

SPECIES Scholarship Host Institute

Computational Intelligence Group, Vrije Universiteit Amsterdam, The Netherlands

1. CV of the advisor

Dr. Anil Yaman (<https://www.anilyaman.com/>) is an Assistant Professor in the Computational Intelligence Group (<https://cs.vu.nl/ci/>) at the Vrije Universiteit Amsterdam. He received his PhD in Computer Science from the Eindhoven University of Technology (TUE) in 2020. His main areas of research include: nature-inspired individual and social learning, evolutionary computing, artificial neural networks, multi-agent systems.

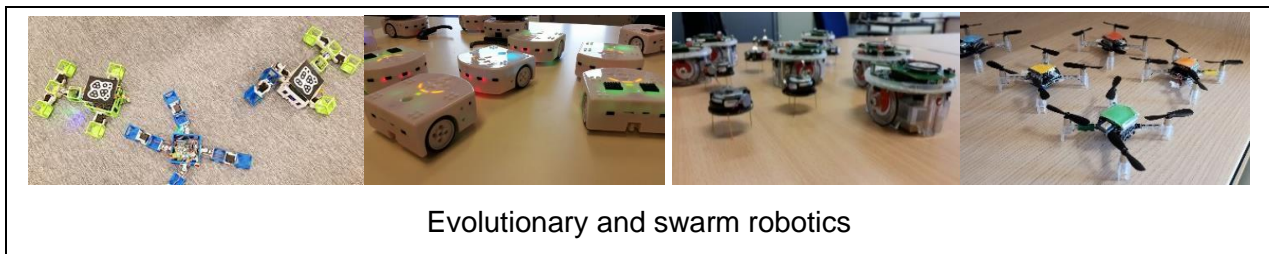
Experience

Assistant Professor, Vrije Universiteit Amsterdam, Amsterdam, The Netherlands	12.2021 – Present
Postdoctoral Researcher, KAIST, Daejeon, Republic of Korea	03.2020 – 11.2021
PhD, Eindhoven University of Technology, Eindhoven, The Netherlands	11.2015 – 11.2019
Researcher, Dep. of Biomedical Informatics, Columbia University, New York, USA	11.2013 – 09.2015

2. Research in the Computational Intelligence Group

The Computational Intelligence Group is specialized in the nature-inspired computational methods where fundamental research questions concern how to design, use, and understand intelligent systems consist of autonomous agents that can self-organise, evolve, and learn. In particular, we work in evolutionary computing, machine learning and complex systems for optimization, modeling, robotics and sensory data processing.

The group has developed Revolve2 (<https://github.com/ci-group/revolve2>) platform to conduct evolutionary robotics and artificial life research projects on simulation. In addition, we have a bio-inspired robotics lab (<https://cs.vu.nl/ci/index.php/robot-lab/>) where these projects are tested and validated in real world on hardware. Images below show some of the projects from evolvable modular robotics and swarm robotics projects. For instance, the robotics platforms we possess include Crazyflie, Thymio, Kilobot and Robobo.



Our group is led by Prof. Dr. Agoston E. (Gusz) Eiben (<https://www.cs.vu.nl/~gusz/>), an expert in evolutionary computing and evolutionary robotics. Our group hosts researchers (faculty members, PhD and master's students) with diverse background, and is connected to a large collaborative network of researchers all around the world.

3. The work to be carried out by the student

The following topics are actively researched on and thus available within the scholarship period. Please feel free to contact me if you have any questions or require further information.

A. Social learning strategies and cultural evolution models:

This project aims to design efficient and effective individual and social learning approaches in a population of lifetime-learning agents [1, 2], and spread and evolution of cultural knowledge. Some of the key questions include:

- How to design meta-learning strategies that can effectively use individual and social learning to provide optimum learning as a collective of lifetime-learners [1]?
- How can a group level collective knowledge emerge and evolve to benefit to the individuals in the collective system [3]?

B. Learning generalist controllers:

This project aims to design controllers that can generalize to various environments and tasks. Previously, we proposed approaches to learn robust/generalizable artificial neural network (ANN) based controllers to function well on a wide range of environments/tasks without need for retraining [4]. Future research aims to improve the generalizability of the controllers and efficiency of these training processes.

C. Real world embodied learning/evolution:

The behaviors learned in simulations are often not transferable to the real world due to the reality gap. To avoid this issue, it is possible to optimize the controllers directly in real world. However, this is very costly process. This project aims to propose efficient approaches that can be used to improve the optimization processes of controllers in real world. We use our modular robotic platform available in our group to demonstrate the efficiency of the proposed approaches.

D. Neuroscience-inspired AI:

This project aims to develop learning and decision-making models inspired by neuroscience to improve information processing of ANNs [5]. In particular, we are interested in learning spatial representations inspired by various types of cells in the brain.

E. Learning representations and evolutionary exploration in complex design spaces:

Extending on our previous work [6], this project aims to learn representations of complex design spaces such as Art images, and perform evolutionary search process (also in collaboration with humans) to discover various kinds of designs efficiently.

References:

- [1] Yaman, A., Bredeche, N., Çaylak, O., Leibo, J. Z., & Lee, S. W. (2022). Meta-control of social learning strategies. *PLoS computational biology*, 18(2), e1009882.
- [2] Yaman, A., & Iacca, G. (2021). Distributed embodied evolution over networks. *Applied Soft Computing*, 101, 106993.
- [3] Yaman, A., Leibo, J. Z., Iacca, G., & Wan Lee, S. (2023). The emergence of division of labour through decentralized social sanctioning. *Proceedings of the Royal Society B*, 290(2009), 20231716.
- [4] Triebold, C., Yaman, A. (2024). Evolving generalist controllers to handle a wide range of morphological variations. GECCO'24. <https://arxiv.org/abs/2309.10201>
- [5] Yaman A, Iacca G, Mocanu DC, Coler M, Fletcher G, Pechenizkiy M. Evolving Plasticity for Autonomous Learning under Changing Environmental Conditions. *Evolutionary Computation*. 2020. DOI: 10.1162/evco_a_00286
- [6] Hall, O., & Yaman, A. (2024). Collaborative Interactive Evolution of Art in the Latent Space of Deep Generative Models. In *International Conference on Computational Intelligence in Music, Sound, Art and Design (Part of EvoStar)* (pp. 194-210). Cham: Springer Nature Switzerland. (*EVOMUSART best paper award*)

4. Other relevant information

Amsterdam is one of the well-connected hubs in Europe with a population of 1.1 million. It is a vibrant city with diverse international community. It offers lots of interesting and historical places such as museums, exhibitions, restaurants and social life.

The Vrije Universiteit Amsterdam (VU, <https://vu.nl/en>) is a public research university in Amsterdam. It ranks among the top 150 universities in the world. Its campus is located in the south of Amsterdam next to the Zuidas business district. For virtual tour, see <https://www.youvisit.com/tour/vuamsterdam>.

Accommodation

The university may be able to help with the accommodation by providing a place to stay close to the university for a relatively lower price. In addition, the international office helps with the administration and visa application.

(see <https://vu.nl/en/education/more-about/looking-for-accommodation-in-amsterdam>)