

Faculty of Science and Engineering

Profile report: Medical Robotics (Medische Robotica)

- Discipline: Biomedical engineering, medical robotics, advanced medical devices
- Level: full professor
- Fous: Research
- Fte: 1,0 fte

1. Scientific discipline

The position is dedicated to a novel line of research and design of medical robots and advanced medical devices. Research takes place in a multidisciplinary environment in close cooperation with research in basic and medical sciences, and will lead to clinical translation.

2. Vacancy

This position is opened by the Board of the Faculty of Science and Engineering in the context of the sectorplan Engineering and will be embedded in the Engineering and Technology institute Groningen (ENTEG), new base unit *Medical Robotics* (working title). The position falls within the framework of the faculty's career system [Career Paths in Science and Engineering](#). As the focus domain of the position is research, the criteria of the career path with a focus on research apply. Please see the link above for more information.

3. Selection committee (BAC)

- Prof. dr. B. Jayawardhana (chair), director ENTEG, professor of Mechatronics and Control of Nonlinear Systems;
- Prof. dr. G.J.W. Euverink, education director ENTEG, professor of Products and Processes for Biotechnology in the Biobased Economy
- Prof. dr. ir. E. van der Giessen, director of Biomedical Engineering bachelor programme, professor of Applied Physics, in particular, Micromechanics (Zernike);
- dr Elisabeth Wilhelm (F), assistant professor ENTEG;
- Prof. E. Consten (F), University Medical Center Groningen (UMCG)
- Prof dr. M. Steinbuch, TUE
- student member (name will follow)

Advisors

- dr. J. Sjollema, director of Biomedical Engineering master programme, University Medical Center Groningen (UMCG)
- Dr. A.G.P. Kottapalli, associate professor ENTEG
- Mr. F. Salverda (HR advisor)
- Dr. K.E. Voskamp (scientific coordinator ENTEG)

4. Research area

Medical Robotics is a rapidly expanding field on the cross-roads between science and engineering with the aim to support and improve surgical interventions, diagnosis, drug delivery and rehabilitation treatment. The field encompasses precision instruments that can be deployed by

medical doctors for invasive and minimally invasive surgery and for visualisation, diagnosis, and treatment, and also includes patient-focused robot-assisted prosthetic and orthotic devices. In the past two decades, the field has led to the development of, for instance, laparoscopy and the surgical da Vinci robot, techniques that are now widely used in hospitals.

The position is expected to contribute to the research of novel medical robotics/devices that are aligned to the technological development within HTRIC (Health Technology Research and Innovation Cluster), particularly, on the Operating Theatre of the Future. This includes laparoscopic or robot-assisted surgical systems, novel actuator systems, image-guided medical tools and digital twin for medical devices. As identified in a review in *Science Robotics*¹, common themes in these topics are active/intelligent materials, haptic feedback, medical imaging techniques, instrumentation, control (f.e. digital twinning), and innovative design and manufacturing. For example, novel actuator systems and novel robot-assisted surgical systems will allow flexible and accurate navigation that is supported by digital twin decision systems. The expected research outcomes are the reduction of intraoperative collateral damage and operation time, thus improving patient outcomes, survival, and in case of robotic orthotic devices, improving quality of life. Complementary to innovative actuator systems research may also include soft sensor technology and composite materials.

5. Embedding: institute (and base unit)

ENTEG is the engineering science and technology institute of the faculty of Science and Engineering (FSE) of the University of Groningen. ENTEG research is highly multidisciplinary in nature and focuses on fundamental and engineering research on the development of new and innovative processes and products. The research of ENTEG is conducted in three key research domains:

- Sustainable chemical engineering & biotechnology.
- Mechanical, materials & robotics engineering;
- Optimisation, systems & control;

ENTEG staff strongly links to various engineering degree programmes, such as the bachelor and master programmes in Industrial Engineering and Management, Chemical Engineering, Mechanical Engineering and Biomedical Engineering.

The candidate will serve as the chair of a new base unit *Medical Robotics* (working title) that will be embedded within ENTEG. In the long run additional tenure track assistant professor(s) could be embedded in the base unit.

6. Local and (inter)national position

This position is created to strengthen the faculty's profile in the research area of biomedical engineering and to strengthen its contribution to the Biomedical Engineering (BME) degree programmes. It is strategically located in ENTEG to effectively integrate basic sciences (including physical chemistry and biology) through design and other engineering tools (including applied mathematics, computer science, AI, systems and control) in conjunction with clinicians in the UMCG and local companies. In addition to research and technical innovation, regulatory and manufacturing aspects are incorporated to facilitate swift translation toward clinical applications. Being the proverbial 'spider in the web' of FSE and UMCG, the new position fits seamlessly in the mission of the Health Technology Research and Innovation Center (HTRIC) at UG and will fill a gap between the themes *Operating Theatre of the Future* and *Innovative Technology with Local*

¹ Dupont *et al.*, *Sci. Robot.* **6**, [eabi8017](#) (2021)

Precision. Apart from the northern med-tech industry (represented, for example, by Life-Cooperative), HTRIC encompasses both the faculty of Science and Engineering and the faculty of Medical Sciences as well as local Universities of applied sciences and post-secondary vocational education.

The new research line on medical robotics will open further collaborations within ENTEG and with other institutes of FSE, and with the UMCG. Within ENTEG, it links well to other units that are oriented towards Biomedical Engineering and Mechanical Engineering, such as Discrete Technology and Production Automation (DTPA), Bioinspired MEMS and Biomedical Devices (BMBD), and Product Technology (PT). We foresee strong interactions with fundamental sciences in research institutes in the faculty, on topics such as advanced materials (ZIAM) and the robotics lab (BI). Within the UMCG, our primary objective is to enhance surgical robot optimization through image fusion, digital twin technology, and AI development, ultimately integrating these advancements into computer-assisted robotic surgery. Research collaborations will also be likely with clinical and rehabilitation departments within the research institutes of the UMCG and will be instrumental for valorisation and translation.

The broad field of medical robotics is represented at essentially all universities with a biomedical engineering department. Examples in the Netherlands include the [Biomedical Device Design and Production Technology](#) lab and the [Neuromechanical Engineering Lab](#) at the University of Twente; the [Delft Institute of Prosthetics and Orthotics](#) and the [Medical Instruments and Bio-inspired Technology](#) lab. Medical Robotics is a more specialized, young-and-upcoming field initiated by groups at Harvard University and Johns Hopkins University. In the Netherlands, the [Surgical Robotics Lab](#) at Twente University has achieved a leading role in Europe.

7. Expected contributions to research

The successful candidate for the full professor position is expected to initiate and chair a new base unit and set up a research line in the field of medical robotics. Coaching of tenure track staff that might be affiliated with the unit is crucial. Such a tenure track (assistant) professor will be expected to set up an independent research line that is complementary to that of the Full professor.

The research of the successful candidate should have excellent (inter)national visibility, an outstanding reputation, and lead to publications. An essential part of the research activities comprises the supervision of Ph.D. students and post-doctoral researchers. The candidate is also expected to be successful in obtaining external funding for the research and to contribute to strengthening the international reputation of the group and the institute. The research specifically is expected to strengthen the impact of the research institute via for example collaboration with (pre) clinical researchers, doctors and industrial partners.

8. Expected contributions to teaching

The candidate is expected to teach at the bachelor and master level, in particular in the areas of BME and Mechanical Engineering. In particular, the candidate will extend and innovate the research-driven teaching portfolio in these programmes regarding novel developments in medical robotics and related topics. Furthermore, the candidate will be involved in supervising bachelor, master and PhD students BME.

Also, they will enable the introduction of a fourth track –*Bio-Robotics*– in the MSc programme BME. This track aims to attract technical-oriented students to continue their BME BSc programme in the MSc BME. This track, in conjunction with the existing track Medical device

design, will extensively build upon the Tech and Design lab (“makerspace”) infrastructure that will be established in our new Feringa building (available in 2024).

9. Expected contributions to the organisation

The candidate is expected to have an active interest and to provide a positive contribution to the management and organisational tasks of the institute. The candidate will furthermore contribute to the organisation of the faculty, for example by participating in working groups and committees, in the domains of education, research and management. The candidate will contribute to relevant organisational activities on the national and international level.