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NATURE 4 NATURE

Doctoral Candidate (DC1): Towards a rapid and efficient pipeline for the digitization of natural history specimens for bioinspired design: An integrated tomographic, additive manufacturing, and modelling-based approach

Host Institution: Stellenbosch University, South Africa
Secondments: Hochschule Bremen, Germany (HSB; 5 months)
Fraunhofer IWS, Germany (FHIWS; 5 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.

Stellenbosch University

Stellenbosch University (SU) is among South Africa's leading tertiary institutions based on research output, student pass rates and rated scientists, and is recognised internationally as an academic institution of excellence. This is confirmed by two world university rankings including the 2023 Times Higher Education World University Rankings (ranking SU in the 251-300 category in the world and second in Africa). The Leiden University ranked Stellenbosch 455th out of the top 500 universities worldwide on its CWTS Leiden Ranking list of 2022. This list also ranked the university second in both South Africa and Africa. SU also boasts the second-highest number of scientists in South Africa who have been ranked by the National Research Foundation (NRF) – 490 in August 2022. For the proposed Doctoral Network the efforts of a leading research group “3D Innovation” of Prof Anton du Plessis is proposed. The group is active in additive manufacturing, x-ray tomography and biomimicry research topics. The focus in this proposed work will be on the biomimetic design aspect as well as x-ray tomography for biomimetic design inspiration. The Research Group 3D Innovation aims to push the boundaries of biomimetic design using additive manufacturing, leading to new products and improved performance of existing products, using design inspiration from nature. As a leader in additive manufacturing, Prof du Plessis also draws on experience and knowledge in additively manufactured materials and processes to achieve this.

Project description

Lack of awareness of existing biodiversity and access to quantitative or ‘tangible’ biodiversity information has led most practitioners working in the field of bioinspiration to focus on a limited number of biological organisms. Facilitating exposure to biodiversity data for bioinspired design could reduce this bottleneck and significantly increase the scientific output and innovation potential. Recent progress on the digitization of natural history specimens and the resulting growth in collection databases (e.g., Morphosource) may prove to be extremely useful in this regard, particularly when it comes to discovering meaningful data for bioinspired design. To fully exploit their potentialities and adapt their use for bioinspiration, the candidate will develop a rapid and efficient pipeline for the digitization of natural history specimens, which will be subjected to validation by means of micro-computed tomography, additive manufacturing, and computational simulations.

In particular, the candidate will (1) develop optimized and standardized methodologies for the 3D digitization of natural history specimens using (micro-computed) tomography. For this purpose, high-quality 3D models will be generated for a diversity of filter feeding organisms spanning a broad size range. The limitations and challenges of using (micro)CT data for bioinspiration, and the usefulness of 3D data deposited in publicly accessible repositories, will be explored; (2) build on the recent advances in deep learning image segmentation and automation tools to transform raw tomographic data into a three-dimensional format for efficient usage in bioinspired design; (3) test the suitability of the generated data for computational simulation to accurately predict the functional characteristics of the model (HSB) and enable them to satisfy the demands for additive manufacturing in terms of quality and dimensional accuracy (FHWS). The knowledge and data

gathered by the candidate will be used as a proof-of-concept to validate the feasibility of an open access repository for bioinspiration with can be consulted by practitioners in search of biological solutions to technical problems.

Profile & requirements

- Applicants must hold a master's degree or equivalent in the fields of Physics or Engineering
- Applicants should have basic knowledge of microCT imaging or practical experience with scientific image processing
- Transcripts of the master's degree must be available by the date of the recruitment
- Applicants should have a strong affinity for research
- 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 (South Africa) 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 **32 months**
- **The start date will be April 1st, 2024**
- 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 based on the MSCA allowances in line with the MSCA WP 2021-2022. Moreover, funding is available for technical and personal skills training and participation in international research events.
- Costs associated with the network and training events are to be covered by the host institution.

Application

- Interested candidates are invited to apply for this position by sending their letter of motivation and CV to anton2@sun.ac.za and Genevieve.Diedericks@uantwerpen.be
- The closing date for applications is **February 15th, 2024**.
- 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

