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## New Exciting Ph.D. Position at the AASS Mobile Robotics & Olfaction Lab

*Domain Prior-based Deep Learning (DoPed DL) for Mobile Robot Olfaction*

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### Open Ph.D. Position

The AASS Mobile Robotics and Olfaction Lab, <http://www.mrolab.eu> at University of Örebro, Sweden has an open Ph.D. position within AI/Machine Learning for robotics (Contact: Achim J. Lilienthal, <http://www.mrolab.eu/people/achim-lilienthal/>). The position is fully funded, with a competitive salary, for a period of four years. Applications will be accepted until September 15<sup>th</sup>, 2018, with an expected employment in January 2019.

### Research Topic

#### Research Topic "Domain Prior-based Deep Learning (DoPed DL) for Mobile Robot Olfaction"

Mobile Robot Olfaction (MRO) is concerned with mobile robot systems equipped with an artificial sense of smell and suitable other environmental sensors. Applications range from finding gas leaks to surveillance in the context of climate research. To address key problems in MRO (e.g., gas discrimination, modeling gas distributions and finding gas sources), analytic domain models are of limited use: typically only crude sensor models are available and gas dispersal is a chaotic process in non-artificial environments at non-microscopic scales.

While important developments in sensor technology and signal processing have been achieved recently, MRO has not yet fully leveraged the potential of Deep Learning. This research work will thus be dedicated to re-consider MRO from a Machine Learning perspective. The Ph.D. candidate will be given the opportunity to address research questions including whether more suitable representations for gas discrimination, concentration estimation, gas source localization and gas distribution mapping can be learned rather than hand-crafted (which is current state-of-the-art); how deep reinforcement learning can be used to identify novel gas source localization strategies; how available prior domain knowledge can be included in the learning process; and how generative adversarial networks (GANs) can be used to obtain more realistic simulated gas measurement sequences as well as for extrapolation of sparse measurements to spatio-temporally dense field estimates.

The Ph.D. candidate will have the opportunity to work with an advanced MRO simulation engine, a large number of datasets, and existing gas-sensitive robots and sensor networks. The Ph.D. candidate can also draw upon established research collaborations with, e.g., the German Aerospace Center (DLR)<sup>1</sup>, University of Barcelona<sup>2</sup>, University of Málaga<sup>3</sup>, University of Hertfordshire<sup>4</sup>, Warwick University<sup>5</sup>, Tokyo University of Agriculture<sup>6</sup>, Tianjin University<sup>7</sup>, and Cornell University<sup>8</sup>. The position will also be associated to projects within the WASP-AI initiative (<http://wasp-sweden.org/research/overview-of-the-aimlx-area/>).

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<sup>1</sup> <https://www.dlr.de/dlr/en>

<sup>2</sup> <http://www.ub.edu/web/ub/en/> and <http://www.ibecbarcelona.eu/>

<sup>3</sup> [https://www.uma.es/?set\\_language=en](https://www.uma.es/?set_language=en)

<sup>4</sup> <https://www.herts.ac.uk/>

<sup>5</sup> <https://warwick.ac.uk/>

<sup>6</sup> <http://www.nodai.ac.jp/english/>

<sup>7</sup> <http://www.tju.edu.cn/english/>

<sup>8</sup> <https://www.cornell.edu>



## The AASS Mobile Robotics & Olfaction Lab

The Centre for Appled Autonomous Sensor Systems (AASS, <http://aass.oru.se>) carries out multi-disciplinary research at the intersection of robotics, machine learning, artificial intelligence, computer vision, computer science, and measurement technology. The research and human environment at AASS is young and enthusiastic. Researchers come from different countries and have different scientific and cultural backgrounds. AASS also frequently hosts international researchers and is involved in several international projects. This means that enrolled Ph.D. candidates will have the opportunity to travel and to cooperate with people in other countries.



The Mobile Robotics & Olfaction Lab (MRO Lab, <http://www.mrolab.eu>) is one of three research groups within AASS. Our research is recognized world-wide with its focus generally on the development of perception systems for mobile robots. The goal is to advance the theoretical and practical foundations that allow mobile robots to operate in an unconstrained, dynamic environment. The approaches that we develop address real-world needs and are typically characterized by fusion of different sensor modalities. Where possible the results of our research work are timely integrated in industrial demonstrators. Major directions are<sup>9</sup> Mobile Robot Olfaction, Robot-assisted Environmental Monitoring, Rich 3D Perception, Long-term Autonomous Navigation, Autonomous Manipulation, and Human Robot Interaction. Currently, the Mobile Robotics & Olfaction Lab consists of 13 Ph.D. students and 13 senior researchers.



## Prerequisites and Application Process

In addition to a strong interest in the topic, a solid theoretical background and excellent programming skills, applicants should also have the equivalent of a Master's degree (120 ECTS) in a relevant field (e.g., Machine Learning, Computer Science Physics, Applied Mathematics, Robotics) or a related discipline with a clear focus on Artificial Intelligence or Machine Learning. Experience in Robotics is a plus. Proficiency in written/spoken English is mandatory.

To apply for the position, please send a motivation letter / research statement along with an updated CV (including at least two academic references) by e-mail to Prof. Achim J. Lilienthal ([achim.lilienthal@oru.se](mailto:achim.lilienthal@oru.se)). If possible, please include copies/links to publications and software samples. Applications can be sent immediately and will be considered until the position is fixed.

We are looking forward to *your* application!

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<sup>9</sup> <http://www.mrolab.eu/research/>



## Practical Information – Ph.D. Studies in Sweden

Ph.D. students in Sweden are University employees and they have all the social and financial rights of other employees. Among these: a fixed monthly salary adequate to the cost of living in Sweden, inclusion in the Swedish social security system, and at least 28 days of paid vacation each year. These conditions are guaranteed for three years as long as the requirements for the Ph.D. studies are fulfilled.

Ph.D. students in Sweden have to take advanced courses during their study program. These are typically technical courses relevant to their research project, but may also be courses about other related disciplines, including scientific methodology and project management. Courses at AASS are meant to provide students with a unique educational background in autonomous sensor systems.

Ph.D. candidates in Sweden may devote up to 20% of their time to institutional work. This work typically consists in helping with the undergraduate education. The percentage of time spent with institutional work is added to the total duration of the Ph.D. studies.

In summary, the Ph.D. students at AASS will be doing four sorts of things during their Ph.D.: work on their research project; take graduate courses; contribute to undergraduate education; and participate in the scientific life of AASS and of the international community.

More information about the Ph.D. studies at AASS can be found under <http://www.aass.oru.se/Research/Learning/openPh.D.posfaq.html>.

## Örebro University

The University of Örebro (<http://www.oru.se>) is a young university currently enrolling more than 17,000 students. It is located in Örebro, a city with 130,000 inhabitants, which is situated in central Sweden at 59°16'N 15°13'E. More information about Örebro can be found, for example, at <http://en.wikipedia.org/wiki/Örebro>.



## Additional Information

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| Contact Person:           | Prof. Achim J. Lilienthal.  |
| Contact Person, E-mail:   | <a href="mailto:achim.lilienthal@oru.se">achim.lilienthal@oru.se</a>  |
| Contact Person, Web Page: | <a href="http://www.mrolab.eu/people/achim-lilienthal/">http://www.mrolab.eu/people/achim-lilienthal/</a>                             |
| MR&O Lab:                 | <a href="http://www.mrolab.eu/">http://www.mrolab.eu/</a>   |
| AASS:                     | <a href="http://www.aass.oru.se">http://www.aass.oru.se</a>   |
| Ph.D. studies at AASS:    | <a href="http://www.aass.oru.se/Research/Learning/openphdposfaq.html">http://www.aass.oru.se/Research/Learning/openphdposfaq.html</a> |
| Örebro University:        | <a href="http://www.oru.se">http://www.oru.se</a>   |