PhD Positions in Ultra-Low-Power Wearable Brainwave Processor

Staff Category: PhD-student
Department: Department of Electrical Engineering
Full time equivalent (FTE): 1.0
Starting date: As soon as possible
Number of positions: 3 PhD positions
Application closing date: May 8, 2016
Application number: V36.2565

Eindhoven University of Technology

Eindhoven University of Technology (TU/e, www.tue.nl), founded in 1956, is a world-leading research university specializing in engineering science & technology. The Department of Electrical Engineering is responsible for research and education in Electrical Engineering. The TU/e is the world’s best-performing research university in terms of research cooperation with industry (#1 since 2009). Eindhoven is also the world’s most innovative city with the highest number of patents per resident.

PhD positions in the BrainWave project (http://brain-wave.nl/)

Brain-related diseases, such as epilepsy and Parkinson’s Disease (PD), are severely degrading people’s quality of life. Few of the disease cases can be cured by medication alone. Many patients have to go to specialized hospitals to receive continuous monitoring of their electroencephalogram (EEG) signals, which is costly and impacts patient’s well-being. Current EEG sensing and processing platforms used in advanced hospitals are bulky and wired to the patient’s head. The used equipment is also power hungry and not self-sustainable, thereby far from being wearable, prohibiting continuous monitoring. A solution is urgently needed to help these patients and raise their quality of life.

In this BrainWave project, we research and develop a wearable brainwave processing platform enabling 24/7 healthcare of epilepsy and Parkinson’s Disease patients in non-hospital environments. Its key contribution is a novel brainwave processor which will analyze and interpret the EEG signals that are collected non-invasively by a multi-channel sensor interface. Ultra-low-power, on-chip context-aware and patient-specific signal processing together with features such as data logging and cloud connection will make this brainwave processing platform really wearable and suitable for non-hospital environments.

In this project, the Electronic Systems (ES) group at TU/e collaborates with the Signal Processing System (SPS) group at TU/e, Kempenhaeghe, and the Donders Institute at the Radboud University Nijmegen. Two of our industrial partners NXP and TMSi will be heavily involved in the chip and system development as well. Three PhD students will be involved in this project. The first PhD student is in charge of signal processing algorithm development, who will be supervised by professors from the TU/e SPS group, Kempenhaeghe, and Donders Institute. The TU/e ES group is in charge of supervising the other two PhD students. The three opening positions are

- PhD 1: specifies and defines the brainwave processing algorithms and apply the brainwave platform to epilepsy and Parkinson’s Disease patients.
- PhD 2: focusses on ultra-low-power architectural innovations for mapping the new brainwave processing algorithms.
PhD 3: student researches new ultra-low-power circuit-level implementation methods and the process technology interface.

PhD1 will be supervised by Prof. dr. Richard van Wezel, Prof. dr. Johan Arends, and Dr. Mike Cohen. PhD2 and PhD3 will be supervised by Prof. dr. Henk Corporaal, Prof. dr. José Pineda de Gyvez, and Dr. Hailong Jiao.

**Requirements**

We look for excellent candidates who meet the following requirements.

- A master degree in Electrical Engineering, Computer Engineering, or a similar relevant programme.
- For the PhD 1 position: Knowledge of data-analysis, preferably related to neural signals and/or biomedical applications; clinical experience is considered as a plus.
- For the PhD 2 position: In depth knowledge of computer architecture; knowledge of VLSI circuits and systems; familiarity with state-of-the-art architecture development and evaluation tools; familiarity with HDL coding.
- For the PhD 3 position: Knowledge of VLSI circuit design and familiarity with state-of-the-art EDA tools for digital circuit design (such as Cadence Virtuoso, RTL Compiler, and SoC Encounter, or equivalent).
- Preferable to be familiar with Matlab and script language (such as Perl or Python).
- Preferable to have good programming skills in C.
- Good communication skills. Excellent proficiency in written and spoken English.
- Highly motivated, team player.

You should be eager to push the state-of-the-art, and to demonstrate your research with working prototypes and publications in top conferences and journals.

**What we offer for PhD students**

We offer a challenging job at a respected university through a fixed-term appointment for 4 years. The research during this period is intended to lead to a PhD degree. We offer a salary starting at **Euro 2174** per month (gross) in the first year, increasing up to **Euro 2779** per month (gross) in the last year. Moreover, an 8% bonus share (holiday supplement) is provided annually. Assistance for finding accommodation can be given. The university offers an attractive package of fringe benefits such as excellent technical infrastructure, child care, savings schemes, and excellent sports facilities.

TU/e also offers you the opportunity for personal development by developing your social and communication skills. We do this by offering every PhD student a series of courses that are part of the Proof program as an excellent addition to your scientific education.

**Application procedure**


Please submit at least the following information (only pdf files are accepted):

1. Cover letter, including availability (starting date), and statement of research interests.
2. Curriculum vitae, including full education and employment histories, publication record, proof of proficiency in English, any teaching experience, and the names of at least three references that can be contacted.
3. Scans of certificates showing BSc, MSc, and other courses followed, with grades and rankings.
4. Up to two selected publications (e.g. MSc thesis, conference paper) in English of which you are the first or main author.

**More information**

For more information about the advertised positions, please contact:

**For PhD 1:**
- Prof. dr. Johan Arends, ArendsJ@kempenhaeghe.nl
- Prof. dr. Richard van Wezel, r.vanwezel@donders.ru.nl
- Dr. Mike Cohen, M.Cohen@donders.ru.nl

**For PhD 2 and PhD 3:**
- Prof. dr. Henk Corporaal, H.Corporaal@tue.nl
- Prof. dr. José Pineda de Gyvez, J.Pineda.de.Gyvez@tue.nl
- Dr. Hailong Jiao, h.jiao@tue.nl

**Electronic Systems group at the TU/e**

The Electronic Systems (ES) group (www.es.ele.tue.nl) comprises three full professors, two part-time full professors, two associate professors, six assistant professors, about 40 PhD candidates and postdocs, and several technical and support staff. The group has excellent infrastructure that includes individual computers, servers, state-of-the-art FPGA and GPU farms, sensor- and ad-hoc networking equipment, and a comprehensive range of electronic-design software. The group is member of Europractice and CMP, having access to advanced CMOS technologies down to 28nm. The group is authorized user of ARM DesignStart design suite, and has acquired the ARM Cortex-M0 processor IP from ARM.

The ES group is world-renowned for its design automation and embedded systems research. It is our ambition to provide a scientific basis for design trajectories of digital electronic circuits, embedded and cyber-physical systems. The group excels in the area of digital VLSI circuit and system design. A variety of state-of-the-art chips have been developed by our ES group together with our industrial partners, such as NXP Semiconductors and IMEC-Holst Centre.

**Signal Processing Systems group at the TU/e**

The Signal Processing Systems (SPS) group of the TU/e is broadly concerned with signal and information processing theories, algorithms, architectures and systems. The group uses challenging application vehicles to drive the development of its fundamental expertise. These vehicles are selected in close collaboration with strategic partners in the regional innovation ecosystem, in areas such as personal healthcare, smart surveillance, self-driving cars, wireless and fiber-optical communication, and intelligent lighting. A thorough understanding of such applications permits key application features to be captured in mathematical models, as a basis for model-based signal and information processing techniques which are inherently more powerful than classical 'black box' techniques. This model-based approach permits the group to combine academic excellence with a strong real-world impact, visible in many strong industrial and clinical collaborations and in 9 spin-off companies.

The group is very well known for its signal analysis research in the health area. Various areas are covered from which epilepsy is one. The TU/e and Kempenhaeghe have a long-term scientific collaboration with continuous exchange of engineers and doctors. This cooperation creates a unique research infrastructure.
**Kempenhaeghe**

Kempenhaeghe is the leading expertise centre for epileptology and sleep medicine. Kempenhaeghe has the largest EEG facility of the Netherlands with over 20 EEG systems running continuously, for the diagnosis of epilepsy and the detection of epileptic seizures. BrainWave has therefore access to a large set of EEG data for the off-line tests of the proposed algorithms and processor. Furthermore, Kempenhaeghe has more than 200 patients with non-convulsive seizures. The on-line testing of the brainwave processor and brainwave processing platform can be done in a sample of these patients. Kempenhaeghe is also well-known for its research in seizure detection, with clinical research at all levels (neurologist, clinical engineer, trial nurse), in close connection with the TU/e.

**The Donders Institute for Brain, Cognition and Behaviour (DI) at the Radboud University Nijmegen**

The Donders Institute for Brain, Cognition and Behavior is a world-class research centre devoted to understanding the mechanistic underpinnings of human cognition and behaviour in health and disease. The Institute is home to more than 600 researchers from 35 countries who share the common goal of contributing to the advancement of the brain-, cognitive- and behavioural sciences through investigator-driven research, and improving health, education and technology by applying advances in this field.