Faculty of Science and Engineering

Profile report: Visual Computing and Analytics (Visueel rekenen en analyseren)

- Discipline: Computer Science
- Level: tenure-track Assistant professor
- Fte: Full time (1.0)

1. Scientific discipline
Visual computing encompasses computer science disciplines dealing with images and 3D models, such as computer graphics, image processing, visualization, virtual and augmented reality, or video processing. It also includes aspects of human-computer interaction and machine learning, particularly in the form of visual analytics, which is the science of analytical reasoning facilitated by interactive visual interfaces.

2. Vacancy
This position is opened by the Board of the Faculty (PT/gl/19/00298) and will be embedded in the Bernoulli Institute (BI), basic unit Scientific Visualization & Computer Graphics, according to 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 (Chair) and professor Scientific Visualization and Computer Graphics
Prof.dr. N. Petkov	Program director master Computing Science and professor Intelligent Systems
Prof. dr. D. Karastoyanova	Professor Information Systems
Prof.dr. N. Taatgen	Professor Cognitive Modeling
Prof.dr. N.M. Maurits	Professor Clinical Neuroengineering (UMCG)
G. Hettinga	Student member
Prof.dr.ir. J.J. van Wijk	Ext. member, professor Visualization, TU Eindhoven

Advisor:

Dr. J. Kosinka	Assistant professor Computer Graphics

HR advisor:
L.A. Boomsma

4. Research area
The research area is broadly defined as Visual Computing and Analytics, including Visualization, Human Computer Interaction, Computer Graphics, and Graphical

Interfaces. The goal of visualization can be explanatory, when used to communicate a message about scientific data through visual means. The data can be concrete (e.g., spatial data) or abstract (e.g., high-dimensional data). Visualization can also be used as an exploratory tool for gaining insight in the structures or processes generating the data. Many application fields exist, such as medical visualization, biological visualization, text visualization, molecular visualization, environmental visualization, astronomical visualization, etc. Combining visualization with areas such as machine learning and human-computer interaction (HCI) has led to the subfield of Visual Analytics. The problems in this research field center around the discovery of interesting relations, structures, and patterns in very large and high-dimensional data, by combining automated data processing with human reasoning, creativity and intuition, supported by interactive visualization. The growth of this field is strongly driven by the explosion of data sources, applications, and problems, which is currently known under the generic term of Big Data. Visual analytics aims to fully integrate human expertise in the human-machine dialogue to steer the sense-making process. It supports collaborative exploration and decision making by combining fast access to large distributed databases, data integration, powerful computing infrastructures, and interactive visualization facilities.

Visual Computing and Analytics (VCA) bring together several scientific and technical communities from computer science, scientific and information visualization, cognitive and perceptual science, interactive design, graphic design, and social science. VCA integrates new computational and theory-based tools with innovative interactive techniques and visual representations to enable scientific discovery, visual communication, and human-information discourse. The design of the tools and techniques is based on cognitive, design, and perceptual principles. Applications to real world problems form an essential part of research efforts in VCA.

5. Embedding: institute (and base unit)

The position will be embedded in the Scientific Visualization & Computer Graphics research unit of the BI. The group was founded in 2003 and has a broad research profile in scientific visualization, information and software visualization, visual analytics, and computer graphics, with a strong focus on applications from the life sciences (in particular functional brain imaging and bioinformatics), astronomy, and large-scale software engineering. The group's staff members have a strong international reputation and are actively involved in (inter)national research projects and major conferences in this field. In 2016 the group hosted the EG/VGTC Conference on Visualization (EuroVis), the largest visualization conference in Europe. Current research activities focus on scalable techniques for e-Visualization of big data; visual storytelling of big medical data; Multiscale shape processing of point clouds, range data, or volumetric data; Multidimensional data exploration and explanation with applications to machine learning and deep learning, software understanding, and astrophysics; Geometric modelling and vector graphics.

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.

The Bernoulli Institute has a leading role in the recently established cross-disciplinary research theme on Data Science and Systems Complexity (DSSC) within the Faculty of Science and Engineering. This concerns a research cluster of 60+ researchers in a number of basic disciplines (mathematics, computer science, artificial intelligence, systems & control, engineering, astronomy) and various scientific application domains. The ambition is to understand and solve big data problems by exploiting the joint perspectives from both data science and complexity science. The institute is also heavily involved in the Groningen Cognitive Systems and Materials Center (CogniGron), which is a joint venture between the Bernoulli Institute 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 programme in the direction of cognitive systems and materials.

6. Local and (inter)national position

Within the Dutch visualization community, data visualization and visual analytics constitute on-going highly active research areas. There are a number of groups at TU Eindhoven, TU Delft, University of Twente, University of Leiden, CWI Amsterdam, and RUG whose main research interests lie within these (or closely related) areas and their applications. The Scientific Visualization & Computer Graphics group at the RUG is one of the major players in this area. A distinguishing feature of the group is its strong focus on a broad set of applications, including the life sciences, medicine, and astronomy, facilitated by the presence of all these fields at the RUG and the University Medical Center (UMCG). Also, visual analytics is one of the most active areas within the visualization domain worldwide, both within Europe as well as outside it. The group has many international collaborations, in particular with the University of Bergen, Norway; the University of Vienna; several universities in Brazil; the University of Toulouse, France; the University of Cambridge; the Johannes Kepler University Linz, Austria; the University of West Bohemia, Czech Republic; and with the Basque Center for Applied Mathematics, Bilbao, Spain. The senior members of the group regularly act as associate or guest

editors in top journals in the field, frequently give keynotes and invited talks in international conferences, serve on numerous Program and Steering Committees of international conferences, act as reviewers for (inter)national funding agencies, chair international conferences and workshops, and receive best paper awards in top conferences. Within the Bernoulli Institute the group has strong connections with the Software Engineering group and the Cognitive Modeling group.

7. Expected contributions to research

The candidate is expected to initiate and develop an internationally leading research programme in the field of Visual Computing and Analytics, or a closely related field. The research should have visibility on the national and worldwide level and lead to publications in top journals. Furthermore, it is expected that the new assistant professor will take a leading role in the field of Computer Science within the Netherlands. The research should lead to a strengthening of the international reputation of the group and the institute. Obtaining substantial external funding is crucial. Supervision of PhD students is an important part of the research activities. The research is expected to strengthen the existing collaborations of the Bernoulli Institute within DSSC and CogniGron.

8. Expected contributions to teaching

The candidate is expected to contribute to teaching in the bachelor and master degree programmes within the Undergraduate and Graduate Schools of Science and Engineering. She/he is expected to participate in the teaching programme of specialized courses in topics related to the research area, e.g., visual analytics for big data, scientific visualization, computer graphics, or image processing, as well as general CS courses in the bachelor programme. 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 (UTQ - University Teaching Qualification), successful completion of which is a condition for extensions and tenure. During the first 5 years of the appointment the tenure-track assistant professor will devote at most 30% of the total time to educational tasks. Once tenure has been obtained, these tasks amount to 40%.

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.