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Research profile

develop few-shot machine learning algorithms using neurocomputational models of biological learning based on temporal correlation and memory based on dynamic neural field theory, that learn continuously, quickly and online. Application areas include autonomous robot navigation as well as cognitive robots for home and industry.

Technical competences

- Robotic perception and control
- Neural networks and machine learning
- Digital signal processing
- Mobile robots, modular robots, UAVs, ROVs and AUVs
- Mechanical design and analysis
- 3D-printing
- Circuit design, schematic capture and simulation
- Printed Circuit Board design
- Scientific programming
- Digital wired and wireless communication protocols
- Embedded systems design and programming

Educational qualifications

2008-2012	Ph.D. in BioRobotics, University of Southern Denmark, Denmark
2003-2005	M.Sc. in Computer Science, International University Bremen, Germany
1998-2002	B.Eng. in Electronics Engineering, V.I.T, University of Pune, India

Academic experience

12/2017-present	Assistant professor in neural and biorobotics, Embodied Systems for Robotics and Learning, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
05/2015-11/2017	Postdoctoral researcher in sensorimotor integration and learning, Embodied Systems for Robotics and Learning, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
05/2007-08/2008	Research assistant in modular robotics, Adaptronics group, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
06/2006-05/2007	Research assistant in aerial robotics, Robotics, Vision and Control Research Group, University of Sevilla, Spain

Professional experience

08/2013-04/2015	Robot developer in EU FP7 projects, Centre for Robot Technology, Danish Technological Institute, Denmark
03/2013-07/2013	Software developer for hearing aids, GN ReSound A/S, Denmark
06/2012-12/2012	Embedded systems designer for wearable motion-sensing devices, Yoke ApS, Denmark
07/2005-12/2005	Embedded engineer for underwater robots, Royal Netherlands Institute for Sea Research, Netherlands
03/2003-08/2003	Development engineer for industrial communication devices, SAN Telequip Pvt. Ltd., India

Teaching philosophy

I believe that research-based teaching is the best way maximise students' learning and at the same time foster research. I consider students to be my partners in my research. This gives students access to better resources, research networks and to specialised knowledge in a structured manner. Students are more engaged and motivated when they feel like a contributing partner rather than just a recipient. This approach also helps me to maintain a broad and critical view of my own research, to receive feedback from students and to generate new, useful research in partnership with the students.

Teaching approach

Since one cannot assume that the students are prepared in advance for research-based teaching, I structure my lectures to address research-led, research-oriented, research-based and research-tutored approaches in that specific order. These four approaches may be addressed in a single lecture if the topic being presented is quite small and focussed, or it may be spread out over many lectures/sessions, if the topic is quite heavy in content and requires lectures/sessions dedicated to a single approach. This ensures that students learn incrementally, are engaged in multiple ways and are not overwhelmed as well as minimises the disconnect between the course content, myself as the teacher and the students themselves.

By covering knowledge, methods and their importance in palatable research problems from my own and others' research (research-led teaching) via both theory and practical sessions, I teach students not just the what and the how, but also the why (research-oriented teaching). By working on self-defined research problems in groups under my supervision in practical sessions (research-based teaching), students apply knowledge, develop their skills and receive feedback. Finally, by finding and critically discussing relevant research in groups and presenting their opinions to the class via open discussion sessions (research-tutored teaching), students learn to communicate with their peers.

Teaching methods

I teach students the fundamental knowledge and methods used in the BioRobotics and Artificial Intelligence research fields, why these methods are useful and how they fit into the bigger research study. I present small research problems from my own research and relevant research from others in my field, where I identify the scientific hypothesis, the design and execution of the experiment, collection and analysis of relevant data in relation to the hypothesis and finally to derive conclusions. This takes place via both theory and practical sessions. Here the students are also introduced to specific software tools and to hardware such as robots. Students are offered the opportunity to define small sample research problems of their own and conduct independent research in groups. This takes place via practical sessions under my supervision. Here the students can apply the knowledge learnt and develop skills in applying specific methods and tools. They also receive direct feedback on their work. Finally, I instruct students to search online for the latest relevant research, critically discuss the research reported in associated scientific articles in groups and present their chosen topic and their opinions to the rest of the class in an open session where other students and I can ask questions. In this way, the students learn to be critical and objectively question the scientific hypothesis, methods and tools utilised in conducting the research, the experimental design and the conclusions drawn from the study. This occurs via interactive Q&A sessions in the lectures and practical work.

Students are expected to recall most of the background knowledge they have gained in their undergraduate studies, to be relatively comfortable with group discussions and group presentations, and to be open to working independently on a research problem in groups. I ensure that students have the time to "re-develop" these knowledge and skills by incorporating these activities in supervised classroom "break" sessions. By focussing more on students' ability to form a cogent argument and less on whether they are right or wrong, I minimise the possibility of the students feeling stigmatised if they are wrong or make a mistake.

Teaching experience

Target audience: Master students

2017-2019	Learning Algorithms in Artificial Intelligence, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
2019	Design of Software Systems in a Global Context, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
2017-onwards	BioRobotics for Beginners, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
2016	Artificial Intelligence 1 – Introduction to Artificial Intelligence¸ Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
2016	Artificial Intelligence 2 – Tools of Artificial Intelligence, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark
2011-2012	Artificial Intelligence 3 – Adaptive Robots, Maersk Mc-Kinney Moller Institute, University of Southern Denmark, Denmark

Management skills

05/2017-present	Work package leader on the SMOOTH (Seamless huMan-robot interactiOn fOr THe support of elderly people) project (http://smooth-robot.dk/en/home/)

Organisational skills

12/2015-present	Monthly seminar with talks from biologists, computational neuroscientists and roboticists
11/2018	Local chair for the 2nd International Youth Conference of Bionic Engineering (IYCBE2018)

Honourble mentions

14/2019 Top 8 finalist at the Wearable Robotics Innovation Challenge 2019

List of publications

2022

Shaikh, D. (2022). Learning multisensory cue integration: a computational model of crossmodal synaptic plasticity enables reliability-based cue weighting by capturing stimulus statistics. *Frontiers in Neural Circuits*. https://doi.org/10.3389/fncir.2022.921453, https://doi.org/10.3389/fncir.2022.921453

Rosado, B. F., & Shaikh, D. (Accepteret/In press). *Smooth dynamic control of an elastic tendon driven knee orthosis*. Poster session præsenteret ved ICRA 2022 Workshop on Online Machine Learning-Based Control of Lower Limb Exoskeletons, Philadelphia, Pennsylvania, USA.

2021

Pequeno-Zurro, A., Shaikh, D., & Rano, I. (2021). Analysis of an Extended Model of Bio-Inspired Source Seeking. I *2021 European Control Conference, ECC 2021* (s. 1265-1270). IEEE. 2021 European Control Conference, ECC 2021 https://doi.org/10.23919/ECC54610.2021.9655181

Bong, J. H., Christensen, A. L., Shaikh, D., & Jeong, S. (2021). Estimator of knee biomechanics based on deep learning. *Journal of the Korean Society for Precision Engineering*, *38*(11), 871-877. https://doi.org/10.7736/JKSPE.021.075

2020

Zurro, A. P., Rano, I., & Shaikh, D. (2020). A Chemosensory Navigation Model Inspired by the On/Off Neural Processing Mechanism in Cockroaches. *IEEE Transactions on Medical Robotics and Bionics*, *2*(3), 338-346. [9136760]. https://doi.org/10.1109/TMRB.2020.3007948

Shaikh, D., & Rañó, I. (2020). Braitenberg Vehicles as Computational Tools for Research in Neuroscience. *Frontiers in Bioengineering and Biotechnology*, *8*, [565963]. https://doi.org/10.3389/fbioe.2020.565963

Juel, W. K., Haarslev, F., Ramírez, E. R., Marchetti, E., Fischer, K., Shaikh, D., Manoonpong, P., Hauch, C., Bodenhagen, L., & Krüger, N. (2020). SMOOTH Robot: Design for a novel modular welfare robot. *Journal of Intelligent and Robotic Systems*, *98*, 19-37. https://doi.org/10.1007/s10846-019-01104-z

2019

Zurro, A. P., Rano, I., & Shaikh, D. (2019). A chemosensory navigation model inspired by the neural odour processing mechanism in cockroaches. I *Proceedings of the 2019 IEEE International Conference on Cyborg and Bionic Systems* (s. 17-23). IEEE. https://doi.org/10.1109/CBS46900.2019.9114486

Shaikh, D., & Manoonpong, P. (2019). A neuroplasticity-inspired neural circuit for acoustic navigation with obstacle avoidance that learns smooth motion paths. *Neural Computing and Applications*, *31*(6), 1765-1781. https://doi.org/10.1007/s00521-018-3845-y

Shaikh, D., Bodenhagen, L., & Manoonpong, P. (2019). Concurrent intramodal learning enhances multisensory responses of symmetric crossmodal learning in robotic audio-visual tracking. *Cognitive Systems Research*, *54*, 138-153. https://doi.org/10.1016/j.cogsys.2018.10.026

2018

Shaikh, D. (2018). *Concurrent Unimodal Learning Enhances Multisensory Responses of Symmetric Crossmodal Learning in Robotic Audio-Visual Tracking*. 30-31. Abstract fra 19th Annual International Multisensory Research Forum, Toronto, Ontario, Canada. http://imrf.info/wp_imrf/wp-content/uploads/2018/06/IMRF2018_Abstracts.pdf

Juel, W. K., Haarslev, F., Fischer, K., Marchetti, E., Shaikh, D., Manoonpong, P., Hauch, C., Bodenhagen, L., & Krüger, N. (2018). *The SMOOTH Robot: Design for a Novel Modular Welfare Robot*. Paper præsenteret ved ICRA2018 Workshop on Elderly Care Robotics – Technology and Ethics, Brisbane, Queensland, Australien.

Shaikh, D., & Kjær Schmidt, M. (2018). Three-dimensional Acoustic Localisation via Directed Movements of a Two-dimensional Model of the Lizard Peripheral Auditory System. I *Proceedings of the 2017 IEEE 5th International Symposium on Robotics and Intelligent Sensors (IEEE IRIS2017)* (s. 25-31). IEEE. https://doi.org/10.1109/IRIS.2017.8250093

Haarslev, F., Docherty , D., Suvei, S-D., Juel, W. K., Bodenhagen, L., Shaikh, D., Krüger, N., & Manoonpong, P. (2018). Towards Crossmodal Learning for Smooth Multimodal Attention Orientation. I S. S. Ge, J-J. Cabibihan, M. A. Salichs, E. Broadbent, H. He, A. R. Wagner, & Á. Castro-González (red.), *Social Robotics: Proceedings of the 10th International Conference, ICSR 2018* (s. 318-328). Springer. Lecture Notes in Computer Science Bind 11357 Lecture Notes in Artificial Intelligence Bind 11357 https://doi.org/10.1007/978-3-030-05204-1_31

2017

Shaikh, D., & Manoonpong, P. (2017). A Neural Circuit for Acoustic Navigation combining Heterosynaptic and Non-synaptic Plasticity that learns Stable Trajectories. I G. Boracchi, L. Iliadis, C. Jayne, & A. Likas (red.), *Engineering Applications of Neural Networks: 18th International Conference Engineering Applications of Neural Networks* (s. 544-555). Springer. Communications in Computer and Information Science Bind 744 https://doi.org/10.1007/978-3-319-65172-9_46

Pequeno-Zurro, A., Nitschke, J., Szyszka, P., Shaikh, D., & Couzin-Fuchs, E. (2017). *Active antennal movement in cockroaches - towards understanding multimodal exploration*. Poster session præsenteret ved PIRE Workshop/Summer School 2017: Hierarchical Multisensory Integration: Theory and Experiments, Girona, Spanien.

Shaikh, D., & Manoonpong, P. (2017). An adaptive neural mechanism for acoustic motion perception with varying sparsity . *Frontiers in Neurorobotics*, *11*, [00011]. https://doi.org/10.3389/fnbot.2017.00011

Pequeno-Zurro, A., Nitschke, J., Szyszka, P., Shaikh, D., & Couzin-Fuchs, E. (2017). Modelling active antennal movements of the American cockroach: towards biorobotic models of active sensing. I *Proceedings of the 2nd International Symposium on Swarm Behavior and Bio-Inspired Robotics* SWARM.

Shaikh, D., Manoonpong, P., Tuxworth, G., & Bodenhagen, L. (2017). Multisensory guidance of goal-oriented behaviour of legged robots. I M. F. Silva, G. S. Virk, M. O. Tokhi, B. Malheiro, P. Ferreira, & P. Guedes (red.), *Human-centric Robotics: Proceedings of the 20th International Conference on CLAWAR 2017* (s. 97-105). World Scientific. https://doi.org/10.1142/9789813231047_0015

Shaikh, D., & Manoonpong, P. (2017). Predictive Acoustic Tracking with an Adaptive Neural Mechanism. *Procedia Computer Science*, *105*, 99-104. https://doi.org/10.1016/j.procs.2017.01.208

Kjær Schmidt, M., & Shaikh, D. (2017). *Three-dimensional sound localisation with a lizard peripheral auditory model*. Poster session præsenteret ved 2017 ACM Symposium on Applied Perception, Cottbus, Tyskland.

Shaikh, D., Bodenhagen, L., & Manoonpong, P. (2017). *Unimodal Learning Enhances Crossmodal Learning in Robotic Audio-Visual Tracking*. Paper præsenteret ved 7th Joint IEEE International Conference on Development and Learning and on Epigenetic Robotics, Lisbon, Portugal. https://www2.informatik.uni-hamburg.de/wtm/WorkshopCrossmodalLearning2017/papers/Shaik_Final.pdf

2016

Shaikh, D., & Manoonpong, P. (2016). An Adaptive Neural Mechanism with a Lizard Ear Model for Binaural Acoustic Tracking. I E. Tuci, A. Giagkos, M. Wilson, & J. Hallam (red.), *From Animals to Animats 14: 14th International Conference on Simulation of Adaptive Behavior, SAB 2016, Aberystwyth, UK, August 23-26, 2016, Proceedings* (s. 79-90). Springer. Lecture Notes in Computer Science Bind 9825 https://doi.org/10.1007/978-3-319-43488-9_8

Shaikh, D., Hallam, J., & Christensen-Dalsgaard, J. (2016). From “ear” to there: A review of biorobotic models of auditory processing in lizards. *Biological Cybernetics*, *110*(4-5), 303-317. https://doi.org/10.1007/s00422-016-0701-y

2012

Shaikh, D. (2012). *Exploring a Robotic Model of the Lizard Peripheral Auditory System*. Syddansk Universitet. Det Tekniske Fakultet.

2011

Shaikh, D., Hallam, J., & Christensen-Dalsgaard, J. (2011). *Combining Bio-inspired Sensing with Bio-inspired Locomotion* . Abstract fra The 5th International Symposium on Adaptive Motion of Animals and Machines, Hyogo, Japan.

Shaikh, D., Hallam, J., & Christensen-Dalsgaard, J. (2011). *Learning to Localize Sound with a Lizard Ear Model*. Abstract fra International Workshop on Bio-Inspired Robots, Nantes, Frankrig.

2010

Shaikh, D., Hallam, J., & Christensen-Dalsgaard, J. (2010). Modifying Directionality through Auditory System Scaling in a Robotic Lizard. I S. Doncieux, B. Girard, A. Guillot, J. Hallam, J-A. Meyer, & J-B. Mouret (red.), *From Animals to Animats 11: 11th International Conference on Simulation of Adaptive Behavior, SAB 2010, Paris - Clos Lucé, France, August 25-28, 2010. Proceedings* (1st udg., Bind 6226, s. 82-92). Springer. Lecture Notes in Computer Science Bind 6226 https://doi.org/10.1007/978-3-642-15193-4_8

2009

Shaikh, D., Hallam, J., Christensen-Dalsgaard, J., & Zhang, L. (2009). A Braitenberg Lizard: Continuous Phonotaxis with a Lizard Ear Model. I *Bioinspired Applications in Artificial and Natural Computation: Third International Work-Conference on the Interplay Between Natural and Artificial Computation, IWINAC 2009, Santiago de Compostela, Spain, June 22-26, 2009, Proceedings, Part II* (s. 439-448). Springer. Lecture Notes in Computer Science Bind 5602 https://doi.org/10.1007/978-3-642-02267-8_47

Shaikh, D., Hallam, J., & Christensen-Dalsgaard, J. (2009). Control of a Braitenberg Lizard in a Phonotaxis Task with Decision Models. I T. Kyriacou, U. Nehmzow, C. Melhuish, & M. Witkowski (red.), *Proceedings of Towards Autonomous Robotic Systems* (s. 48-54). Intelligent Systems Research Centre, University of Ulster. Technical Report Series

Christensen, D. J., Bordignon, M., Schultz, U. P., Shaikh, D., & Støy, K. (2009). Morphology Independent Learning in Modular Robots. I H. Asama, H. Kurokawa, J. Ota, & K. Sekiyama (red.), *Proceedings of the International Symposium on Distributed Autonomous Robotic Systems* (s. 379-391). Springer.

2008

Brandt, D., Larsen, J. C., Christensen, D. J., Garcia, R. F. M., Shaikh, D., Schultz, U. P., & Støy, K. (2008). Flexible, fpga-based electronics for modular robots. I *Proceedings of the IROS Workshop on Self-Reconfigurable Robots, Systems and Applications*