Faculty of Science and Engineering

Profile report: Optimization (Optimalisatie)

- Discipline: Mathematics
- Level: Associate or Full Professor
- Fte: 1,0

1. Scientific discipline.
The field of mathematical optimization is a very active area of research, both with respect to theoretical developments, new application areas, and algorithmic aspects. There is an immensely wide range of applications, ranging from diverse economical industrial uses and to many scientific connections with machine learning and AI, operations research, engineering, systems biology, and more. Because of the varied ways in which optimization problems show up, the discipline has a large number of subfields. A first (rough) subdivision distinguishes discrete optimization and continuous (for example convex, global, infinite dimensional, distributed, stochastic, or robust) optimization.

2. Vacancy.
This position is opened by the Board of the Faculty in the context of the sector plans and will be embedded in the Bernoulli Institute, basic unit Systems, Control, and Applied Analysis or basic unit Algebra, depending on the candidate's profile. The position falls within the framework of 'Career Paths in Science 4' ('Bèta's in Banen 4'). Please see link for <u>criteria and conditions</u>.

3. Selection committee (BAC).

Prof. dr. N.A. Taatgen	Scientific director Bernoulli Institute and Professor, Cognitive Modeling
Prof. dr. ir. R.W.C.P. Verstappen	Program director Mathematics and Applied Mathematics Associate Professor, Computational Science
Prof. dr. J. Top	Department head of Mathematics Professor, Number Theory & Algebraic Geometry
Prof. dr. M.K. Camlibel	Associate professor, Systems & Control
J.H. Dwarshuis	Master's student in mathematics
Prof. dr. M. Dür	Professor, Mathematical Optimization (University of Augsburg)
Prof. dr. M. Laurent	Professor, Discrete Mathematics and Optimization (CWI Amsterdam and Tilburg University)

Advisory members:

Prof. dr. A.J. van der Schaft	Professor, Systems & Control

HR advisor:
L.A. Boomsma

4. Research area.
Mathematical optimization theory deals with the mathematical analysis of classes of optimization problems, including the existence and characterization of solutions, and the design and properties of algorithms for obtaining the solutions. The techniques developed depend very

much on whether the parameters in the problem are in a discrete set, or rather vary continuously (or mixtures of both). For specific subclasses of continuous/discrete optimization problems, a large amount of dedicated theory is developed. The wide and ever-increasing range of application (including the handling of big data and its use in complex technological systems) as well as purely scientific applications in a broad range of disciplines make mathematical optimization a vital and dynamic area of research. Furthermore, mathematical optimization is strongly intertwined with a range of mathematical subdisciplines, such as convex analysis, graph theory, and linear algebra.

The discipline of Mathematics, as part of the Bernoulli Institute in Groningen, wishes to strengthen itself by building a strong research group in a central subfield of optimization, preferably related to one or more of the existing research areas. The candidate for the present position should be qualified to lead this group and make it into a recognized player in the national and international research landscape.

5. Embedding: institute (and base unit)
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. In all three disciplines of the institute and particularly in Mathematics, we strive at maintaining a balanced mix of fundamental and applied research. The Bernoulli Institute comprises five mathematics groups, seven computer science groups, and four artificial intelligence groups. The constituting groups participate in various national research schools. Most of the PhD students are enrolled in an educational program and take part in a number of activities offered by these schools. The Bernoulli Institute has a leading role in the cross-disciplinary research theme on Data Science and Systems Complexity (DSSC), and in the Groningen Cognitive Systems and Materials Center (CogniGron) within the Faculty of Science and Engineering.

The candidate, depending on his/her profile, will work in the group Systems, Control, and Applied Analysis or in the group Algebra. The group leaders are respectively Prof. dr. A.J. van der Schaft and Prof. dr. J. Top. The candidate is expected to keep an open eye for research connections to other groups within the Bernoulli Institute.

6. Local and (inter)national position
Nationally, most universities have research groups working on subfields of optimization, or specific areas of applications of this. Examples of larger groups within mathematics include the ones at CWI-Amsterdam, TU-Delft, Tilburg University, TU Eindhoven, U-Twente and Utrecht. Optimization is one of the central themes in the NWO mathematics cluster DIAMANT. The Dutch master's program Mastermath annually offers, through this cluster, a number of national courses on various aspects of optimization. At present no researcher specialized in Optimization works within the Bernoulli Institute. The broad range of applications of the research area include connections with Machine Learning and thereby strengthening the Institute in the theme of Optimization will enhance the local coherence between research in mathematics, computer science, and artificial intelligence. Optimization moreover fits perfectly in the Groningen research of DSSC and CogniGron. To re-establish the (inter)national position the institute had in the past regarding optimization, we look for a recognized candidate with a strong research network. He/she should have the ambition to build a strong new group, active on every level (local, national, international).

7. Expected contributions to research
The candidate is expected to extend his/her research program in the field of optimization, acting as a link between the Bernoulli Institute and national research activities. The research should compete on a worldwide level and lead to publications in top journals. Obtaining substantial external funding for PhD projects is pivotal. Supervision of PhD students is an important part of the envisioned research activities and of establishing a local research group on optimization. In the framework of the NWO cluster DIAMANT as well as internationally, he/she should establish or maintain strong connections with other research groups in related areas.

8. Expected contributions to teaching
The candidate is expected to contribute to the bachelor and master programs of the Faculty. She/he will also be actively involved in the development of new courses related to the research area, also in relation with the national Mastermath program. Furthermore, he/she will supervise final research projects of bachelor and master students.

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.