

Faculty of Science and Engineering

Profile report: Advanced modelling of energy systems and conversions / Innovatieve modellering van energiesystemen en conversies

- Discipline: Mechanical Engineering, Process Design, Modelling, Fluid dynamics
- Level: Tenure track assistant professor
- Fte: Full time (1,0)

1. Scientific discipline

Mechanical engineering is the discipline that applies engineering, physics, and materials science principles to design, analyze, manufacture, and maintain mechanical systems. At the University of Groningen the focus of this Mechanical Engineering position lies on process design with emphasis on advanced modelling studies in the field of energy systems and conversions.

2. Vacancy

This position is opened by the Board of the Faculty of Science and Engineering (letter with reference JPT/gl/17/00662) and will be embedded in the institute Engineering and Technology Institute (ENTEG), new basic unit Process Design.

3. Selection committee (BAC)

- Prof. Dr. Ir. J.M.A. Scherpen (chair, director ENTEG)
- Prof. Dr. F. Picchioni (deputy director of bachelor program chemistry and chemical engineering)
- Prof. dr. ir. H.J. Heeres (chairman ENTEG, head of the green chemical reaction engineering cluster)
- Prof.dr. B. Noheda (Professor in Functional Nanomaterials)
- Prof dr. J.A.M. Kuipers (TUE, Multi-scale Modelling of Multi-phase Flows)
- Prof. dr. W. de Jong (Honorary professor Integrated Thermochemical Biorefineries and professor TU Delft)
- Martine Schouten Hoogendijk (student member)

Advisors

- Prof .dr. H.A.J. Meijer (ESRIG)
- Mr. H. Y. Haagsma (HR advisor)
- Dr. K.E. Voskamp (scientific coordinator ENTEG)

4. Research area

The development of efficient energy systems and sustainable, low-carbon-emission energy generation processes are essential. It requires identification of attractive fuel sources, preferably renewable though advanced fossil options are also possible, and technologies to use those sources in efficient, environmentally benign ways. Advanced process modelling has

become an important tool to design and improve new and existing processes, without the need for expensive experimental facilities.

The current position has been created to strengthen the research efforts in this emerging area in the ENTEG institute of the Faculty of Science and Engineering (FSE). The research line will contribute to the necessary breakthroughs in the area within the mechanical engineering context. The foreseen research activities of the candidate will have a focus on advanced modelling of such processes, for instance using fluid dynamics analysis using 1D, 2D, and 3D analytical tools, including computational fluid dynamics (CFD) analysis with software such as Fluent. Examples of research topics (not limited) can be found in the fields of advanced energy carrier technologies and energy conversion devices such as fuel cells, hydrogen storage systems, hybrid transportation and power systems, as well as "smart" ways of accomplishing chemical-to-work energy conversions.

5. Embedding: institute (and basic unit)

ENTEG aims at performing technology-driven scientific research. It focuses on the creation and manufacture of innovative products and production strategies in the different mechanical, physics, chemistry and biotechnology based sectors. The research of ENTEG is conducted in three key research domains:

- the application of fundamental sciences to the design of new (sustainable) product and research in the area of product and production technology for (bio)chemical based products,
- the development of quantitative and analytical theories and methodologies for model-based design and control of complex industrial processes and systems and
- research in advanced production engineering aiming at improving the production processes of increasingly complex materials

The candidate is expected to set up his/her research line on advanced modeling of energy systems and conversions within the newly established basic unit on Energy systems and conversions. This new unit is expected to have close research and teaching links to the Chemical and Mechanical Engineering oriented units of ENTEG - the research units Green Chemical Reaction Engineering (GCRE), Product Technology (PT), Advanced Production Engineering (APE) and Discrete Technology and Production Automation (DTPA). The GRCE research unit focuses on the development of highly intensified catalytic methodology and technology for biomass conversion to biofuels and biobased chemicals. Research within PT is focused on the design of new or improved chemical products. Particular attention is devoted to the development of new catalytic systems and of polymeric products for specific applications. The APE research unit focuses on mechanical precision engineering and on material science. Research within DTPA, on the other hand, is focused on the dynamical modeling, analysis and systems engineering of complex electro-mechanical systems.

6. Local and (inter)national position

Engineering research at the University of Groningen is embedded in a broad scientific community. The mechanical engineering research will have a defining unique feature in the Netherlands: its research can cover the entire innovation cycle, from basic science to the

development of processes and products. Within the Faculty of Science and Engineering of the University of Groningen, basic research on (process) design for energy systems is done at the Energy and Sustainability Institute Groningen (ESRIG),¹ whereas materials related research is performed at the Zernike Institute for Advanced Materials² and the Stratingh Institute for Chemistry³. In the Netherlands, research activities in Mechanical Engineering are present at the Delft University of Technology, Eindhoven University of Technology and University of Twente. Research groups related to Energy Systems and conversions at these universities focus on thermos fluids engineering, energy technology and process technology. Worldwide, research in Mechanical Engineering is present at most technical universities providing mechanical engineering master and bachelor program.

7. Expected contributions to research

The candidate is expected to initiate and set up his/her research line in the field of advanced modelling in energy systems and conversions. The research should compete on a worldwide level and lead to publications in top journals. Obtaining substantial external funding is crucial. Supervision of PhD students is an important part of the research activities. The research is expected to cross-fertilize the existing research within the institute and should lead to a strengthening of the international reputation of the group and the institute.

8. Expected contributions to teaching

The candidate will contribute 30% of his/her time to the teaching programs at the University of Groningen, in particular the Bachelor's and Master's degree programs in Chemical Engineering,⁴ Industrial Engineering and Management⁵ and other engineering programs. The candidate is expected to become actively involved in the to-be-developed Master's degree program in Mechanical Engineering (start date September 2019) and design and teach courses for the track Process Design for Energy Systems (e.g. Computational Fluid Dynamics for Engineers and Advanced Thermodynamics). Furthermore, the training and supervision of master and PhD students is an important part of the educational task. The candidate should have excellent teaching skills and is expected to be an inspiring and innovative teacher.

9. Expected contributions to the organization

The candidate is expected to have an active interest and to provide a positive contribution to the management and organizational tasks of the institute. At the level of the Faculty of Science and Engineering, the candidate will contribute to the organization of the faculty, for example

¹ See <http://www.rug.nl/research/esrig/>

² See <http://www.rug.nl/research/zernike/>

³ See <http://www.rug.nl/research/stratingh/?lang=en>

⁴ Details of the BSc Chemical Engineering program can be found in <https://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=4965> and that of the MSc Chemical Engineering program can be read in <https://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=3235>

⁵ Details of the BSc IEM program can be found in <http://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=3753> and that of the MSc IEM program can be read in <http://www.rug.nl/ocasys/fwn/vak/showpos?opleiding=3754>

by participating in working groups and committees, in the fields of teaching, research and management. The candidate will participate in relevant national and international organizations.

10. Career perspective

The position will be offered as a tenure track assistant professor (UD) position according to the document "Career Paths in the Sciences" of the faculty of the faculty (www.rug.nl/fwn/careerpathsinscience).

