

2 PhD positions in Cardiovascular Modeling and Inverse Problems

Organisation

Founded in 1614, the University of Groningen enjoys an international reputation as a dynamic and innovative institution of higher education offering high-quality teaching and research. Flexible study programs and academic career opportunities in a wide variety of disciplines encourage the 30.000 students and researchers alike to develop their own individual talents.

Within the Faculty of Science and Engineering, the Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence conducts research along several research areas, including Computational Mathematics and Mechanics.

Job description

The Computational Mathematics group of the University of Groningen has **two four-year PhD positions** on imaged-based numerical modeling of the cardiovascular system. The positions are embedded in the project "*CardioZoom: High-Fidelity Cardiovascular Modeling from super-fast Magnetic Resonance Imaging*", a 1.5M Euro, 5-year ERC-Starting Grant awarded to Dr Cristóbal Bertoglio by the European Research Council. Therefore, the PhD candidates will join a vibrant and collaborative research group, with access to a large, (inter)national and multidisciplinary scientific network.

Context and relevance of the project

Biophysical computational models of the cardiovascular system need to be adapted to each particular patient from clinical data. The state-of-the-art imaging method for assessing cardiovascular diseases is Magnetic Resonance Imaging (MRI), which is hence the preferred source of data for the personalization of the models. However, MRI is still not able to reliably image the kinematics of thin structures like cardiac valves and the arterial wall. Moreover, MRI measurements of the 3D kinematics of the heart are a challenging task. These restrictions hamper the clinical translation of patient-specific modeling. Therefore, a new paradigm for model personalization is urgently needed. The ambition of *CardioZoom* is to propose novel methods for biophysical parameter estimation in

computational models of the heart, large vessels and valves using MRI data acquired in very short scan times. The approach will be based on the deep integration imaging and biophysical principles, relaxing the constraints of standard cardiovascular imaging implying long MRI scans. Extensive validations using experimental (phantom) data will be performed and tests on volunteer and patients' data are planned. The findings of *CardioZoom* will allow obtaining clinically feasible, detailed characterizations of the cardiovascular system.

Position 1

The goal of the proposed doctoral research is to develop robust, efficient, and flexible numerical algorithms to estimate mechanical properties of cardiovascular tissue (blood vessels, heart) from state-of-the-art MRI measurements.

Position 2

The goal of the proposed doctoral research is to develop robust, efficient, and flexible numerical algorithms for estimating relevant properties of cardiac valves from state-of-the-art MRI measurements.

Therefore, the successful candidates will gain expertise in numerical mathematics, computational (fluid) mechanics, inverse problems, and medical imaging, areas where our group has a recognized international position.

The graduate school also offers training plan tailored to the background and interests of the candidate. The positions involve a small teaching load (about 0.1 fte, which may include supervision of student projects) in topics directly related to the research project.

Qualifications

We look for talented and dedicated candidates with an MSc degree (or equivalent) in Applied/Computational/Technical Mathematics, Theoretical Engineering (Mechanical/Civil) or Physics. The candidate has to possess excellent communication skills in English and be enthusiastic to work in a team.

Strong programming experience in Python or other similar language is a must. It is also mandatory to have proved experience in implementing, analysing and critically assessing numerical methods fluid and/or solid mechanics problems, e.g. through an outstanding performance during the Master's project.

Knowledge of inverse problems and/or medical imaging is an advantage. The ideal candidates will also have a deep commitment to interdisciplinary work and highly motivated for biomedical applications.

Conditions of employment

The University of Groningen offers a salary of € 2,325 gross per month in the first year up to a maximum of € 2,972 gross per month in the fourth year. It is a temporary assignment for a period of four years. First, you will get a temporary position of one year with the perspective of prolongation with another three years. Before the end of the first year, there will be an evaluation as to the feasibility of successful completion of the PhD thesis within the next three years.

The University of Groningen has adopted an active policy to increase the number of female scientists across all disciplines of the University. Therefore, female candidates are especially encouraged to apply.

The ideal start of the project for **Position 1** is February 1st 2020. However, other (earlier/later) arrangements may be possible. The start of **Position 2** is flexible within 2020.

Expressions of interest

You can express your interest for (one of) these positions continuously. However, a first assessment of the candidates will be performed on November 1st 2019.

Please send to c.a.bertoglio@rug.nl the following documentation:

1. A full curriculum vitae
2. A cover letter explaining your motivation to join the project
3. contact information of two references.

For more details about the motivation and methods involved in the project we recommend to read Chapters 1,3 and 5 of this thesis (<https://tel.archives-ouvertes.fr/tel-00768188/>).

For information you can contact:

- Dr Cristóbal Bertoglio, c.a.bertoglio@rug.nl
- Cardiovascular Mathematics Team: www.math.rug.nl/~bertoglio