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NATURE **4** NATURE

Doctoral Candidate (DC6): Experimental evaluation of filtration performance and hydrodynamics of 3D-printed bioinspired prototypes

Host Institution: University of Groningen, The Netherlands

Secondments: Hochschule Bremen, Germany (HSB; 5 months)

Fraunhofer IWS, Germany (FHIWS; 6 months)

About Nature4Nature

Bioinspiration (including biomimetics and biomimicry) develops novel materials, devices, and applications inspired by biological structures and strategies. However, the main obstacle preventing this field from achieving its goals derives from differences in tools, practices and viewpoints of its practitioners. The EU-funded Nature4Nature project brings biologists, engineers, designers and manufacturers together to deliver early-stage researchers (ESRs) teaching in a learning environment that connects the inspiration, integration and implementation aspects of the bioinspiration process to undertake the conceptual, methodological and practical challenges. To do so, the project will collectively focus on biological filtration mechanisms to explore, test and design high-throughput, clog-resisting filtration systems, which could ultimately alleviate the current problems facing aquatic environments.

University of Groningen

The University of Groningen (UG), founded in 1614, enjoys an international reputation as one of the oldest and leading research universities in Europe. It is a top 100 research university with a global outlook: The UG is currently ranked in 64th place (August 2021) on The Academic Ranking of World (Shanghai ranking) and 80 (2020) on the Times Higher Education ranking. The university has over 30,000 students, more than 8000 international students and about 6,000 employees, of which 3000 are R&D personnel, and an annual turnover of around €800 million. One of its scientific spearheads is the cluster of engineers, chemists, biologists and physicists of the Faculty of Science and Engineering (FSE) that intensively collaborate to generate fundamental understanding of natural processes and to exploit this knowledge for building designs and devices for novel applications.

The Biomimetics Group, partner in this consortium, is part of the Energy & Sustainability Research Institute Groningen (ESRIG) and is co-chaired by Prof. Dr. D. Lentink and Prof. Dr. E.J. Stamhuis. The aim of the group, currently hosting 2 postdocs, 8 PhD students, 3 technicians and 8 Master students, is to study organismal form and function regarding fluid handling processes such as swimming, flying, maneuvering, filtration, etc. Results from these rather fundamental studies are in many cases used to either design and perfect technical solutions that can be applied in everyday life, or to innovate, improve or perfect industrial processes and thereby e.g. become more sustainable and/or save energy. Many research projects lean on cooperation with industrial partners to safe-guard the application-side of such studies.

Project description

In an aquatic environment a wide-spread principle of collecting food particles is by filtration. Although filter feeding is found in almost all aquatic/marine animal groups, this project will concentrate on vertebrates, namely fish and birds. A number of animal filtration systems will serve as models to derive technical filtration systems from that should not be clogging when functional and can thereby inspire to improve existing industrial/technical filtration systems or inspire to develop new systems. The objective is to develop and realize physical prototypes of biomimetic filter systems that will then be evaluated for their filtration performance. The analysis will start with a study on filtration in manta ray-inspired designs based on existing literature. The efficiency will be quantified in terms of (1) particle concentration and sizes in filtrate versus unfiltered streams, (2) flow energy demands, and (3) their performance in single-pass configurations. Together with results from DC5 (see website for more information), design improvements will be implemented and evaluated. Flow visualization on physical models of other animal groups, such as cross-step filtering paddlefish and pulsatile crossflow filtering ducks, will be performed to validate computational models of DC5, and to be integrated with the results of DC4 to uncover the biomechanical principles involved. Initial results from DC4 may also serve as input for model development.

You will mainly be working at the Biomimetics Group (BMM) of the Energy & Sustainability Institute Groningen (ESRIG) of the University of Groningen (UoG), The Netherlands. Models will primarily be developed and produced using Computer Aided Design and HiRes 3D printing. Tests will be performed in our flow laboratories using classic quantification methods to assess filter efficiency and analyze for hydrodynamic functioning using Particle Image Velocimetry (PIV). 3D prototyping will

be further developed during a secondment to Fraunhofer IWS and comparisons with Computational Fluid Dynamics analyses will be performed during a secondment to the HSB (Dept of Biomimetics).

Profile & requirements

- Applicants must hold a master's degree or equivalent in the fields of Biology, (Applied) Physics or Mechanical Engineering
- Transcripts of the master's degree must be available by the date of the recruitment
- Applicants should have a strong affinity with research on animal morphology and biomechanics
- Applicants should have a strong affinity with CAD and hydrodynamics and a basic knowledge of programming (e.g. MATLAB, Python, or other)
- Applicants may be of any nationality but must comply with the Horizon Europe MSCA eligibility criteria*
- Applicants must be able to understand and express themselves in both written and spoken English to a level that is sufficient for the completion of a PhD
- All qualified applicants, including minorities and woman, are encouraged to apply

* **HORIZON MSCA Mobility Rule:** Applicants must not have resided or carried out their main activity (work, studies, etc.) in the country of the host organization (The Netherlands) for more than 12 months in the past 3 years immediately before the recruitment date. Compulsory national service, short stays such as holidays, and time spent as part of a procedure for obtaining refugee status are not taken into account.

* **HORIZON MSCA eligibility criteria:** Applicants may not hold a doctoral degree or equivalent at the start date of the recruitment. Researchers who have successfully defended their doctoral thesis but who have not yet formally been awarded the doctoral degree will not be considered eligible.

Benefits

- The selected candidate will be employed by the host organisation for **36 months***
 - **The start date will be as of September 1st, 2023**
 - The opportunity to be part of an MSCA Doctoral Network: the selected candidate will benefit from the designed training programme offered by the host organisation and the Nature4Nature consortium.
 - The selected candidate will participate in international secondments to other organisations within the Nature4Nature network.
 - Doctoral candidates are offered a competitive remuneration in line with the MSCA Doctoral Networks salary scale (see PDF on website), and consists of a monthly *Living Allowance*, *Mobility Allowance* and *Family Allowance* (if applicable).
 - Costs associated with the network and training events are to be covered by the host institution
- *An additional year's funding available from the host university, based on satisfactory progress.

Application

- Interested candidates are invited to apply for this position: <https://www.rug.nl/about-ug/work-with-us/job-opportunities/?details=00347-02S0009WWP>
- The closing date for applications is **March 14th, 2023**.
- The selection committee will review all the applications upon the application deadline.
- The recruitment process of Nature4Nature is in line with the principles set out in the [European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers](#).
- Ukrainian researchers are eligible to benefit from the Science4Refugees initiative without the need of holding the refugee status.

Additional information

- For more information on the Nature4Nature consortium, please visit our website at <https://www.nature4nature.net/>
- Any additional questions can be directed to the project manager, Genevieve Diedericks, at Genevieve.Diedericks@uantwerpen.be



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