

TOMASZ PIOTR KUCNER, PH.D.

RESEARCH OBJECTIVE

My research objective is to enable autonomous intelligent systems to **efficiently and safely operate in noisy and dynamic reality** of shared human-robot environments. My conviction is that to achieve this goal it is essential to enable robots to **acquire high-level knowledge through implicit cues** of daily human behaviour and through **enabling robots to continuously self assess and evaluate the quality of the said models.**

KEY WORDS

Mapping Localisation Maps of Dynamics Robotics
Machine Learning Integration Human awareness

EDUCATION AND RESEARCH EXPERIENCE

Post-doctoral Researcher

MRO Lab

📅 November 2018-Present 📍 Örebro University

- Building spatial models of dynamics,
- Development of map quality assessment methods,
- Development of human aware motion planners
- Integration work

PhD Thesis in Computer Science *Probabilistic Mapping of Spatial Motion Patterns for Mobile Robots.*

MRO Lab

📅 September 2012-October 2018 📍 Örebro University

- Building spatial models of dynamics,
- Development of human aware motion planners
- Integration work

MSc Thesis in Robotics *Seekur robot motion planning based on SLAM algorithm*

Faculty of Electronics

📅 March 2011-June 2012 📍 Wrocław University of Technology

BSc Thesis in Computer Management Systems in Manufacturing

Faculty of Electronics

📅 October 2007-February 2011 📍 Wrocław University of Technology

TEACHING AND SUPERVISION

Teaching responsibilities

📅 September 2012 - Present 📍 Örebro University

- Laboratory tutor
 - Imperative Programming (BSc level) - 30 students

AFFILIATION

Post-doctoral researcher

Mobile Robots and Olfaction Lab
AASS Research Centre
School of Science and Technology
Örebro University
Sweden

CONTACT INFORMATION

@ tomasz.p.kucner@gmail.com

@ tomasz.kucner@oru.com

☎ +46(0)739055654

🌐 <https://mro.oru.se/people/tomasz-kucner/>

🌐 <https://tpkucner.eu>

🌐 <https://github.com/tkucner>

✉ Storgatan 21 Lgh 305

📍 70361 Örebro, Sweden

ACADEMIC RECORDS

Google Scholar (H-index/total citations)

7/310

Scopus(H-index/total citations)

6/157

🆔 <https://orcid.org/0000-0002-9503-0602>

PERSONAL DATA

Date of birth

23/06/1988

Place of birth

Złotoryja, Poland

Residency

Sweden

Citizenship

Polish

LANGUAGES

- Polish (Native)
- English (Full Professional)

- Basic Programming (BSc level) - 30 Students
- Probabilistic Robotics (MSc level) - 30 students
- Course responsible/Lecturer
 - Probabilistic Robotics (MSc level) - 10 students
 - Integrated Project Work (MSc level) - 20 students
 - Probabilistic Robotics (SMARTER program - Supplementary courses for industry) - In preparation, for details please contact prof. Amy Loutfi Vice-Chancellor for AI (amy.loutfi@oru.se)

Supervision responsibilities

📅 September 2012 - Present 📍 Örebro University

- PhD students:
 - Co-supervisor for the PhD topic *Site awareness for task and motion planning in obile robots* - C. Swaminathan (2018-Present)
- MSc students: 2
- BSc students 4

Examiner responsibilities

📅 September 2012 - Present 📍 Örebro University

- MSc students: 2
- BSc students 3

RESEARCH PROJECT INVOLVEMENT

ILIAD - Intra-Logistics with Integrated Automatic Deployment: safe and scalable fleets in shared spaces

EU H2020 Project

📅 2017-Present

Role in the project:

- Development of methods for building spatial models of human dynamics.
- Development of human dynamic aware motion planning methods.
- Development of Map Quality assessment methods.
- Refactoring and maintaining mapping and localisation code.
- Integration and deployment work for multirobot system.

Project outcomes:

- Circural-Linear Flow Field Map - spatial model for describing flow of people in the environment. [1, 6, 8]
 - Flow aware motion planner in collaboration with Luigi Palmieri and Chittaranjan Srinivas Swaminathan. [1, 10, 11]
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AiR - Action and Intention Recognition in Human Intentions with Autonomus Systemes

KKS Project

📅 2018-2019

Role in the project:

- Development of methods for building spatial models of human dynamics.
- Co-implementation of a demonstrator.
- Management tasks.

Project outcomes:

- Novel, high quality dataset for evaluation of human motion prediction algorithms in collaboration with Andrey Rudenko, Chittaranjan Srinivas Swaminathan, Ravi Teja Chadalavada [2]
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SPENCER - Social situation-aware perception and action for cognitive robots

EU FP7 Project

📅 2015-2016

Role in the project:

- Development of methods for building spatial models of human dynamics.
- Development of human dynamic aware motion planning methods.

- Deployment of mapping and localisation system for a mobile autonomous robot.
- Integration and deployment work.

Project outcomes:

- Circural-Linear Flow Field Map - spatial model for describing flow of people in the environment. [1, 6, 8]
- Flow aware motion planner in collaboration with Luigi Palmieri and Chittaranjan Srinivas Swaminathan. [1, 10, 11]
- Informed prior generator solving global localisation problem [16]

ALLO - Autonomous Long-Term Load-Haul-Dump Operations

KKS Project

📅 2012-2015

Role in the project:

- Development of methods for building spatial models of dynamics.
- Design, assembly and deployment of a long term data collection system.
- Integration and deployment work.

Project outcomes:

- Circural-Linear Flow Field Map - spatial model for describing flow of people in the environment. [1, 6, 8]
- Condition-Transition Map - conditional model describing the occupancy changes in the occupancy grid map based on the local neighbourhood. [17]

KEY PUBLICATIONS

Probabilistic Mapping of Spatial Motion Patterns for Mobile Robots.

Tomasz Piotr Kucner, Achim J. Lilienthal, Martin Magnusson, Luigi Palmieri and Chittaranjan Srinivas Swaminathan
Number 40 in Cognitive Systems Monographs. Springer International Publishing, 2020.

The contribution of this book is three fold. First of all it present the state of the art of spatial models of dynamics. Second it summarises my contribution in the domain of building flow maps (which are special case of map of dynamics). Finally I also discuss the further development of this field of research, considering how it will impact human robot interactions in shared environments.

I am the key author of the book. I have developed key concepts presented in the manuscript and write the majority of the text. Achim J. Lilenthal and Martin Magnusson took part in the discussion of the said concepts and supported the editing process. Luigi Palmieri and Chittaranjan Swaminatna focused on the application of flow maps for motion planning.

THÖR: Human-robot navigation data collection and accurate motion trajectories dataset.

Andrey Rudenko, Tomasz Piotr Kucner, Chittaranjan Srinivas Swaminathan, Ravi Teja Chadalavada, Kai O. Arras, and Achim J. Lilienthal.
IEEE Robotics and Automation Letters, 5(2):676682, 2020.

The contribution of this paper is dual. In the first place we are presenting a novel concept of designing a data set collation setups relying on weekly scripted human actions. Second, we presented a resulting data set designed to study problems related to human tracking, human interaction and group dynamics.

In this paper my contribution was, involvement in development of the idea of weekly scripted interactions. I was also responsible for setting ups the people tracking system setup, data collection and data labeling.

Robust Frequency-Based Structure Extraction

Tomasz Piotr Kucner, Stephanie Lowry, Martin Magnusson, Achim J. Lilienthal
arXiv:2004.08794 [cs.RO] (pre-print)

They key contribution of this paper is a reference free approach towards assessing the quality of a map based on detecting repeating structures and self symmetries in the map.

The presented idea is my original concept as well as the implementation. The other co-authors contributed through refining the details of the idea, help in evaluation and final editing.

COMMUNITY INVOLVEMENT

IEEE P2751 (Robot 3D Map Data Representation) Working Group of IEEE SA

Vice-chair

📅 2017-Present

The role of the committee is to develop a standard for exchanging map data among heterogeneous robots.

- Working Group leadership
 - Chair: Francesco Amigoni - Polytechnic University of Milan
 - Vice-Chair: Tomasz Piotr Kucner
 - Secretary - Wonpil Yu - Electronics and Telecommunications Research Institute, Korea
 - Voting members: 10
 - Non-voting members: 20
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The Head Organiser of **Introspective methods for Reliable Autonomy** workshop

IROS 2017 Workshop

- Remaining Organisers:
 - Sören Schwertfeger - SahanghaiTech University - STAR-Lab
 - Martin Magnusson - Örebro University - AASS
 - Achim J. Lilenthal - Örebro University - AASS
 - Invited speakers:
 - Martial Hebert - Carnegie Mellon University - Robotics Institute
 - Oliver Brock - Technische Universität Berlin - Robotics and Biology Laboratory
 - Rudolph Triebel - DLR - Robotics and Mechatronics Center
 - Andreas Birk - Jacobs University - Jacobs Robotics
 - Leon Kester - TNO
 - Raymond Sheh - Curtin University - Intelligent Robots Group
 - Ingmar Posner - University of Oxford - Oxford Robotics Institute
 - Attendance 30 people
 - During the workshop there were also presented six novel papers
 - My role:
 - Write the workshop proposal
 - Invite speakers
 - Advertise the workshop for the community
 - Coordinate the review process
 - Moderate the panel discussion
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Program Committee member **Long-term Human Motion Prediction** workshop

ICRA 2020

Reviewer for: IROS, ICRA, ECMR, RA-L, IJARS, T-RO, MDPI Sensors

INVITED TALKS

Invited talk at Department of Cybernetics and Robotics

Probabilistic models of dynamic objects for mobile robots

📅 25-10-2018

📍 Wrocław University of Technology

Event announcement:

<https://kcir.pwr.edu.pl/index.php/pl/seminaria/274-1216-posiedzenie-seminarium-cybernetyki-i-robotyki>

DATA SETS

THÖR - Tracking Human Motion at Örebro University

<http://thor.oru.se/>

A dataset of motion trajectories with diverse and accurate social human motion data in a shared indoor environment.

Total number of downloads: 665 (<https://zenodo.org/record/3382145>)

RELEASED CODE

CLiFF-map-matlab

<https://github.com/tkucner/CLiFF-map-matlab>

Matlab implementation of the method for computing Circural-Linear flow field map

CLiFFpy

<https://github.com/tkucner/CLiFFpy>

Python implementation of the method for computing Circural-Linear flow field map

ROSE

<https://github.com/tkucner/rose>

Python implementation method for assessing map quality using Fast Fourier transform.

TECHNICAL EXPERIENCE

Programming languages

C/C++ (10+ years)

Python (3 years)

Matlab/Ocatve (10+ years)

Bash (8 years)

ROS (8 years)

Sensors

laser range sensors (SICK - 8 years, Velodyne - 5 years, Ouster - 1 year)

motion capture systems (Qualisys - 2 years)

depth cameras (Asus - 1 year, Kineckt - 1 year)

Deep learning Frameworks

Pytorch (1 year)

Other

Basic circuit design

Soldering

ALL PUBLICATIONS

Citation count according to Google Scholar.

Books

1. (Cited by: 5) Tomasz Piotr Kucner, Achim J. Lilienthal, Martin Magnusson, Luigi Palmieri and Chittaranjan Srinivas Swaminathan . *Probabilistic Mapping of Spatial Motion Patterns for Mobile Robots*. Number 40 in Cognitive Systems Monographs. Springer International Publishing, 2020.

Peer Reviewed Journal Papers

2. (Cited by: 3) Andrey Rudenko, Tomasz Piotr Kucner, Chittaranjan Srinivas Swaminathan, Ravi Teja Chadalavada, Kai O. Arras, and Achim J. Lilienthal. Thör : Human-robot navigation data collection and accurate motion trajectories dataset. *IEEE Robotics and Automation Letters*, 5(2):676–682, 2020.
3. (Cited by: 2) Victor Hernandez Bennetts, Kamarulzaman Kamarudin, Thomas Wiedemann, Tomasz Piotr Kucner, Sai Lokesh Somisetty, and Achim J. Lilienthal. Multi-domain airflow modeling and ventilation characterization using mobile robots, stationary sensors and machine learning. *Sensors*, 19(5), 2019.
4. (Cited by: 5) Hongqi Fan, Tomasz Piotr Kucner, Martin Magnusson, Tiancheng Li, and Achim Lilienthal. A dual phd filter for effective occupancy filtering in a highly dynamic environment. *IEEE transactions on intelligent transportation systems (Print)*, 19(9):2977–2993, 2018.

5. (Cited by: 9) Hakan Almqvist, Martin Magnusson, [Tomasz Piotr Kucner](#), and Achim Lilienthal. Learning to detect misaligned point clouds. *Journal of Field Robotics*, 35(5):662–677, 2018.
6. (Cited by: 22) [Tomasz Piotr Kucner](#), Martin Magnusson, Erik Schaffernicht, Victor Manuel Hernandez Bennetts, and Achim J. Lilienthal. Enabling flow awareness for mobile robots in partially observable environments. *IEEE Robotics and Automation Letters*, 2(2):1093–1100, 2017.
7. (Cited by: 12) Victor Hernandez Bennetts, [Tomasz Piotr Kucner](#), Erik Schaffernicht, Patrick P. Neumann, Han Fan, and Achim J. Lilienthal. Probabilistic air flow modelling using turbulent and laminar characteristics for ground and aerial robots. *IEEE Robotics and Automation Letters*, 2(2):1117–1123, 2017.

Refereed Conference and Workshop Articles

8. (Cited by: 8) Tomas Vintr, Sergi Molina, Ransalu Senanayake, George Broughton, Zhi Yan, Jiri Ulrich, [Tomasz Piotr Kucner](#), Chittaranjan Srinivas Swaminathan, Filip Majer, Maria Stachova, Achim J. Lilienthal, and Tomas Krajnik. Time-varying pedestrian flow models for service robots. In *2019 European Conference on Mobile Robots (ECMR)* :, 2019.
9. Hongqi Fan, Dawei Lu, [Tomasz Piotr Kucner](#), Martin Magnusson, and Achim Lilienthal. 2D spatial keystone transform for sub-pixel motion extraction from noisy occupancy grid map. In *Proceedings of 21st International Conference on Information Fusion (FUSION)* :, pages 2400–2406, 2018.
10. (Cited by: 5) Chittaranjan Srinivas Swaminathan, [Tomasz Piotr Kucner](#), Martin Magnusson, Luigi Palmieri, and Achim Lilienthal. Down the CLiFF : Flow-aware trajectory planning under motion pattern uncertainty. In *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* :, IEEE International Conference on Intelligent Robots and Systems, pages 7403–7409, 2018.
11. (Cited by: 15) Luigi Palmieri, [Tomasz Piotr Kucner](#), Martin Magnusson, Achim J. Lilienthal, and Kai Arras. Kinodynamic motion planning on gaussian mixture fields. In *IEEE International Conference on Robotics and Automation (ICRA 2017)* :, pages 6176–6181, 2017.
12. (Cited by: 2) Martin Magnusson, [Tomasz Piotr Kucner](#), Saeed Gholami Shahbandi, Henrik Andreasson, and Achim Lilienthal. Semi-supervised 3D place categorisation by descriptor clustering. In *2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* :, Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems, pages 620–625, 2017.
13. (Cited by: 151) Rudolph Triebel, Kai Arras, Rachid Alami, Lucas Beyer, Stefan Breuers, Raja Chatila, Mohamed Chetouani, Daniel Cremers, Vanessa Evers, Michelangelo Fiore, Hayley Hung, Omar A. Islas Ramirez, Michiel Joosse, Harmish Khambhaita, [Tomasz Piotr Kucner](#), Bastian Leibe, Achim J. Lilienthal, Timm Linder, Manja Lohse, Martin Magnusson, Billy Okal, Luigi Palmieri, Umer Rafi, Marieke van Rooij, and Lu Zhang. Spencer : A socially aware service robot for passenger guidance and help in busy airports. In *Field and Service Robotics : Results of the 10th International Conference*, number 113 in Springer Tracts in Advanced Robotics, pages 607–622, 2016.
14. (Cited by: 13) Victor Hernandez Bennetts, Erik Schaffernicht, Achim J. Lilienthal, Han Fan, [Tomasz Piotr Kucner](#), Lena Andersson, and Anders Johansson. Towards occupational health improvement in foundries through dense dust and pollution monitoring using a complementary approach with mobile and stationary sensing nodes. In *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)* :, pages 131–136, 2016.
15. (Cited by: 3) Martin Magnusson, [Tomasz Piotr Kucner](#), and Achim J. Lilienthal. Quantitative evaluation of coarse-to-fine loading strategies for material rehandling. In *Proceedings of the IEEE International Conference on Automation Science and Engineering (CASE)* :, IEEE International Conference on Automation Science and Engineering (CASE), pages 450–455. IEEE conference proceedings, 2015.
16. (Cited by: 6) [Tomasz Piotr Kucner](#), Martin Magnusson, and Achim J. Lilienthal. Where am I? : An ndt-based prior for mcl. In *2015 European Conference on Mobile Robots (ECMR)* :, IEEE conference proceedings, 2015.
17. (Cited by: 60) [Tomasz Piotr Kucner](#), Jari Sarinen, Martin Magnusson, and Achim J. Lilienthal. Conditional transition maps: learning motion patterns in dynamic environments. In *IEEE/RSJ International Conference on Intelligent Robots and Systems* :, IEEE International Conference on Intelligent Robots and Systems, pages 1196–1201, 2013.

Thesis

18. [Tomasz Piotr Kucner](#). *Probabilistic Mapping of Spatial Motion Patterns for Mobile Robots*. PhD thesis, Örebro University, School of Science and Technology, 2018.

Preprints and Workshops

19. [Tomasz Piotr Kucner](#), Stephanie Lowry, Martin Magnusson, Achim J. Lilienthal Robust Frequency-Based Structure Extraction In *arXiv:2004.08794 [cs.RO] (pre-pint)*
20. (Cited by: 2) [Tomasz Piotr Kucner](#), Martin Magnusson, Erik Schaffernicht, Victor Hernandez Bennetts, and Achim Lilienthal. Tell me about dynamics! : Mapping velocity fields from sparse samples with semi-wrapped gaussian mixture models. In *Robotics : Science and Systems Conference (RSS 2016) Workshop*, 2016.