2025
ACTIVITY REPORT

Team

Biscuit

Bio-Inspired Situated Cellular and Unconventional Information Technology

DEPARTMENT

D5: Complex Systems, Artificial Intelligence and Robotics

Loria
Laboratoire lorrain de recherche en informatique et ses applications

Contents

Team Biscuit

Keywords

Distributed and decentralized computing, neural networks, self-organization, reinforcement learning, unsupervised learning, neuromorphic engineering.

1 Team members, visitors, external collaborators

Research Scientists

- Alain Dutech [INRIA, Junior Researcher, HDR]

Faculty Members

- Bernard Girau [Team leader, Université de Lorraine, Professor, HDR]
- Hervé Frezza-Buet [CentraleSupélec, Enseignant chercheur contractuel de droit public, HDR]
- Yann Boniface [Université de Lorraine, Maitre de conférence]
- Jérémy Fix [CentraleSupélec, Enseignant chercheur contractuel de droit public]

PhD Students

- Elena Berhocoirigoin [CNRS, PhD Student, until Oct. 2025] : Spatio-temporal interpolation and hybrid AI for application to biodiversity. Co-supervised Jérémy Fix, Cédric Pradalier (HDR, CNRS). ATER Université de Lorraine (2025-2026).
- Marion Richardot [CentraleSupélec, PhD Student, until Oct. 2025] : Spatio-temporal interpolation and hybrid AI for application to biodiversity. Co-supervised Jérémy Fix, Cédric Pradalier (HDR, CNRS). ATER ENS-PSL (2025-2026).
- Quentin Gabot [ONERA, PhD Student, until Sept. 2026] : Complex-Valued Generative Neural Networks for SAR Imaging Applications. Co-supervised Jérémy Fix, Jean Philippe Ovarlez (ONERA, HDR), Chengfang Ren (CentraleSupelec), Joana Frontera-Pons (ONERA)
- Maxime Plocharski [Université de Lorraine, PhD Student, until Sept. 2027] : Vers une approche événementielle de l'émergence de comportements. Co-supervised Alain Dutech, Hervé Frezza-Buet
- Nasr Allah Aghelias [Université de Lorraine, PhD Student, until Nov. 2027] : Modèles neuronaux de quantification vectorielle, apprentissage continu et distributions non-stationnaires. Co-supervised Hervé Frezza-Buet, Bernard Girau
- Xuan-Huy Nguyen [CentraleSupélec, PhD Student, until Oct. 2027] : Détection d'anomalies auto-supervisée pour l'imagerie SAR à valeurs complexes. Co-supervised Jean-Philippe Ovarlez (HDR), Chengfang Ren, Jérémy Fix, Joana Frontera-Pons
- Zewalina Amadou [Université de Lorraine, PhD Student, until Oct. 2028] :. Co-supervised Savisa Jovanovic (IJL-Univ. Lorraine), Bernard Girau
- Johanna Rondony [DGA, PhD Student, until Oct. 2028] : Vision artificielle bio-inspirée avec réseaux neuronaux à valeurs complexes. Co-supervised Jean-Philippe Ovarlez (ONERA, HDR), Benoit Cottereau (CNRS, HDR), Jérémy Fix
- Kamenan N'gadi [CentraleSupelec, PhD Student, until Nov. 2028] : Apprentissage automatique pour la détection et quantification probabiliste des traits morphologiques en bioindication. Co-supervised Jérémy Fix, Cédric Pradalier (HDR, CNRS), Martin Laviale (MCF, Université de Lorraine)

Scientific staff

- Romain Poiré [Univ. Lorraine, Engineer, october 2025 - october 2026]

Interns and Apprentices

- Alexis Gleyo [Univ. Paris Saclay, Stage M1, march-july 2025]
- Naël Bensaadi [Univ. Lorraine, Stage L3, april-july 2025]
- Thomas Marque [Univ. Lorraine, Stage L3, april-july 2025]

Administrative Assistant

- Antoinette Courrier [UL]

2 Overall objectives

The long-term goal of BISCUIT is to propose bio-inspired computing architectures that will learn to control persistent autonomous systems interacting with dynamical, complex and unforeseeable environments. These architectures consist of very large sets of modular computing elements that are mostly inspired by neural mechanisms of self-organization and computation emergence from neural populations driven by sensorimotor feedback.

3 Research program

Despite tremendous achievements from both software and hardware points of view, several tasks remain out of reach of mainstream computational approaches, including recent amazing successes of deep learning and other artificial intelligence models, even if these tasks sometimes appear quite simple for humans. Such tasks may be characterized by variable unforeseeable conditions that result in an impossibility to sufficiently specify the problem to solve. In other words, each related particular problem may be relatively easy to solve for each given set of specified conditions, but the global problem requires to handle numerous and unexpected conditions, so as to ensure long-term autonomy, adaptability and generalization. In domains where the system evolves under unknown and uncertain conditions (mobile robotics, autonomous drones, etc.), it is impossible to specify every possible context that the system will face during its life-time, leading to the need to re-define the implemented system when required by an environment with totally different features. Interestingly enough, the biological brain has ”solved” this problem using a dedicated architecture and mechanisms that offer both adaptive and dynamic computations, namely, self-organization by means of various kinds of cortical plasticity. This term refers to one of the main developmental properties of the brain where the organization of its structure (**structural** plasticity) and the learning of the environment (**synaptic** plasticity) develop simultaneously toward an optimal computing efficiency.

Inspired by these cortical principles, our ambition is to design the hardware-compatible architecture and algorithmic mechanisms of modular computing elements for the construction of **decentralized** and **distributed** systems endowed with **self-organization** properties. In order to address this scientific challenge, we combine three complementary research topics: 1) define brain-inspired computing principles with more complex intrinsic behaviors than the neural population models we have already studied, 2) combine these computing principles with a distributed motivation mechanism to guide unsupervised learning, based on reinforcement learning, 3) ensure the hardware compatibility of our computing bricks and their learning rules so as to contribute to the development of neuromorphic solutions.

3.1 Self-organization and population computing

The brain remains our first source of inspiration to define low-level adaptation rules that make it possible to modularize, specialize and differentiate subsets of computing bricks in a massively distributed fine-grain homogeneous computing substrate. As stated before, these properties are grounded on several levels of *self-organization* through correlated forms of cortical *plasticity*. We need to explore these various mechanisms and model them from a computerized point a view, so as to propose and explore a wide range of bottom-level adaptation and interaction neural mechanisms at a mesoscopic scale, to assess their relative merits and shortcomings in the view of the top-level emergent behavior they generate and of the structural self-organization they induce.

3.2 Feedback-driven unsupervised learning

Because of the relative unpredictability of the emerging behaviors of assemblies of our bio-inspired computing bricks, feedback signals from the behavior level of the agent (i.e: a scalar signal linked to the overall performance of the agent) should be used in order to drive the local neural mechanisms. This kind of cybernetic system can be formulated within the well founded framework of *Reinforcement Learning (RL)*. Our idea is to benefit from well established RL in monitoring the complex dynamics of our self-organizing neural populations.

Mixing Reinforcement Learning with neural computing can take inspiration from the works that look at the biological basis of reinforcement learning in the brain. These works offer complex sensorimotor architectures, with an explanatory goal in mind, that are out of reach for our emergent architectures, but they stress the importance of basal ganglia and dopamine from which we can propose mechanisms to translate feedback at the level of local learning rules.

3.3 Neuromorphic compatibility

Whether the goal is to bring structural and functional self-organization properties to current neuromorphic chips or to define our own models of neuromorphic computing elements, a strong focus of our work will take into account the compatibility of our models with hardware constraints and neuromorphic trends.

Spike-based computing appears as a promising way to conciliate strong neural properties with hardware compliance, and it has now been widely adopted by the neuromorphic engineering community. Moreover, being massively distributed, decentralized, and based on local interactions between simple units, neuromorphic engineering solutions induce technological constraints that fit the computing framework of our research. Our main goal in this research topic is thus to adapt the multilevel self-organization models that will derive from our bio-inspired approach to the constraints of a neuromorphic computing substrate using spikes.

4 New software, platforms, open data

- cxsom, `https://frezza.pages.centralesupelec.fr/cxsom-web/cxsom/index.html`: software suite for computing consensus-based multi-self-organizing maps architectures,
- gdyn, `https://github.com/HerveFrezza-Buet/gdyn`: generic C++-20 library for dynamical systems. It serves as a basis for rllib2,
- rllib2, `https://gitlab.inria.fr/biscuit/rllib2`: generic C++20 library for reinforcement learning. Leveraging “concepts” in C++, it offers a way to formalize Rl problems and RL algorithms. Comes with many didactic examples.,
- torchdnf, `www.github.com/jeremyfix/torchdnf`: optimisation of dynamic neural fields with differential programming using pytorch,
- torchcvnn, `www.github.com/torchcvnn/torchcvnn` : complex valued neural networks with pytorch.

- SORData, https://test.pypi.org/project/sordata/: a flexible and extensible library built by the ANR SORLAHNA Team to generate samples of data according to specified multi-context non-stationary distributions for machine/deep learning applications.

5 New results

5.1 Self-organization and population computing

Participants: Hervé Frezza-Buet, Jérémy Fix, Bernard Girau, Nasr Allah Aghelias, Romain Poiré, Thomas Marque.

Topographic Vector Quantization for continual learning

In the framework of the ANR SORLAHNA project, we have improved our theoretical formalism for unsupervised learning of non i.i.d. data extracted from non stationary distributions. This formalism can be viewed as an extension of the usual concept of continual learning, since it captures the various tasks related to this concept within the notion of "contexts", while enabling these contexts to drift slowly. We have designed a first algorithm based on multiple GNG-T (growing neural gas with target) to solve simple artificial problems with such non i.i.d. data from non stationary distributions. An article is currently being written about this work.

This work also relies on the PhD of Nasr Allah Aghelias which started in december 2024. He has defined two heuristics to augment existing TVQ algorithms for general continual learning. The most recent one is called SAND (Stable Adaptive Network Drift-handling). It employs an online out-of-distribution detector to identify context switches and subsequently updates the labels of vector quantization model nodes accordingly. The proposed algorithm is fully unsupervised, requiring no external labels to learn, recall, or adapt to varying contexts. SAND thus provides an efficient solution to continuously learn representations of evolving data streams in dynamic environments. This algorithm will be published (already accepted) in ESANN 2026.

In the framework of the SORLAHNA project, we also started the design of a flexible and extensible library to generate samples of data according to specified multi-context non-stationary distributions for machine/deep learning applications.

5.2 Feedback-driven unsupervised learning

Participants: Yann Boniface, Alain Dutech, Hervé Frezza-Buet, Jérémy Fix, Maxime Plocharski.

Event based reinforcement learning

This work aims at exploring the following fundamental question : given a *reactive* agent evolving in a fully continuous environment (continuous *time*, continuous state and action spaces), how can this agent develop its own discrete representation of "moments" where decision have to be taken. This question is not at all considered in the classic formalism of reinforcement learning where time is already considered as a sequence of decision moments, but where no one explore the question of how an agent can develop this representation by itself. Furthermore, this question is strongly linked to one of AI most fundamental question: the "symbol grounding" problem.

This work relies mainly on the PhD of Maxime Plocharski which started in october 2024.

5.3 Neuromorphic compatibility

Participants: Bernard Girau, Alexis Gleyo, Naël Bensaadi.

Population coding and fault tolerance of neuromorphic hardware

In [10], we investigated the inherent and passive fault tolerance conferred by population coding as a robustness strategy in regression tasks peformed by spiking neural networks (SNN) on neuromorphic hardware. We proposed a methodology where continuous variables are represented using Gaussian Receptive Field (GRF) population encoding and decoded from the SNN's output using a Maximum Likelihood Estimation (MLE) method designed to mitigate the influence of faulty neurons. Our results demonstrated that population- coded models may be significantly more resilient to permanent faults than those using a direct single-neuron output, without the overhead of active fault detection and reconfiguration hardware.

Hardware implementations of topographic VQ for continual learning

With our electronician colleagues of the ANR SORLAHNA project, we co-design models of adaptive topographic vector quantization algorithms so that they are able to learn from non i.i.d. samples extracted from non stationary data, while being compatible with an efficient hardware implementation using highly configurable and scalable neural processing units (NPUs) on reconfigurable circuits.

5.4 Related researches

Participants: Jérémy Fix.

Pytorch based library for experimenting with complex valued neural networks

After several years of collaboration through student projects, we strenghtened the collaboration with the SONDRA laboratory to which Jeremy Fix is a part time member. The SONDRA laboratory is born from a collaboration between France and Singapore and is advancing fundamental research in electromagnestism and signal processing, artificiazl intelligence and quantum technologies applied to radar. The Phds of Quentin Gabot (2023-2026), Huy Nguyen (2024-2027) are on exploring complex valued neural networks for generative modeling and anomaly detection on SAR (Synthetic Aperture Radar) data. These are in the topics of the Biscuit. Still, these lead to some published works such as [9, 8]. In particular, in [8], we introduce `torchcvnn` a pytorch based library for experimenting with complex valued neural networks offering complex valued specific layers as well as datasets.

Unsupervized object discovery

Following initiatives of Quentin Gabot (PhD), we started a collaboration with Benoit Cottereau (CNRS, IPAL) on the topic of complex valued neural networks as a model of spiking neural networks. The PhD of Johanna Rondonny, which started end 2025, is on the topic of unsupervized object discovery with complex valued neural networks. Complex valued neural networks with the magnitude and phase can be considered as models of spiking neural networks. This modeling perspective as well as the topic of unsupervized object discovery is part of the Biscuit topics of research.

6 Partnerships and cooperations

National initiatives

ANR

1- BioIndic-IA

Participants: Jérémy Fix.

Title: BIOINDICIA ANR-24-CE04-0345, PRCI

Duration: 48 months (01/10/2024 - 31/03/2029)

Coordinator: Martin Laviale

Partners:

- LIEC - Université de Lorraine
- LORIA - CentraleSupélec
- CEREGE - CNRS & Aix Marseille Université
- LPG - Université d'Angers
- IRL 2958 Georgia Tech CNRS
- EABX - INRAE
- Luxembourg Institute of Science and Technology

Loria contact: Jérémy Fix

Summary: The BIOINDIC-IA project main objective is to improvie aquatic ecosystem biomonitoring through the innovative combination of machine learning and imaging techniques. The project is structured around three core objectives. First, it aims to evaluate machine learning-based bioindicators of water quality for regulatory monitoring purposes. Second, it will develop deep learning algorithms specifically designed for species identification and morphological trait quantification. Third, the team will create robust image datasets through automated workflows, essential for model training and validation.

The project will develop automated, high-throughput imaging systems for both organism types, while creating unprecedented labeled image datasets that combine taxonomic and trait information. The team will also implement novel approaches to address the complex challenge of classifying highly similar species. This initiative promises several significant benefits for the field of aquatic biomonitoring. The machine learning approach will enhance robustness and reduce operator variability compared to traditional human-based methods, while delivering substantial time and cost savings. Furthermore, it will improve the ability to evaluate ecological status and distinguish between different types of anthropogenic pressures, supporting regulatory frameworks such as the Water Framework Directive and Marine Strategy Framework Directive.

The expected impact of BIOINDIC-IA extends beyond technical innovation. By modernizing aquatic ecosystem monitoring, it will provide faster, more robust, and more reliable assessment tools while maintaining high accuracy standards. Particularly significant is its potential to strengthen the position of benthic foraminifera as regulatory bioindicators for coastal ecosystems while simultaneously improving existing diatom-based monitoring approaches. This dual advancement represents a substantial step forward in our ability to monitor and protect aquatic ecosystems effectively.

2- SORLAHNA

Participants: Bernard Girau, Hervé Frezza-Buet, Jérémy Fix, Nasr Allah Aghelias, Alexis Gleyo.

Title: SORLAHNA ANR-23-IAS3-0001

Duration: 60 months (01/10/2023 - 30/09/2028)

Coordinator: Bernard Girau

Partners:

- LORIA - Université de Lorraine
- LORIA - CentraleSupélec
- IJL - Université de Lorraine

Loria contact: Bernard Girau

Summary: The preprocessing, categorization and visualization of data play an increasingly essential role with the exponentially increasing amount of digital data collected and stored in all fields. If the currently booming field of deep learning (DL) offers multiple possibilities to meet some of these needs, unsupervised learning is increasingly put forward to overcome some of its limits. Indeed, DL is based on the training of a complex parametric model to a huge set of data, provided during this training phase. The model, once trained, is then deployed in real applications, assuming that the statistics of the data then remain the same as those used in the learning phase. However, some contexts provide non-stationary data, whose statistics gradually drift over time. Having a parametric model of these data supposes that this model can derive with them. Models supporting continual or incremental learning must therefore be favoured to dynamically process such non-stationary data, in particular encountered by many embedded systems (internet of things - IoT, edge computing). Among the possible models, we are interested in models based on topographic vector quantization (self-organizing maps, incremental networks). The algorithmic simplicity and the distributed nature of the calculations of such models makes it possible to consider a hardware implementation of these algorithms, which takes on its full meaning in the context of embedded systems. The project that we propose therefore aims to combine complementary skills in computer science and electronics to co-design modern topographic vector quantization algorithms so as to integrate from their design the double requirement of an adequacy with online learning of non-stationary data, and a compatibility with a feasible and efficient hardware implementation, in particular using reconfigurable circuits allowing a flexibility that is unreachable on ASIC circuits. This co-design approach will lead to proposing generic hardware architectures based on innovative, highly configurable and scalable neural processing units (NPUs), which will help reduce the high dimensionality of the permanent data streams generated by IoT infrastructures, or even help building optimized layers for hybrid neural models aimed at continual learning.

3- SmartBioDiv

Participants: Jérémy Fix.

Title: Smart-Biodiv ANR-21-AAFI-0002

Duration: 48 months (01/01/2022 - 01/16/2026)

Coordinator: Cédric Pradalier (CNRS, Georgia Tech)

Partners:

- IRL 2958 Georgia Tech CNRS, local coordinateur
- LORIA - CentraleSupélec
- LIEC - Université de Lorraine
- LOV
- LOCEAN

Loria contact: Jeremy Fix

Summary: Marine environments are undergoing rapid change, and monitoring the state of their ecosystems is becoming critical. Such monitoring requires the collection of data, its processing and the extraction of indicators summarizing the state of the environment. However, data in environmental sciences is often sparse and unbalanced, posing a challenge for AI algorithms.

This leads to the two directions followed in the SMART-BIODIV proposal:

- Harnessing the power of machine learning algorithms to complement and process the sparse and unbalanced data we often encounter in environmental sciences;
- Design indicators to qualify the ecological status of the environments under consideration. We will also exploit the large image databases collected by the partners on marine plankton, and make them available to participants in the challenge.

Project website: Challenge IA-BioDiv

Multidisciplinary initiatives

1 - PSYPHINE

Participants: Yann Boniface, Alain Dutech.

Title: PSYPHINE

Duration: ongoing longterm multi disciplinary research project.

Partners:

- ATILF - Université de Lorraine
- AHP - PReST (Archives Poincaré) - Université de Lorraine
- IMN - INRIA Bordeaux
- Interpsy - Université de Lorraine
- ENSEA/ETIS - Université de Cergy
- LORIA - Université de Lorraine / INRIA

Summary: Our relationship to manufactured objects has been transformed in recent years by the appearance in many homes of objects capable of acting and perceiving, such as autonomous vacuum cleaners (iRobot), artificial companions (Aibo, Cozmo, Furby) or even artificial assistants (Amazon Echo, Apple Siri, Google Home) [1]. While these objects offer varying degrees of complexity, their main characteristic is that they interact with the environment and people. Yet understanding and analyzing these interactions requires the interweaving of numerous hypotheses, conditions and parameters that are ultimately very difficult to appreciate within a single scientific discipline. Anthropology, philosophy, psychology, neuroscience, robotics, computer science, sociolinguistics, art, design: all these disciplines, whether scientific or not, have something to contribute to the subject and to teach other disciplines.

To study these issues, the Psyphine group brings together researchers from different disciplines (anthropology, computer science, neuroscience, philosophy, psychology, sociolinguistics), from various laboratories at the University of Lorraine (ATILF, Interpsy, LORIA, AHP-Prest), the Institut des Maladies Neurodégénératives in Bordeaux, the Institut Jean Nicod in Paris and the Laboratoire d'Anthropologie Sociale at the EHESS.O

In that context, this year was more focussed on:

- participating to the group work and reflexion on annotation of multi-modal recording of human-behaviora object interactions.
- organising and participating to the multidisciplinar scientific conference "Drôles d'Objets 2025" (`https://drolesdobjets25.sciencesconf.org`).

7 Dissemination

7.1 Promoting scientific activities

7.1.1 Scientific events: organisation

- We continued to play a key role in establishing a scientific community around the themes explored during the "Drôles d'Objets" conference of 2023, by organizing "Drôles d'Objets" 2025 (joint organization with Orange Lab - Vannes, ETIS - Cergy Pontoise)

7.1.2 Journal and conference reviews

- **A. Dutech** : AAMAS'2026, ARLET'2025, EWRL'2025, ICML EXAIT Workshop'2025, JFPDA'2025, reviewer for a special issue of 'Philosophia Scientae'.
- **B. Girau** : reviewer for Frontiers in Computational Neuroscience, review editor for Frontiers in Neuromorphic engineering

7.2 Teaching - Supervision - Juries

7.2.1 Teaching

- As MCF or PU, **Yann Boniface**, **Jérémy Fix**, **Hervé Frezza-Buet** and **Bernard Girau** are teaching at least 192 HETD in various components of the Université de Lorraine or at CentraleSupélec, campus de Metz.
- Master IA2VR , Apprentissage Statistique et Deep Learning (13 HETD), Ingénierie Logicielle pour l'IA et la robotique (13 HETD), **Jérémy Fix**
- **Alain Dutech** : Master 2 Sciences Cognitives, UL (15 HETD, "Agents Intelligents"), 3A CentraleSupelec (21 HETD, "Reinforcement Learning").
- **Yann Boniface** is head of the "Parcours DWM" of the Computer Science Bachelor of the IUT Nancy-Charlemagne.
- **Bernard Girau** resumed his role as head of the "Département informatique" of the "Faculté des Sciences et Technologies" on October 1st, 2025.
- **Hervé Frezza-Buet** is head of the new Computer Science Diploma of CentraleSupélec. He teaches Machine Learning and Advanced C++ programming.

7.2.2 Supervision

- 3rd year CentraleSupélec project, "Holographie numérique et deep learning pour le suivi 3D de bactéries", 3 students supervised by **Jérémy Fix**, in partnership with the LEMTA laboratory (Simon Becker, Simon Louvet)
- 3rd year CentraleSupélec project, "Automatic extraction of electrocardiogram (ECG) time series", 3 students supervised by **Jérémy Fix** and Michel Barret, in partnership with the INSERM's IADI team (Julien Oster)
- 3rd year CentraleSupélec project, "Complex-valued contrastive learning withapplications to SAR imaging", 3 students supervised by **Jérémy Fix**, in partnership with the SONDRA laboratory
- Alexis Gleyo's internship, supervised by **B. Girau**, on "Modèles neuronaux auto-organisateurs sur circuits neuromorphiques", Université Paris Saclay
- Thomas Marqué's internship, supervised by **B. Girau**, on "Algorithmes neuronaux de quantification vectorielle pour l'apprentissage continu non supervisé", Université de Lorraine

- Naël Bensaadi's internship, supervised by **B. Girau**, on "Modèles neuronaux auto-organisateurs sur circuits neuromorphiques", Université de Lorraine
- 3rd year CentraleSupélec final project, "Reinforcement learning in a multi-SOM architecture" (OLIVEIRA GOMES Eric, BREHAT Paul), supervized by **H. Frezza-Buet**
- 3rd year CentraleSupélec final project, "Génération de distributions à partir de graphes" (Sohaib Choufani, Ameur Echaabi, Marouane Talaa), supervized by **H. Frezza-Buet**

7.2.3 Juries

- **A. Dutech**: reviewer and member of the jury for the PhDs of Nicolas CASTANET (15/01/2025) and Zhuofang XH (11/12/2025).

7.2.4 Internal or external responsibilities

- **A. Dutech** is the head of the "D5: Complex systems, Artificial Intelligence and Robotics" department of the Loria (2023 - ongoing)

7.2.5 Interventions

- **Y. Boniface**: invited speaker at the annual workshop of the 2RSHS science network (14th of october 2025). Presentation with V. André (ATILF - Nancy).
- **A. Dutech**: several "Procès du robot", a recurring mediation staged by the Inria NGE Center's Com' Department.
- **A. Dutech**: several screening-debates, "SF et AI", co-hosted with N. Dupuy (UL).

8 Scientific production

8.1 Major publications

[1] C. P. Collectif Psyphine. *Que prêtons-nous aux machines ? Approches interdisciplinaires des interactions homme-robot.* Ed. by C. P. : V. A. ; J. B. ; Y. B. ; A. B. ; A. D. ; V. G. ; F. L. ; M. R. ; M. R. ; N. R. ; F. Verhaegen. Presses Universitaires de Nancy, Sept. 2021, p. 242. URL: https://inria.hal.science/hal-03550469.

[2] J. Fix. 'Template based black-box optimization of dynamic neural fields'. In: *Neural Networks* 46 (2013), pp. 40–49. DOI: https://doi.org/10.1016/j.neunet.2013.04.008. URL: https://www.sciencedirect.com/science/article/pii/S089360801300124X.

[3] A. Fois and B. Girau. 'Enhanced representation learning with temporal coding in sparsely spiking neural networks'. In: *Frontiers in Computational Neuroscience* 17 (2023). DOI: 10.3389/fncom.2023.1250908. URL: https://www.frontiersin.org/articles/10.3389/fncom.2023.1250908.

[4] N. Gonnier, Y. Boniface and H. Frezza-Buet. 'Input Prediction Using Consensus Driven SOMs'. In: *ISCMI 2021:8th Intl. Conference on Soft Computing & Machine Intelligence.* Cairo, Egypt, Nov. 2021. DOI: 10.1109/ISCMI53840.2021.9654851. URL: https://hal.science/hal-03375134.

[5] N. P. Rougier and Y. Boniface. 'Dynamic Self-Organising Map'. In: *Neurocomputing* 74.11 (2011), pp. 1840–1847. DOI: 10.1016/j.neucom.2010.06.034. URL: https://inria.hal.science/inria-00495827.

8.2 Publications of the year

International journals

[6] C. Galinier, P. Villefourceix-Gimenez, C. Bojic, C. E. Wetzel, J. Fix, S. Morin and M. Laviale. 'DIATLAS - The French freshwater DIatom ATLAS image dataset'. In: *Zenodo* (2025). DOI: 10.5281/zenodo.16260887. URL: https://hal.inrae.fr/hal-05505612.

[7] J. Becker, V. André and A. Dutech. 'Experimenting Meaning in Human-Robot Interactions'. In: *Cybernetics and Human Knowing* 31.3-4 (Dec. 2024), pp. 69–89. URL: https://hal.science/hal-05000369.

International peer-reviewed conferences

[8] J. Fix, Q. Gabot, X. H. Nguyen, J. Frontera-Pons, C. Ren and J.-P. Ovarlez. 'torchcvnn: A PyTorch-based library to easily experiment with state-of-the-art Complex-Valued Neural Networks'. In: International Joint Conference on Neural Networks. Rome, Italy: IEEE, 30th June 2025, pp. 1–9. DOI: 10.1109/IJCNN64981.2025.11229081. URL: https://centralesupelec.hal.science/hal-05235749.

[9] X. H. Nguyen, C. Ren, J. Fix, J.-P. Ovarlez and J. Frontera-Pons. 'VAE pour la détection d'anomalies en imagerie SAR'. In: GRETSI 2025. Strasbourg, France, 25th Aug. 2025. URL: https://centralesupelec.hal.science/hal-05235797.

[10] A. Gleyo and B. Girau. 'Population coding to improve fault tolerance of neuromorphic networks in regression tasks'. In: *Proceedings of the DATE 2026 conference (accepted on Nov. 10, 2025, to be published)*. Vérone / Verona, Italy, Apr. 2026. URL: https://inria.hal.science/hal-05450820.

Conferences without proceedings

[11] P. Villefourceix-Gimenez, C. Galinier, C. E. Wetzel, C. Bojic, J. Fix, S. Morin and M. Laviale. 'De l'intérêt de l'approche participative entre diatomistes : de l'exploitation des atlas taxonomiques à la mise à disposition d'outils informatiques à l'usage de la communauté'. In: 43ème Colloque de l'Association des Diatomistes de Langue Française (ADLaF). Rouen, France, 8th Sept. 2025. URL: https://hal.inrae.fr/hal-05254580.