Johannes Nauta

Dr./Ph.D./Ir.

4 August, 1994

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About me

Postdoctoral researcher with the goal of unraveling how local mechanisms affect global dynamics in complex systems. I am most interested in mechanisms that facilitate long-term stability in ecological systems under the influence of perturbations.

Programming & tools

Julia

LaTeX

Python

Bash

Git

Languages

Dutch (native)

English (full professional proficiency)

German (limited proficiency, B1)

Italian (novice, A1)

[Scales are from 0 (novice) to 6 (native)]

Summary

Postdoctoral researcher at the University of Padova studying how local mechanisms affect global dynamics in complex systems. More specifically, I focus on ecological systems and aim to unravel the mysteries behind their apparent stability in a rapidly changing world. To this end, I take an interdisciplinary approach and employ tools from mathematics and physics to study the stability and change of ecological systems that are affected by perturbations.

Positions

2023-now Postdoctoral researcher (University of Padova)
Project description: Mathematical modeling of complex systems with a specific focus on developing compartment models and reaction-diffusion systems for researching the influence of pathogens on population dynamics and community composition in microbial systems.

Education

2017-2022 Ph.D. in Computer Science Engineering (Ghent University)
Defense: January 13th, 2022
Dissertation title: "*The interplay between resource distributions and optimal foraging behavior: from individuals to populations*"

2015-2017 M.Sc. Physics- and Astronomy (Radboud University)
(Minor: Neuroscience)
Thesis title: "*On path integrals, trust regions and Feynman diagrams*"

2011-2015 B.Sc. Physics- and Astronomy (Radboud University)
(Minor: Computational Physics)
Thesis title: "*Synaptic pruning in the aging brain using Hopfield networks*"

Highlighted projects

2023-now Human Frontiers Science Program (International research project)
Three year international and interdisciplinary project on how ecological network dynamics mediate the response of organisms to novel environments. The project is a joint collaboration with experimentalists (Liverpool, United Kingdom), ecologists (Be'er Sheva, Israel) and theoreticians (Padova, Italy). This project realizes a unique international collaboration that bridges ecology and evolution, microbiology, and statistical physics.

Selected publications

▷ **Johannes Nauta**, Pieter Simoens, Yara Khaluf, and Ricardo Martinez-Garcia. "Foraging behavior and patch size distribution jointly determine population dynamics in fragmented landscapes". In: *Journal of the Royal Society Interface* 19.191 (2022), p. 20220103

▷ **Johannes Nauta**, Yara Khaluf, and Pieter Simoens. "Resource ephemerality influences effectiveness of altruistic behavior in collective foraging". In: *Swarm Intelligence* (2021), pp. 1–31

Full list of publications

Main author:

▷ **Johannes Nauta**, Pieter Simoens, Yara Khaluf, and Ricardo Martinez-Garcia. "Foraging behavior and patch size distribution jointly determine population dynamics in fragmented landscapes". In: *Journal of the Royal Society Interface* 19.191 (2022), p. 20220103

▷ **Johannes Nauta**, Yara Khaluf, and Pieter Simoens. "Resource ephemerality influences effectiveness of altruistic behavior in collective foraging". In: *Swarm Intelligence* (2021), pp. 1–31

▷ Johannes Nauta, Pieter Simoens, and Yara Khaluf. "Group size and resource fractality drive multimodal search strategies: A quantitative analysis on group foraging". In: *Physica A: Statistical Mechanics and its Applications* 590 (2022), p. 126702

▷ **Johannes Nauta**, Yara Khaluf, and Pieter Simoens. "Hybrid foraging in patchy environments using spatial memory". In: *Journal of the Royal Society Interface* 17.166 (2020), p. 20200026

▷ **Johannes Nauta**, Stef Van Havermaet, Pieter Simoens, and Yara Khaluf. "Enhanced foraging in robot swarms using collective Lévy walks". In: *ECAI2020, the 24th European Conference on Artificial Intelligence*. Vol. 325. 2020

▷ **Johannes Nauta**, Pieter Simoens, and Yara Khaluf. "Memory Induced Aggregation in Collective Foraging". In: *International Conference on Swarm Intelligence*. Springer. 2020, pp. 176–189

Co-author:

▷ Ilja Rausch, **Johannes Nauta**, Pieter Simoens, and Yara Khaluf. "Modeling the Influence of Social Feedback on Altruism using Multi-Agent Systems". In: *Artificial Life Conference Proceedings*. MIT Press. 2020, pp. 727–735

▷ Ozan Çatal, Tim Verbelen, **Johannes Nauta**, Cedric De Boom, and Bart Dhoedt. "Learning perception and planning with deep active inference". In: *ICASSP 2020-2020 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. IEEE. 2020, pp. 3952–3956

▷ Ozan Catal, **Johannes Nauta**, Tim Verbelen, Pieter Simoens, and Bart Dhoedt. "Bayesian policy selection using active inference". In: *Workshop on "Structure & Priors in Reinforcement Learning" at ICLR 2019, Seventh International Conference on Learning Representations*. 2019

Scientific experience

Conference talks:

2023 — Presentation at CCS/Italy 2023 (Naples, Italy) (Conference talk)
Oral presentation on linear stability of meta-ecosystems using random matrix theory.
Title: "*Dispersal and network topology strongly influence meta-ecosystem stability*"

2020 — Presentation at ANTS2020 (online) (Conference talk)
Presented full-length paper on how shared memory can induce aggregation in collective foraging.
Title: "*Resource ephemerality influences effectiveness of altruistic behavior in collective foraging*"

2020 — Presentation at ECAI2020 (online) (Conference talk)
Presented full-length paper on collective behavior that can enhance foraging efficiency of a robot swarm.
Title: "*Enhanced foraging in robot swarms using collective Lévy walks*"

2019 — Presentation at COMPLEXIS2019 (Heraklion, Greece) (Conference talk)
Presentation about Ornstein-Uhlenbeck process and its applications for exploration in Reinforcement Learning.
Title: "*Using the Ornstein-Uhlenbeck process for random exploration.*"

Funded projects:

2023-now — Human Frontiers Science Program (Interdisciplinary research)
Three year international and interdisciplinary project on how ecological network dynamics mediate the response of organisms to novel environments.

2018 — RoboCure (Interdisciplinary research)
One-year project within an interdisciplinary team on medical applications of Human-Robot Interfaces.

Teaching experience

2019-now **Lab assistant – Informatics (Python)** (Teaching)
Teaching first year engineering students the basics of programming in Python by assisting weekly lab sessions and supervising and correcting exams.

2018-2019 **Master thesis supervision** (Supervisor)
Supervising students' research for thesis in Computer Science Engineering.
Thesis title: "*Evolving exploratory agents for model-based Reinforcement Learning*"

Technical skills

* **Efficient scientific computing** (General scientific computing)
Implementing numerical simulations using parallelized and compiled Python code to greatly decrease computation times of complex, particle-based simulations. Implementing efficient grid-based architectures for fast neighbor detection in interacting systems.

* **Computing on powerful remote computer clusters** (Cloud-based infrastructure)
Parallelization of simulations of collective (foraging) systems that take advantage of cloud-based, high-performance computing systems.

Additional relevant experience

2018-2021 **Ambassador of Ph.D. community Ghent** (Association for Ph.D. students)
Aiding with events organized for Ph.D. students at Ghent University.

2016-2017 **Employee of Sportproductions** (Sports events)
Employee of company that organizes sports events for team-building, business outings, etc. Work consisted of running events and training sessions.