

# Faculty of Mathematics and Natural Sciences

## Profile report

Cognitive Robotics

Discipline: Artificial Intelligence

Level: Assistant professor (tenure track UD)

Fte: 1.0

### 1. Scientific discipline

Cognitive Robotics refers to an area within the discipline of Artificial Intelligence that uses cognitively and biologically inspired mechanisms for the realization of autonomous, effective behaviors in robotic systems.

### 2. Vacancy

This position is opened by the board of the faculty as a strategic investment in this subject (#letter FB ref.).

### 3. Selection committee

Prof. dr. L.R.B. Schomaker, Chair	(Professor in Artificial Intelligence, scientific director ALICE)
Prof. dr. J.T.M. Elzenga	(Director Undergraduate School of Science)
Prof. dr. L.C. Verbrugge	(Professor in Logic and Cognition, ALICE)
Prof. dr. J.B.T.M. Roerdink	(Professor in Computer Science)
Prof. dr. N.A. Taatgen	(Professor in Cognitive Modeling, ALICE)
Dr. M.A. Wiering	(Assistant professor in machine learning, ALICE)
Dr. M. Cao	(Assistant professor in Systems & Control)
Vacancy	(Student)

#### *Advisor*

Lourens Boomsma (HR services)

### 4. Research area

The ALICE institute hosts a top research programme in Autonomous Perceptive Systems. Current research covers pattern recognition (handwriting recognition) and machine learning, notably reinforcement-based machine learning. The current programme requires a strategic consolidation and expansion of the research in robotic systems. In order to sustain and expand the current level of success, we are looking for an assistant professor (tenure track) who can deepen and extend the research program of the group. More specifically, we are looking for a candidate with extensive experience and proven track record in cognitive robotics, in any case in one or more of the following areas:

- Adaptive behavior modeling and learning;
- Cognitive and/or biologically inspired robotic behavior modeling;
- Assistive mobile robotics.

These topics currently enjoy considerable international interest, they are on the frontline of current robotics research and have proven to be areas in which the ALICE institute can further increase its scientific visibility. Although affinity with the low-level and hardware aspects of robotics research is desirable for a candidate, the focus of the research is specifically oriented at the higher, more abstract ('AI') aspects of autonomous behavior. It is our goal to lift robotics research to the next level using concepts of continuous adaptivity and robust goal achievement in 'always on' robotic systems.

### 5. Research group and Institute

The position is embedded in the ALICE institute of Artificial Intelligence & Cognitive Engineering of the Faculty of Mathematics and Natural Sciences (35 researchers). The institute's bachelor and master programmes (220+ students) are evaluated as one of the best in the Netherlands as shown by a recent audit. ALICE has four research themes: (1) Autonomous Perceptive Systems, (2) Multi-Agent Systems, (3) Cognitive Modeling, and (4) Sensory Cognition. The position concerns a tenure track position within the **Autonomous Perceptive Systems** group. This group currently consists of the programme leader, prof. dr. Lambert Schomaker, tenure-track assistant professor dr. Marco Wiering, seven PhD students and a scientific programmer.

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

The University of Groningen has a long tradition in artificial-intelligence and cognitive-engineering research, which started in the early nineteen nineties. The ALICE institute obtained its independent position as a

research institute and educational programme in artificial intelligence in the year 2001. It addresses the fields of Logic, Cognitive Modeling, as well as Perceptual and Computational Intelligence. Within these domains, we study multi-agent systems, social cognition, auditory cognition, visual pattern recognition, machine learning and cognitive robotics. The APS group has a world-renowned status in handwriting recognition and reinforcement learning. Furthermore, the robotics researchers and AI undergraduate students actively participate in global competitions in robotics, such as Robocup and [Robocup@Home](#) and have obtained prestigious awards in these areas. Within The Netherlands, the ALICE institute is the largest integrated, comprehensive AI institute, covering both research and teaching (BSc/AI and Msc/AI). The robotics research attracts a considerable number of undergraduate students. The focus on cognitive modeling (prof. Taatgen) and human-computer communication provides for an environment in which robotics research can benefit from a multi-disciplinary perspective on the modeling of behavior. Similarly, the modeling of robotic cooperation will benefit from the presence of a world-renowned group in formal modeling of multi-agent systems (prof. Verbrugge).

#### *Position in the world*

The APS group is strong in large-scale pattern-recognition problems and machine learning. The Monk system for word-retrieval in historical manuscript collections is one of the first instances of autonomous '24/7' machine learning using crowd-sourcing over internet, in this domain. The focus of our research is on robust systems and models ('big data' as opposed to toy problems). Apart from reinforcement learning and partially-observable Markov decision processes, there is a strong position in 'new' neural network modeling algorithms for dimensionality reduction and new, fundamental innovations in support-vector machines (dr. Wiering). International collaborations are with strong groups in neural networks, reinforcement learning and handwriting recognition. Furthermore, researchers within humanities and forensic science make use of the group's pattern-recognition algorithms, using our e-Science services on the high-performance computing cluster of the University of Groningen. This is made possible through our participation in the 30M€ project 'Target', using a ten petabyte storage architecture with HPC, together with astronomy and genomics research groups. The ALICE institute has its own robotics lab with five Nao humanoids, a number of dedicated mobile robots for assistive home robotics and other robotics (sub)systems.

#### **7. Expected contribution to research**

The candidate is expected to develop their own highly visible line of cognitive robotics research, with robust technical results surpassing the level of toy problems, and to attract additional sources of funding. The candidate will be involved in current PhD-projects and will need to acquire new projects. The candidate has a strong publication record with a stress on high-ranked ISI/Thomson rated journals and more specialized conference or workshop proceedings. The candidate has a talent for coaching several teams of junior robot researchers. The candidate has demonstrated success in obtaining research grants.

#### **8. Expected contribution to teaching**

The tenure-track assistant professor is expected to contribute to the teaching programmes of the bachelor and master programmes of Artificial Intelligence in the Undergraduate and Graduate schools of Science, notably the courses in robotics. Furthermore the candidate will be involved in supervising master students in the area of (Cognitive) Robotics and AI in general. The assistant professor will spend 30% of his/her time on these tasks.

#### **9. Expected contribution to the organisation**

During the first five years, the assistant professor is free from substantial administrative tasks. However, it is expected that he/she will play a role in the general organisation of research programme, such playing a role in outreach activities, which are aimed at a high visibility of research in the ALICE institute.

#### **10. Career perspective**

*The position will be offered for a period of six years as tenure track researcher according to the document "Career Paths in the Sciences" (version 3) of the faculty. The position will be at the level of Universitair Docent (UD) according to the actual university function ordering system and regulations. After five years, the performance of the UD will be assessed according to the criteria as outlined in the document. A negative assessment will result in the termination of the appointment after a total duration of six years. A positive assessment will lead to a tenured appointment as tenure and a promotion to adjunct professor at a salary level of UHD in line with the actual university function ordering system. An adjunct professor has the ius promovendi, i.e. the right to formally complete the supervision of PhD students and is entitled, but not obliged, to run his/her own independent research unit.*