PhD Position Model-Based Sensor Fusion to Estimate Human Biomechanics

Job description

Surprisingly, human mobility disorders are treated with very limited actual movement data and even less information on the biomechanics of the individual patient. In the limited instances, data is acquired in the lab with sophisticated and expensive motion capture systems. Similarly, emerging video-based systems use neural networks trained on hand annotations by non-experts to estimate the motion of key points on the body. While video permits recording outside of the lab, the training sets of hand-annotated landmarks from which joint angles and motion are estimated lack the accuracy and repeatability needed in clinical care.

Inertial measurement units (IMUs) have the potential to solve both the problems of accuracy and measuring outside the laboratory. Indeed, there are already numerous commercial products to record human movement and replay motions as a virtual avatar. They provide a great starting point since clinicians and patients require the same portability and ease of use, but also need systems that provide metrics of performance important to describe and quantify treatment progress. In walking, for example, these include gait speed, cadence, step width, step length and their asymmetries. When considering the efficacy of interventions, quantifying the (muscular) effort required by the patient outside of the lab environment would be groundbreaking. Estimates of muscle forces, work, and even metabolic cost have been made in the lab using precise experimental data and musculoskeletal dynamics (models).

The challenge for this PhD position will be to estimate these and other outcome measures by exploiting all the sensor information from IMUs and potentially fuse this with video or other wearable/portable sensors that also satisfy the dynamics of a musculoskeletal model. Furthermore, the algorithm should be adaptable to different dynamical models with different topologies and constraints that can represent both the lower and upper extremities as well as devices. You will work closely with experts in biomechanical modeling, sensor fusion, and rehabilitation to deliver solutions to the needs of monitoring mobility in the home setting.

Requirements

You are a highly motivated candidate with a master's degree in state estimation, sensor fusion and/or dynamical modeling with a background in automatic control, and/or robotics. You are eager to boost your skills in nonlinear (Kalman) filtering, optimization,

control theory, and multibody dynamics and excited to apply these skills to biomechanics and rehabilitation. In addition, you are proficient in academic writing and presenting in English, as you will be part of a multidisciplinary team where good communication skills are essential. You are eager to learn and comfortable working in a fast-paced, dynamic and multifaceted Technical University environment at TU Delft and Erasmus MC.

Doing a PhD at TU Delft requires English proficiency at a certain level to ensure that the candidate is able to communicate and interact well, participate in English-taught Doctoral Education courses, and write scientific articles and a final thesis. For more details please check the Graduate Schools Admission Requirements.

Conditions of employment

What we offer:

A challenging position within the largest, oldest and number one ranked Technical University in the Netherlands with high-impact research and education in the fields of mechanical & materials engineering, systems and control, and AI applied to societal challenges in human health and environmental sustainability.

Doctoral candidates will be offered a 4-year period of employment in principle, but in the form of 2 employment contracts. An initial 1,5 year contract with an official go/no go progress assessment within 15 months. Followed by an additional contract for the remaining 2,5 years assuming everything goes well and performance requirements are met.

Salary and benefits are in accordance with the Collective Labour Agreement for Dutch Universities, increasing from € 2541 per month in the first year to € 3247 in the fourth year. As a PhD candidate you will be enrolled in the TU Delft Graduate School. The TU Delft Graduate School provides an inspiring research environment with an excellent team of supervisors, academic staff and a mentor. The Doctoral Education Programme is aimed at developing your transferable, discipline-related and research skills.

The TU Delft offers a customisable compensation package, discounts on health insurance and sport memberships, and a monthly work costs contribution. Flexible work schedules can be arranged. For international applicants we offer the Coming to Delft Service and Partner Career Advice to assist you with your relocation.

Working part-time, i.e. 4 days / 5-year position is a possibility for each of the positions we offer.

TU Delft (Delft University of Technology)

Delft University of Technology is built on strong foundations. As creators of the world-famous Dutch waterworks and pioneers in biotech, TU Delft is a top international university combining science, engineering and design. It delivers world class results in education, research and innovation to address challenges in the areas of energy,

climate, mobility, health and digital society. For generations, our engineers have proven to be entrepreneurial problem-solvers, both in business and in a social context.

At TU Delft we embrace diversity as one of our core values and we actively engage to be a university where you feel at home and can flourish. We value different perspectives and qualities. We believe this makes our work more innovative, the TU Delft community more vibrant and the world more just. Together, we imagine, invent and create solutions using technology to have a positive impact on a global scale. That is why we invite you to apply. Your application will receive fair consideration.

Challenge. Change. Impact!

Faculty Mechanical, Maritime and Materials Engineering

The Faculty of 3mE carries out pioneering research, leading to new fundamental insights and challenging applications in the field of mechanical engineering. From large-scale energy storage, medical instruments, control technology and robotics to smart materials, nanoscale structures and autonomous ships. The foundations and results of this research are reflected in outstanding, contemporary education, inspiring students and PhD candidates to become socially engaged and responsible engineers and scientists. The faculty of 3mE is a dynamic and innovative faculty with an international scope and high-tech lab facilities. Research and education focus on the design, manufacture, application and modification of products, materials, processes and mechanical devices, contributing to the development and growth of a sustainable society, as well as prosperity and welfare.

Click here to go to the website of the Faculty of Mechanical, Maritime and Materials Engineering. Do you want to experience working at our faculty? These videos will introduce you to some of our researchers and their work.

Additional information

About Convergence

The pressing and complex social challenges of our time call for convergence; crossing boundaries between institutions and disciplines to create new perspectives and solutions. For this reason TU Delft, Erasmus MC and Erasmus University Rotterdam are joining forces in Convergence. Within the convergence theme Health & Technology we form new frameworks that promote scientific discoveries and technological innovation in health and healthcare. We do this by working on groundbreaking research and innovation bundled in 10 international leading research flagships.

For more information about this position please contact:

Dr. Ajay Seth, project supervisor in Biomechanical engineering, a.seth@tudelft.nl
Dr. Manon Kok, project supervisor in Systems and Control, m.kok-1@tudelft.nl

Prof. Dr. Gerard Ribbers, program leader: g.ribbers@erasmusmc.nl,
Dr. Agaath Sluijter MHBA, program manager a.sluijter@erasmusmc.nl, 06-21804367.

If your CV fits to the position, you will be invited for an interview with your thesis supervisor(s). If this interview goes well there will be a second interview with the program leader Prof. Dr. Gerard Ribbers and the program manager, Dr. Agaath Sluijter. Working part time i.e. 4 days / 5 year position is a possibility for each of the positions we offer.

Application procedure

Please send your application for this position, **before January 31st 2023** to **healthandtechnology@convergence.nl** together with :

- your motivation letter
- curriculum vitae
- publications in pdf-form (if applicable)
- grades lists of your bachelor and master degree
- two or three references

For more information about this vacancy, please visit the Convergence website.