

## Faculty of Science and Engineering

### Profile report: Stochastics (Stochastiek)

- Discipline: Mathematics
- Level: tenure-track Assistant professor/Associate professor/Full professor
- Fte: Full time (1.0)

### 1. Scientific discipline

A position on Stochastics is expected to focus on simulation and inference to model stochastic properties of complex systems, such as (stochastic) differential equation models. The position could have connections with machine learning, statistics and data science.

### 2. Vacancy

This position is opened by the Board of the Faculty (PT/dja/18/00153) as part of the new Center "Groningen Cognitive Systems and Materials", which aims to develop systems and materials for cognitive computing. The position will be embedded in the Bernoulli Institute and falls within the framework of 'Career Paths in Science 4' ('Bèta's in Banen 4'). Please see link for [criteria and conditions](#).

### 3. Selection committee (BAC)

Prof.dr. J.B.T.M. Roerdink	Scientific director Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence (Chair), and professor Scientific Visualization and Computer Graphics
Prof.dr. B. Noheda	Director Groningen Cognitive Systems and Materials and Professor Nanostructures of Functional Oxides
Prof.dr. R.W.C.P. Verstappen	Program director Mathematics and professor Computational and Numerical Mathematics
Dr. M.A.J. van Duijn	Associate professor Applied Statistics
Prof.dr. T. Müller	Professor Combinatorics and Probability
C. Schoenmaker	Student member
Prof. dr. P. Grünwald	Professor Statistical learning, University of Leiden

#### *Advisors:*

Prof.dr. K. Camlibel	Associate professor Systems and Control
Prof.dr.ir. C.H. van der Wal	Scientific director Zernike Institute for Advanced Materials and professor Nanostructures of Functional Oxides
Dr. J.H.M. van der Velde	Scientific Coordinator Groningen Cognitive Systems and Materials and secretary of the selection committee

*HR advisor:*  
L.A. Boomsma

#### **4. Research area**

Complex stochastic systems comprises a vast area of research, from modelling specific applications to model fitting, estimation procedures, and computing issues. The exponential growth in computing power over the last two decades has revolutionized statistical analysis and led to rapid developments and great progress in this emerging field. Methodological research in modelling and inference of complex stochastic systems in high-dimensional data settings is aimed at developing modern statistical inference strategies for high-dimensional models, among which networks and systems of differential equations.

The challenge to build cognitive systems from basic nanoscale components involves both modelling and experimental approaches that will involve generating data on complex systems. For example, nano-connections in novel “cognitive” materials can be described by random graph models, where it is interesting to infer the parameters from experimental data and to learn the emerging properties of such networks. General challenges that arise here concern stochastic modelling, inference of complex systems, robustness to noise, and variability.

#### **5. Embedding: institute (and base unit)**

The position will be embedded in the basic unit Probability & Statistics of the Bernoulli Institute, which focuses on the methodological developments of statistics and probability theory. The group has active collaborations with social statisticians, medical statisticians, econometricists, statistical physicists, and quantitative philosophers. A specific interest lies in the areas of network learning and high-dimensional inference methods. The position will play a crucial role within the Center “Groningen Cognitive Systems and Materials” (CogniGron).

The Groningen Cognitive Systems and Materials Center is a joint venture between FSE-institutes Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence, and the Zernike Institute for Advanced Materials. It comprises researchers from materials science, physics, chemistry, mathematics, computer science and artificial intelligence. The center provides structure, coherence, and visibility for a joint research program in the direction of cognitive systems and materials. The main goal of the Groningen Cognitive Systems and Materials Center is to create self-learning materials that will perform the tasks that are now assigned to thousands of transistors and complex algorithms in a more efficient and straightforward manner, hence, forming the basis for a new generation of computer platforms for cognitive applications, such as pattern recognition and analysis of complex data.

The Bernoulli Institute for Mathematics, Computer Science and Artificial Intelligence is part of the Faculty of Science and Engineering (FSE). The profile of the institute centers around modelling, computation, and cognition with a focus on science and technology, keeping a balanced mix of fundamental and applied aspects. The Bernoulli Institute comprises five mathematics programmes, six computer

science programmes, and four artificial intelligence programmes. The constituting programmes participate in various national research schools and most of the PhD students are enrolled in an educational programme and take part in other activities offered by these schools. The Bernoulli Institute aims to strengthen the current research portfolio in Mathematics, Computer Science and Artificial Intelligence by expanding both in fundamental areas that have a prominent role in education as well as in directions that are essential for new technological and societal developments.

## **6. Local and (inter)national position**

Locally, there are a number of groups that work on inference of complex systems. Within the psychology department and the UMCG, several groups work on modelling and inferring complex brain networks. Within linguistics, there is a strong group on inferring linguistic complexity. Within the Netherlands, groups in Eindhoven, Amsterdam (UVA/VU) and Leiden are involved in the EU Statistical Network Science initiative, COSTNET, which is currently led by the Bernoulli Institute (Groningen).

At the national level the Bernoulli Institute participates in the Dutch mathematics Research Schools for Fluid Mechanics (J.M. Burgerscentrum) and the National Graduate School for Systems and Control (DISC). It is also involved in the NWO research clusters “Discrete, Interactive and Algorithmic Mathematics, Algebra and Number Theory” (DIAMANT), “Geometry and Quantum Theory” (GQT), “Nonlinear Dynamics of Natural Systems” (NDNS+) and “Stochastics – Theoretical and Applied Research” (STAR) and in the national research school WONDER.

Locally the Systems, Control and Applied Analysis research unit is part of the Jan C. Willems Center for Systems and Control, that furthermore consists of the control engineers in the Engineering institute ENTEG.

The Bernoulli Institute has a strong position in national and international mathematics, as evidenced by participation in NWO and EU projects (*e.g.* HYCON2, Cosmic Web, CA15109), publications in renowned journals and conferences, memberships of editorial boards, boards of mathematical societies, and program committees, conference chairing (*e.g.* MTNS 2014, IWSM 2017, NecSys 2018), etc. Mathematics research in Groningen is strongly focused on mathematical systems, in particular, Nonlinear Dynamical Systems, Mathematical Physics and Systems & Control.

## **7. Expected contributions to research**

The candidate is expected to initiate and develop an internationally leading research programme in the field of Statistics and Probability. The research should have a visibility on the national and worldwide level and lead to publications in top journals. Further it is expected, that the new professor will take a leading role in the field of Mathematics within the Netherlands. Obtaining substantial external funding for PhD projects is crucial. Supervision of PhD students is an important part of the research activities. The research is expected to strengthen the existing efforts in the field of Mathematics within the Bernoulli Institute and the Groningen Cognitive Systems and Materials center, and should lead to a strengthening of the international reputation of the group, the research center and the institute.

## **8. Expected contributions to teaching**

The candidate is expected to contribute to the teaching programmes in the bachelor and master degree programs within the Faculty of Science and Engineering. She/he is expected to participate in the teaching programme of specialized courses in relation to Statistics and Probability and other related topics, *e.g.*, service courses in statistics. Furthermore, the candidate will be involved in supervising bachelor, master and PhD students. Upon appointment, depending on experience and formal qualifications to date, the candidate may be required to enter a nationally standardized tertiary teaching skills certification trajectory (BKO or Basis Kwalificatie Onderwijs), successful completion of which is a condition for extensions and tenure.

## **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 FSE, the candidate will contribute to the organization of the faculty, for example 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.