexandre (examiner)
Oct. 2000	Ph.D. in Computer Science, Université Henri Poincaré *Modèles de mémoires pour la navigation autonome* Jury: Philippe Gaussier (reviewer), Jean-Claude Paul (reviewer), John G. Taylor (reviewer), Yves Burnod (examiner), Noëlle Carbonell (examiner), Frédéric Alexandre (examiner)
Oct. 1996 - June 1997	French Navy (*aéronavale*), Landivisiau & Clémenceau aircraft carrier.
Sept. 1995 - June 1996	Université Henri Poincaré Master in Computer Science (DEA)
Sept. 1993 - June 1996	ESIAL (Telecom Nancy) Engineering studies in Computer Science

Computational Neuroscience

My research activities in the domain of computational neurosciences attempt to understand these higher brain function using computational models. I've recently investigated visual attention in order to understand what are the inner mechanisms of occular saccades. More recently, I've investigated the self-organization of representations within the primary somato-sensory cortex and the influence of attention in the formation and the refinement of these representations. I'm now investigating the mechanisms of action selection through the modeling of the basal ganglia complex with a special emphasis on the motor cortex. The challenge in all these modelling approaches is to understand how a consistent behavior emerges from a purely distributed, asynchronous, numerical and adaptive computing, i.e. without any form of a central supervisor or homonculus, not even a soft one like a central clock.

Embodied Cognition

One important aspect of my research is to consider the brain and the body as a whole. The brain does not live outside the body. If we aim at understanding brain and cognition, we cannot do so without considering the brain-body complex. "Minds are not disembodied logical reasoning devices." as Andy Clark explained.

Distributed, Asynchronous, Numerical, Adaptive Computing

Computational models of the brain exist at several different levels of description, from the very precise modelling of a unique spiking neuron, taking into account ion channels and/or dendrites spatial geometry, up to the modelling of very large assemblies of neuron that express complex dynamic interactions. I'm interested in a mesoscopic approach of the brain where the computational paradigm is grounded on the notion of a unit that is essentially a set of time dependent values varying under the influence of other units via adaptive weighted connections. The evolution of the units' value and weights are simply defined by a set of differential equations. This is a strongly constrained framework that has been designed such as to avoid any modeling artifact like a central supervisor or a homonculus. If some properties are to emerge from our models, we want to make sure they are properties of the model as opposed to properties of the software that run the simulation.

GPU computing

As a side-effect of my research in distributed computing, I've come to to consider GPU computing to speed-up computations. However, I became quickly mostly interested in the parallel you can draw between adaptive distributed computing and fragment-shader programming. The many ways to achieve a global scene effect from a single shader program brings interesting insights to the problem of emergence.

Supervision of Research Activities

Ph.D. students

Ikram Chraibi Kaadoud, 2015–
Bio-inspired approach for hierarchical planing.

Meropi Topalidou, 2013–
Neuroscience of decision making: from motor primitives to actions.

Georgios Detorakis, 2010–2013
Cortical plasticity, dynamic neural fields and self-organization
Jury: F. Alexandre, H. Berry, S. Contassot-Vivier, G. Schöner, D. Shulz, N.P. Rougier
Georgios is now a **post-doctoral fellow** at Supélec Paris.

Wahiba Taouali, 2009–2012
Modélisation de Populations Neuronales pour l'Intégration Visuo-motrice : Dynamiques et Décisions
Jury: F. Alexandre, T. Boraud, S. Contassot-Vivier, B. Girard, M. Quoy, N.P. Rougier
Wahiba is now a **post-doctoral fellow** at the Institut des Neurociences de la Timone.

Jérémy Fix, 2005–2008
Mécanismes numériques et distribués de l'anticipation motrice
Jury: F. Alexandre, S. Contassot-Vivier, J. Lorenceau, G. Masson, A. Revel, N.P. Rougier
Jérémy is now an **associate professor** at Supélec Metz.

Julien Vitay, 2002–2006
Emergence de fonctions sensori-motrices sur un substrat neuronal numérique distribué
Jury: F. Alexandre, P. Gaussier, T.Viéville, J.-M. Pierrel, N.P. Rougier
Julien is now an **associate lecturer** at the Chemnitz University of Technology

Post-doctoral fellows

Zhor Ramdane-Cherif, 2005–2006
→ Visual attention neural models
Z'hor is now an expert engineer at the "Imagerie adaptive diagnostique et interventionelle" unit.

Rémi Coulom, 2003–2004
→ Behaviour planning
Rémi is now an associate professor at the Université Lille 3 and a member of the SequeL research group.

Alistair Bray, 1998–2000
→ Biological vision
Alistair is now a freelance photographer.

Masters & Engineers

Aurélien Marie, Master, Bordeaux, 2015
→ Modeling of the globus pallidus in the mouse

Hima Mehta, Inernship, Hyderabad University, India, 2014
→ Large scale models of the basal ganglia

Meropi Topalidou, Master, Greece, 2013
→ Touch and the Body

Mathieu Zimmer, "License Informatique", Nancy, 2012
→ Consciousness and metarepresentation

David Roland, ENIB, Bordeaux, 2011
→ Control of a robotic arm using the DSOM algorithm.

Maix Gaëtan and Li Shibo, Master 1, Nancy, 2011
→ Control of a robotic arm.

Guillaume Billey and **Bérenger Michel**, Master 1, Nancy, 2010
→ Implementation of the infotaxis algorithm in Python.

Cyril Noël, "IUT Charlemagne", Nancy, 2009
→ Implementation of delayed dynamic neural fields

Wahiba Taouali, "Ecole des Mines", Nancy, 2009
→ Study of the asynchronous integration of a coupled differential equation system

Andrew Szabados, "Master Sciences Cognitives", Paris, 2008
→ Multiple objects tracking using dynamic neural fields

Jessy Cyganczuk and **Matthieu Kluj**, "ESIAL", Nancy, 2008
→ Implementation of an OpenGL/Python widget library

Grégory Rolland, "Ingénieur CESI", Nancy, 2006
→ Development for the DANA platform

Johnatan Gall, "Supélec", Metz, 2006
→ Study of learning rules in the framework of the dynamic neural field theory

Tariq Daouda, "Deug, Licence de Mathématique" Nancy, 2006
→ Study and evaluation of the Kohonen algorithm

Régis Faucheur, "Ingénieur ENSP", Nancy, 2004
→ Implementation of image processing filters (contrast, colors and orientation)

Jérémy Fix, "Ingénieur Supélec et DEA Informatique", Metz, 2004
→ Study of visual anticipation

Yoann Dieu, "DEA Sciences Cognitives", Strasbourg, 2003
→ Computational models of the hippocampus

David Dumortier, "Licence Informatique", Nancy, 2003
→ Implementation of algorithms for automous navigation

Julien Vitay, "DEA Informatique", Rennes, 2002
→ Study of a biological model of sensori-motor coordination

Joshua Vogelstein, Master of Science, University of Colorado, 2001
→ Models of dynamic task switching

Others

Zoé Barbanneau, Ecole Estienne, Paris, 2011
→ Design of a poster for explaining computer science research to junior high-school students

Responsabilities

International

- ICANN 2014, member of the program commitee

- Tutorial chair for Euroscipy 2013

- Co-organization of Euroscipy 2012& Euroscipy 2013

- Computer science chair for the "Frontiers of Science" symposium organized by the French Ministry of Foreign and European Affairs, the French Ministry of Higher Education and Research, the Centre National de la Recherche Scientifique and the Japan Society for the Promotion of Science, 2007–2009

- Scientific advisor for the European project ACORNS (FP6), 2007–2009

- Regular reviewer for several journals and conferences (*Cognitive Neuroscience, Biological Cybernetics, Neural Networks, Neurocomp, IJCNN, etc.*)

- Art designer for several conferences and journals (*Journal of Physiology, PLos Computational Biology, Computational Cognitive Neuroscience Conference, Euroscipy, RMLL, etc*) (see artwork section).

National

- Member of the GDR BioComp steering commitee, 2015

- Member of the jury for hiring new researchers (Bordeaux), 2015

- Member of the INRIA evaluation commitee, 2014

- Member of the FING/INRIA steering commitee, 2014

- Member of selection committee, université de Cergy Pontoise, sections 27-61, 2014

- Expertise for PEPS Bio-Math-Info call, 2013

- Vice-head of INRIA project team Mnemosyne (head Frédéric Alexandre), 2013–

- Co-organization of transdisciplinary conference "Robots et Corps", Nancy, 2012

- Member of selection committee, université de Cergy Pontoise, sections 27-61, 2010

- Co-organization, first French Computational Neuroscience conference (NeuroComp), 2006

- Co-organization, "A multidisciplinary approach to the study of frontal cortex", Nancy, 2013

Local

- 2015–: President of the delegation commitee

- 2014–: Member of the CUMIR

- 2010–2013: Member of popular science committee

- 2010–2012: Elected member of laboratory council

- 2010–2013: Co-organizer of monthly iPAC conferences (image, perception, action & cognition).

- 2003–2008: Member of the COMIPERS-chercheurs ("Comité de recrutement INRIA Lorraine/LORIA des personnels scientifiques contractuels)".

- 2002–2011: Member of the CUMI ("Commission des Utilisateurs de Moyens Informatiques").

- 2002–2012: Webmaster for the team website.

Teaching

International

Advanced Neural Fields, 2015
CNS, Prague, Czech Republic
Tutorial on neural field theory

Reinforcement Learning, 2014
Laconeu Summer school, Valparaiso, Chile
Reinforcement learning definition & methods

Scientific Visualization, 2013
PRACE Winter School, Dublin, Ireland
Introduction to scientific visualization: best practices and tools

Introduction to Python, 2013
PRACE Winter School, Dublin, Ireland
Introduction to the python language

Matplotlib tutorial, 2012, 2013
Euroscipy 2012 & Euroscipy 2013, Brussels
Tutorial on matplotlib

Visual Attention for Human Computer Interaction, 2011
National Insititute of Informatics, Tokyo, Japan.
Embodied Cognition – Visual Attention – Dynamic Neural Fields – Models of Visual Attention

National

Neural Networks, 2014, 12h/year, Cognitive Science, Bordeaux University
This is an introduction to artificial neural networks with a focus on learning and the main classical models (perception, multi-layer perceptron, ART maps, Kohonen maps, Hopfield Networks).

C++, 2012–2013, 12h/year, Engineering School, ESIAL, C++ crash course.
This is a crash course in C++ for students already mastering C and java. This course introduces C++ specificities such as classes, const correctness, template, multiple-inheritance, standard template library, exceptions, streams.

Learning and Memory, 2004–2013, 12h/year, Cognitive Science, Université Nancy 2
This course introduces the main learning mechanisms (supervised, unsupervised and reinforced) in light of computational neuroscience models.

Neural Networks, 2004–2013, 12h/year, Cognitive Science, Université Nancy 2
This is an introduction to artificial neural networks with a focus on learning and the main classical models (perception, multi-layer perceptron, ART maps, Kohonen maps, Hopfield Networks).

Artificial Intelligence, 2003–2008, 24h/year, 3rd year students, Engineering School, ESIAL.
This course introduces classical algorithms from the field of artificial intelligence (general problem solver, expert systems, decision trees, game theory, artificial neural networks, genetic algorithms, MDP, etc.).

Web servers, 2005–2010, 24h/year, professional cursus, IUT Charlemagne.
This course is focused on web servers and their installation (protocols, hosting, calibration, configurations, etc.).

Computer security, 2005–2008, 10h/year, professional cursus, IUT Charlemagne.
This is an introduction to the main concepts of computer security (firewall, passwords, cryptography, etc.)

Algorithmic and programming, 1997–2000, 64h/year, engineering school, ESSTIN.
This is a general introduction to the main concepts of algorithmic and programming aimed at engineering students.
At the end of the course, students are supposed to master methods and tools for the conception, the development
and the integration of software.

Project and Collaborations

Braincraft associated team, 2015

What are the processes by which animals and humans select their actions based on their motivations and on the consequences of past actions? This is a fundamental question in neurosciences, with implications to ethology, psychology, economics, sociology and computer science. Through a unique combination of expertise in cognitive psychology, neurosciences and computer science, this project aims at tackle this problem by evaluating most advanced computational models within a robotic virtual platform and validating these model against experimental data.

Partners

- Computational Cognitive Neuroscience (CCN) Lab at University of Colorado, Boulder, USA (Randall O'Reilly).

BGal associated team, 2014

In this 3-years project "Basal Ganglia at Large (BGaL)", funded by the CNRS and the CEFIPRA, we collaborate with the computer science department of IIIT Hyderabad and the biomedical department of IIT Madras, for the design of models of basal ganglia, of their relation with other brain structures and or their implementation at large scale.

Partners

- Computer science department of IIIT Hyderabad
- Biomedical department of IIT Madras

PEPS Idex, 2014

The neurotransmitter dopamine (DA) plays a key role in basal ganglia (BG) circuits. However, despite the fundamental importance of DA in those circuits, the electrophysiological effects of dopamine on target neurons are largely unknown. Furthermore, contrary to classical models that only view the globus pallidus (GP) as a relay station of the indirect pathway, our neuroscientist colleagues at IMN have discovered a novel GP cell- type called the Arkypallidal (Arky-GP) neurons that only project to striatum in a very dense way. Arky-GP cells represent a novel BG pathway that might contribute massively to the GABAergic inhibition in striatum. In this project, we would like to explore for the first time whether DA has a direct action on Arky-GP neurons through D2 DA receptors. To do so, this project is based on multidisciplinary approaches that bring together 3 teams of IMN with different but complementary expertise (anatomical, in vivo electrophysiology, optogenetic manipulation, and computational modeling).

Partners

- Institute for Neurodegenerative diseases UMR 5293

Psyphine

PsyPhiNe is an ongoing non-financed project between philosophers, psychologists and computer scientists to investigate the relation between cognition, behavior and consciousness.

Partners

- Loria laboratory
- Archives Henri Poincaré
- Interpsy laboratory
- Labri laboratory

Formet projects

- **Cortina associated team** (2011-2013). Much progress has been made in the last decades in understanding the basic organization and function of the nervous system in general. Contributions to this end have come from various domains including computational neuroscience and numerical science of the information in general. The goal of this associate team is to combine our complementary expertise, from experimental biology and mathematical models (U de Valparaiso and U Federico Santa-Maria) to computational neuroscience (Mnemosyne and NeuroMathComp), in order to develop common tools for the analysis and formalization of neural coding and related sensory-motor loops.

- **CNRS/PEPII** on learning in non-stationary environments (2011-2012). In collaboration with the Institute of Neurodegenerative diseases (IMN, Bordeaux), Supélec (Metz), we have been investigating a computational model of the basal ganglia.

- **CNRS/PEPII** IMAVO (2011-2012). In collaboration with the Center of Integrative and Cognitive Neurosciences, Bordeaux, the MAIA team (INRIA Nancy Grand Est) and the Institute of Intelligent System and Robototics (ISIR, Paris) we have been investigating effect on non-stationary environment in learning.

- **CNRS/PEPS** on reinforcement learning (2008-2010). In collaboration with the Center of Integrative and Cognitive Neurosciences, Bordeaux, MAIA team (INRIA, Nancy) and Supelec (Metz), we have been developing bio-inspired reinforcement learning procedures, on the basis of experimental data from behavioural recordings in rats.

- **MAPS (2007-2011)** is an ANR project in collaboration with UMR "Mouvement et Perception", Marseille, INCM-CNRS, Marseille and LIRIS, Lyon, centered around the notion of spatial computation that aims at re- examining the relationship between structure and function, taking into account the topological (spatial aspects) and hodological (connectivity) constraints of the neuronal substrate.

- **MirrorBot, IST-FET European Project (2002-2006)**. In collaboration with the University of Parma (Italy, V.Gallese, G.Rizzolati), the University of Ulm (Germary, P. Günter), the University of Sunderland (United Kingdom, S. Wermter, coordinator) and the medical research council (United Kingdom, F. Pulvermüller), we developed an approach of biomimetic multimodal learning using a mirror-neuron-based robot to investigate the task of foraging for objects. This task involved the search for objects and integrated multimodal sensory inputs to plan and guide behaviour. We examined these per- ceptual processes using models of cortical assemblies and mirror neurons to explore the emergence of semantic representations of actions, percepts, language and concepts in a MirrorBot, a biologically-inspired neural robot. The main hypothesis was to investigate whether a mirror neuron-based cell assembly model is able to produce a life-like perception system for actions.

- **CorTexMex (2008-2012)** is an associated team between INRIA Cortex project, INAOE and Universidad Politecnica de Victoria for the hardware/software codesign of bio-inspired connectionist models for vision using biologically plausible models of visual perception by understanding, modelling and simulating the mechanisms that underlie neural processes in the brain.

- **CPER, Teleoperation and Intelligent Assistants, 2003-2006**. In the framework of the Contrat de Plan Etat Région, we contributed to the project whose goal is to study systems for the monitoring of industrial processes. More specifically, our role was to develop a biologically inspired connectionist system for visual perception and to integrate it on an autonomous robot.

- **Project Robea of the CNRS - Learning of visiomotor transformations (2003-2004)**. In collaboration with Supelec-Metz, INSERM-Paris and EDF-Chatou, this project proposed a generic neuronal methodology inspired from the modular cortical architecture to learn complex visiomotor loops, with application to manipulation, reaching and grasping tasks for complex robots. 6

- **CNRS Specific Action: Perceptive interfaces (2002-2004)**. The aim of the "Perceptive supply and interface" project was to set up a theoretical ergonomy of assisting devices for people with perceptive disabilities. The laboratories involved in this specific action of the CNRS STIC department were : Costech/BIM (Compiègne), ETIS (Cergy), Institut de Sciences Cognitives (Lyon), Neurophysique et Physiologie du Système Moteur (Paris), Laboratoire de Psychologie Expérimentale (Paris), Préhistoire et Technique (Paris) and Psy.Co (Rouen).

- **Van Gogh European Grant (2000-2002)**. In collaboration with the University of Amsterdam (J. Murre), we explored the modelling and interaction between the structures of the hippocampus and the cortex in order to use them in a autonomous navigation task.

Distinctions and Invitations

International

- I've been invited to give a tutorial on Neural Field at the next CNS meeting (Prague, Czech Republic, 2015.).

- The vispy project has been invited by the European Synchrotron Radiation Facility for a 3 days code camp in Grenoble, February 2014.

- I've been invited for the Latin-America Summer School in Computational Neuroscience (Chile, Valparaiso, January 2014.). I've given a lesson on reinforcement learning in the Basal Ganglia and Motivated Learning week.

- The vispy project has been invited to give a conference at the BI Forum (November, 2013, Budapest, Hungary) and Almar Klein introduced "Vispy – a future tool for interactive visualization" in the name of the core team.

- I've been invited by the National Institute of Informatics (Tokyo, Japan) for a one month stay in december 2010 to give a serie of lectures on *Embodied Cognition, Visual Attention, Dynamic Neural Fields and Models of Visual Attention*. Lecture are available on the teaching section of my homepage.

- International Body Art Festival Robot, Hybride and Cyborg, Musée Aquarium de Nancy, 2009.
  The international body art festival is a thematic festival focused on the imaginary of the body in thecontemporary landscape. A cross-over between art, science and imaginary. The event, revolved around an exhibition, brought together about 50 artists forabout 300 works on display (photo, painting, sculpture, installation, digitaland video art,...)

- Computational Vision Workshop, Marseilles, France, October 2008.
  The purpose of this workshop was to bring together experts of the visual system and its modeling within an inter-disciplinary framework.

- Models of Language Evolution, Acquisition and Processing. Leuven, Belgium, November 2007.
  The European Science Foundation Exploratory Workshops are small, interactive output oriented meetings that aimed at opening up new directions in research to explore emerging research fields with potential impact on new developments in science.

- Conceptual Neuroscience, European Para Limes Institute, Wageningen, April 2007.
  The Institute Para Limes, in doesburg, the Netherlands, follows the Santa Fe model and symbolizes the quintessence of the European Union (EU): a community without boundaries, national or disciplinary. It is endorsed by scientists, by leaders of the national science academies, by some companies and by high- ranking EU officials. They recognize that such a community cannot be built from within universities organized along disciplinary lines, or from institutes that serve national interests.

- *Computational Neurocience for Humanoïd robotics*, JFFoS, 2006, Kanagawa, Japan.
  The first French-Japanese Frontiers of Science symposium is organized by the French Ministry of Foreign and European Affairs, the French Ministry of Higher Education and Research, the Centre National de la Recherche Scientifique and the Japan Society for the Promotion of Science. The event gathers 40 French researchers and 40 Japanese researchers from all domain of science.

- The Prefrontal Cortex and Flexible Control of Behavior: Cross-Task Generalization from Systematic Representations. In *Computational NeuroScience 2003. Workshop: Computational Models of Active Maintenance in Prefrontal Cortex*.

National

- 13th forum des sciences cognitives

  Le Forum des Sciences Cognitives est un événement organisé chaque année par Cognivence dans le but de fédérer la communauté scientifique et de promouvoir les sciences cognitives auprès du grand public. Initié en 2002 et ouvert au grand public depuis 2011, le forum accueille tous les ans près de 2000 visiteurs. Chaque année une thématique est choisie.

- Computational Neuroscience, Marseille, 2014.

- *Where is my mind*, La Robotique et le Vivant, Université de Cergy-Pontoise, 2013.

  Les systèmes intelligents ont besoin d'un corps pour interagir avec l'environnement selon le contexte et l'instant. Cette proposition a priori simple a des implications fortes pour qui veut comprendre les organismes vivants dans leur complexité, mais aussi pour qui veut concevoir des robots plus proches des organismes vivants dans leur façon de fonctionner.

- *We see only what we look at*, Cerveau et Informatique, IRIT, Toulouse, 2013.

  Que ce soit dans les thématiques des neurosciences computationnelles, de la suppléance de fonctions cognitives, des interfaces cerveau-machine, de la modélisation, de l'imagerie cérébrale, etc., les systèmes informatiques ont pris une place extrêmement importante. L'objectif de cette journée, organisée par le GDR STIC-Santé et l'axe SISA (Systèmes Informatiques pour la Santé et l'Autonomie) de l'IRIT est de mettre en lumière quelques recherches récentes dans ces différentes thématiques et de discuter des interactions entre les sciences du cerveau et les sciences du numérique.

- Journées du Développement, Ecole Polytechnique, Massy-Palaiseau, 2013.

  Il s'agit d'une Action Nationale de Formation inter-établissements, soutenue par la Mission pour l'interdisciplinarité du CNRS, Inria et l'INRA. Ouvertes à tous les acteurs du développement de logiciels dans l'enseignement supérieur et la recherche, ces journées ont pour but d'améliorer la qualité et la pérennité des productions logicielles, ainsi que d'ouvrir de nouvelles perspectives.

- Brain & Signals, Institut Elie Cartan, Nancy, 2012.

- Intelligence Artificielle Embarquée, ENSEA, Université de Cergy Pontoise, 2011.

- Xèmes Journées Neurosciences et Sciences de l'Ingénieur, 2000.

Dissemination of Scientific Knowledge

Supervision

- Member of the Nancy popular science committee from 2010 to 2013 whose goal is to organize events and meetings around popular sciences (students reception at the laboratory, scientific exhibitions, café scientifique, etc.)

- Supervision of an Art student for the production of a popular science poster explaining research in computer science, 2010)

- Writing articles for the SILO website (Science info lycée, science-info-lycee.fr) and interaction with high-school professors

- Workshop on "Questions Numériques" with FING (Fondation Internet Nouvelle Génération), 2012

- "Cordée de la réussite", conferences and expositions in several places covering the whole Lorraine region such that students have access to science, 2011.

Conferences/Animation

- Interview by college students for their school project, Bordeaux, 2013

- *Café scientifique* around robotics, Epinal, 2012

- Scientific movie festival, meeting with the general public, Nancy, 2012

- Scientifique animation for regional mathematical laureates, Nancy, 2012

- Interview by college students for their school project, Bordeaux, 2011

- Video-interview by college students while I was staying in Japan, 2011

- Neuroscience days, Lunéville, 2009

- Several conferences in high schools (Epinal, Lunéville, etc.), since 2008

- *Café scientifique* with EKOS student association, Nancy, 2009

- "Le cerveau dans tous ses éclats", meeting with the general public for the science festival, Saint-Dizier, 2008

- Exhibition "Exponanciel de l'histoire de l'imaginaire à la réalité des sciences, de l'observation du ciel à la conquête de l'espace.", Nancy, 2002

Media

- Exchange with the *Association des Journalistes Scientifiques de la Presse d'Information*. One week in a redaction, one week in a laboratory, 2012

- TV journal, "12-14 France 3 Lorraine-Champagne-Ardennes" for science festival, 2004

Development

Vispy, interactive scientific visualization

http://vispy.org

Vispy is an OpenGL-based interactive visualization library in Python. Its goal is to make it easy to create beautiful and fast dynamic visualizations. For example, scientific plotting of tens of millions of points, interacting with complex polygonial models, and (dynamic) volume rendering. All thanks to the graphics card's hardware acceleration. The core development team consists of Luke Campagnola, Almar Klein, Nicolas Rougier and Cyrille Rossant. We have each written our own Python visualization toolkit (PyQtGraph, Visvis, Glumpy and Galry, respectively), and decided to team-up.

DANA, distributed, asynchronous, numerical & adaptive computing

http://dana.loria.fr

DANA is a python framework for distributed, asynchronous, numerical and adaptive computing. The computational paradigm supporting the dana framework is grounded on the notion of a unit that is a essentially a set of arbitrary values that can vary along time under the influence of other units and learning. Each unit can be connected to any other unit (including itself) using a weighted link and a group is a structured set of such homogeneous units. DANA offers a set of core objects needed to design and run such models. However, what is actually computed by a unit and what is learned is the responsibility of the modeler who is in charge of describing the equation governing the behavior of units groups over time and/or learning.

Glumpy

http://code.google.com/p/glumpy/

Glumpy is a python library for the rapid vizualization of numpy arrays, (mainly two dimensional) that has been designed with efficiency in mind. If you want to draw nice figures for inclusion in a scientific article, you'd better use matplotlib. If you want to have a sense of what's going on in your simulation while it is running, then maybe glumpy can help you.

Dynamic Self Organizing Map

http://github.com/rougier/dsom

This is a variation of the self-organizing map where the time-dependency learning function has been replaced. This allows for on-line and continuous learning on both static and dynamic data distributions. The newly proposed algorithm does not fit the magnification law and the vector density is not proportional to the density of the distribution as in most vector quantisation

Neural field with finite transmission speed

http://github.com/rougier/delayed-neural-field

This script implements the numerical integration of a dynamic neural fields with finite (or infinite) propagation speed. The integration is made over the finite 2d domain [-l/2,+l/2]×[-l/2,+l/2] discretized into n×n elements considered as a toric surface, during a period of t seconds.

Publications

Most of the modeling articles come with accompanying demonstrations and/or code that can be found in the demo or coding sections of my homepage. See also the publications section on my homepage for a possibly more up to date list of publications.

Habilitation & Thesis

[1] N. P. Rougier, "Fondements biologiques pour le calcul distribué, numérique et adaptatif ", Habilitation, Université Nancy II, May 2011.

[2] N. P. Rougier, "Modèles de mémoires pour la navigation autonome ", PhD thesis, Université Henri Poincaré - Nancy I, Oct. 2000.

Journals

[3] M. Topalidou, A. Leblois, T. Boraud, and N. P. Rougier, "A Long Journey into Reproducible Computational Neuroscience", *Frontiers in Computational Neuroscience* 9.28 (2015).

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

[5] N. P. Rougier, "Antialiased 2D Grid, Marker, and Arrow Shaders", *Journal of Computer Graphics Techniques (JCGT)* 3.4 (2014), pp. 1–52.

[6] N. P. Rougier, M. Droettboom, and P. E. Bourne, "Ten Simple Rules for Better Figures", *PLoS Computational Biology* 10.9 (2014).

[7] N. P. Rougier, "Higher Quality 2D Text Rendering", *Journal of Computer Graphics Techniques (JCGT)* 2.1 (2013), pp. 50–64.

[8] N. P. Rougier, "Shader-based Antialiased Dashed Stroke Poylines", *Journal of Computer Graphics Techniques (JCGT)* 2.2 (2013), pp. 105–121.

[9] G. 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 (2012), e40257.

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Miscellaneous

Artwork

Over the years, I've come to create several illustrations for various conferences I co-organized. These illustrations have then been since used for several other conferences, books, scientific journals, wikipedia entries or simple lessons. You will find more illustrations on the artwork section on my homepage.

Coding

I developed a lot of small coding projets which are useful to test various ideas more or less related to my research but mainly to ensure some kind of technology watch. I've also developped software for the GNU project and contributed to several open source projects.

- Simulation
  Simulation software directly related to my research in computational neuroscience and teaching

- Visualization
  Software related to scientific visualization using modern OpenGL, in C, C++ and Python

- Python
  Various software written in python

- Miscellaneous
  Miscellaneous software (C library python bindings, tutorials, etc.)