

Julian Straub

Citizenship: Germany

Birth Date: March 20, 1988 in Augsburg, Bavaria, Germany

CONTACT INFORMATION

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EDUCATION

MASSACHUSETTS INSTITUTE OF TECHNOLOGY 08/12 – present

Ph.D. Candidate, Computer Science and Artificial Intelligence Laboratory (CSAIL)
Advisors: Senior Research Scientist John W. Fisher III and Professor John J. Leonard
Research Focus: 3D Perception for Autonomous Systems, Bayesian nonparametrics, Computer Vision
Cumulative GPA: 4.8/5.0

GEORGIA INSTITUTE OF TECHNOLOGY 08/10 – 05/11

Master of Science (M.Sc.), Electrical and Computer Engineering,
Research Project with Professor Frank Dellaert
Double Degree Program with the Technische Universität München
Cumulative GPA: 4.0/4.0

TECHNISCHE UNIVERSITÄT MÜNCHEN 08/07 – 08/12

Dipl. Ing. with High Distinction, Electrical Engineering and Information Technology
Major in Signals and Systems as well as Controls
Cumulative GPA: 1.26 (on a scale from 1 to 5, with 1 being the highest score)
Average Rank: 3/155 students

RESEARCH INTERESTS

NONPARAMETRIC 3D PERCEPTION

My research is focused on uncovering, inferring and exploiting fundamental properties and statistics of 3D environments with the aim of empowering artificial perception systems. The sensing and 3D perception process of an artificial perception system is inherently sequential. Furthermore, the amount of data grows at a much higher rate than the complexity of the model needed to describe it. Both aspects are captured by Bayesian nonparametric models, which I utilize to derive principled and efficient inference algorithms. By construction, the derived inference respects and exploits the sequential nature of observations while being able to adapt the complexity of the model to the data. Building on these theoretical foundations, I design novel manifold-aware probabilistic generative models to describe fundamental scene properties such as a scene's surface normal distribution. To obtain high quality 3D input data for those models, I use and develop dense 3D simultaneous localization and mapping systems.

INDUSTRY EXPERIENCE

FACEBOOK OCULUS RESEARCH 05/16 – 08/16

Computer Vision Intern
Supervisors: Steven Lovegrove and Richard Newcombe
Software development.

APPLE 05/15 – 08/15

Intern
Software development.

EVOLUTION ROBOTICS 05/11 – 09/11

Robotics Intern
Supervisor: Mario E. Munich (Chief Technology Officer)
Software development in the field of Computer Vision: Created a camera calibration tool with GUI to give intuitive feedback about calibration quality; Coded a working monocular visual SLAM system.

KUKA ROBOTICS CORP. – DEVELOPMENT DEPARTMENT 10/07 – 12/08

Robotics Intern
Supervisor: Christian Tarragona (Head of Robot Control Development)
Implemented a pose controller for an omni-directional robot platform on an Atmel microprocessor using sensor feedback from optical mouse sensors. Developed several circuit-boards for energy, motor control and the communication infrastructure for prototypes of the commercially-available robot platform KUKA youBot.

RESEARCH EXPERIENCE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY 2012 – present

Ph.D. Candidate
Advisors: Senior Research Scientist John W. Fisher III and Professor John J. Leonard
Current research focuses on 3D environment models for fast and flexible 3D perception. Specifically, I am currently working on extracting and utilizing statistics of man-made environments for 3D perception tasks. Major contributions include novel manifold-aware probabilistic models describing man-made environments and Bayesian nonparametric models for directional data such as surface normals of 3D scenes.

Advisors: S. Hilsenbeck, Dipl. Ing. and G. Schroth, M.Sc.

Investigated deployment of binary features, which can be compute very efficiently, for global and purely visual pose recovery as well as relocalization within a visual odometry system. We show that relocalization using binary features is accurate, fast and robust even in sparsely textured and repetitive indoor environments. Furthermore utilizing Locality Sensitive Hashing we demonstrated state of the art accuracy in large scale visual localization.

Undergraduate Research Assistant

Supervisors: Martin Schäfer, Dipl. Ing.

Developed the hard- and software for a multi-robot soccer lab. On the hardware side, this involved designing an Bluetooth-adaptor board as well as distance sensor adapter-boards for a third party robot platform, the Pololu 3Pi robot. On the software side, I wrote the microcontroller C code as well as the infrastructure C++ code on a central computer to allow remote-control over six robots at the same time via Bluetooth.

Bachelor Thesis

“Pedestrian Indoor Localization and Tracking using a Particle Filter combined with a learning Accessibility Map”

Supervisor: Martin Schäfer, Dipl. Ing.

Developed a particle-filter-based indoor localization algorithm that uses the number of foot-steps and the heading of a person combined with a rough floor-plan. Additionally, investigated ways of learning the accessibility of areas in the map from using movement patterns of people traversing the environment.

PUBLICATIONS

REFEREED CONFERENCE PUBLICATIONS

- **J. Straub**, T. Campbell, J. P. How and J. W. Fisher III. “Efficient Global Point Cloud Alignment using Bayesian Nonparametric Mixtures”. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017.
- **J. Straub**, O. Freifeld, G. Rosman, J. J. Leonard and J. W. Fisher III. “The Manhattan Frame Model—Manhattan World Inference in the Space of Surface Normals”. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), 2017.
- **J. Straub**, T. Campbell, J. P. How and J. W. Fisher III. “Small-Variance Nonparametric Clustering on the Hypersphere”. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015. **(oral presentation)**
- T. Campbell, **J. Straub**, J. W. Fisher III, and J. P. How. “Streaming, Distributed Variational Inference for Bayesian Nonparametrics”. Conference on Neural Information Processing (NIPS), 2015.
- R. Cabezas, **J. Straub**, J. W. Fisher III. “Semantically-Aware Aerial Reconstruction from Multi-Modal Data”. International Conference on Computer Vision (ICCV), 2015.
- **J. Straub**, N. Bhandari, J. J. Leonard, J. W. Fisher III. “Real-time Manhattan World Rotation Estimation in 3D”. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), 2015.
- **J. Straub**, J. Chang, O. Freifeld, J. W. Fisher III. “A Dirichlet Process Mixture Model for Spherical Data”. International Conference on Artificial Intelligence and Statistics (AISTATS), 2015.
- **J. Straub**, G. Rosman, O. Freifeld, J. J. Leonard and J. W. Fisher III. “A Mixture of Manhattan Frames: Beyond the Manhattan World”. IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2014. **(oral presentation, 5.76% acceptance rate)**
- **J. Straub**, S. Zheng and J. W. Fisher III. “Bayesian Nonparametric Modeling of Driver Behavior”. IEEE Intelligent Vehicles Symposium, 2014. **(runner-up best presentation)**
- **J. Straub**, S. Hilsenbeck, G. Schroth, R. Huitl, A. Möller and E. Steinbach. “Fast Relocalization for Visual Odometry using Binary Features”. 20th IEEE International Conference on Image Processing (ICIP), 2013.
- R. Roberts, D. Ta, **J. Straub**, K. Ok and F. Dellaert. “Saliency detection and model-based tracking: a two part vision system for small robot navigation in forested environment”. SPIE Defense, Security, and Sensing, 2012.
- M. Schäfer, **J. Straub** and S. Chakraborty. “Pedestrian Indoor Navigation Using a Wireless Pocket-IMU and User-augmented Maps”. MobiHeld, 2010.

PATENTS

- **J. Straub**, G. Rosman, O. Freifeld, J. J. Leonard and J. W. Fisher III. “System And Method For Extracting Dominant Orientations From A Scene”. US Patent App. 14/678,585, 2015.

IN THE MEDIA

- Research featured on the MIT front page in April 2014. “Orienteering for Robots”.
Online: <http://newsoffice.mit.edu/2014/orienteering-for-robots-0404>
 - Oral Presentation at CVPR about “Small-Variance Nonparametric Clustering on the Hypersphere” in June 2015.
 - Oral Presentation at CVPR about “A Mixture of Manhattan Frames: Beyond the Manhattan World” in June 2014.
Online: <http://techtalks.tv/talks/a-mixture-of-manhattan-frames-beyond-the-manhattan-world/60355/>
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LEADERSHIP,
MENTORING AND
TEACHING

MIT

09/15 – present

Undergraduate Research Opportunity (UROP) Mentor

Currently, I am mentoring five undergraduate students on a project aimed to develop an early detection system for lymphedema. This involves building a 3D scanning device and developing dense 3D reconstruction and machine learning algorithms to detect arm-volume changes. In 08/16 two of the students won EECS-department awards for their work.

MIT

08/15 – 05/16

Undergraduate Research Opportunity (UROP) Mentor

Mentored an undergraduate student on a 3D reconstruction project. In 08/16 the student won the best UROP award by the EECS department.

MIT

08/14 – 12/14

Teaching Assistant

“Introduction to Inference” with Professors Polina Golland and Gregory W. Wornell. I helped develop course material, exams and lead two review sessions each week.

ADVISOE-PROGRAM – A TUTORING PROGRAM FOR FRESHMEN

08/09 – 08/10

Tutor

Led workshops on topics like teamwork, time and project management, learning techniques and presentation methods for a group of 15 students. I helped organize three big events for over 100 people. This program included substantial professional leadership training (4 weeks total, full-day practical training).

ADVISOE-PROGRAM OF THE TECHNISCHE UNIVERSITÄT MÜNCHEN

10/07 – 07/08

Team Leader

Led a team of ten students to victory in a robot line-following competition against four other student teams. Lead the development of the robot as well as the strategy for the competition.

SERVICE

PROFESSIONAL SERVICE

- Chair for a Computer Vision session at the International Conference on Intelligent Robots and Systems (IROS)
- Reviewer for the Conference on Computer Vision and Pattern Recognition (CVPR)
- Reviewer for the Conference on Neural Information Processing Systems (NIPS)
- Reviewer for the Artificial Intelligence and Statistics Conference (AISTATS)
- Reviewer for the International Conference on Machine Learning (ICML)

LEADERSHIP IN STUDENT ORGANIZATIONS

- 2014 President of the MIT EECS Graduate Student Association
- 2013 Vice President for Social Events and Orientation of the MIT EECS Graduate Student Association
- 2012 Mentor for International Exchange Students at Technische Universität München
- 2010 Officer in the World Student Fund Exchange Club at the Georgia Institute of Technology
- 2009 Softskill-tutor for freshman within the so called AdvISOe program at the Technische Universität München

HONORS

- 2013 Runner-up best presentation at the Autonomous Vehicle Symposium
- 2010 Fulbright Scholarship
- 2010 ATLAS Double Degree Program of the European Union
- 2010 Max Weber-Program of Bavaria
- 2010 Heinrich and Lotte Mühlfenzl Foundation
- 2010 MAN SE Scholarship
- 2008 Talent Support Program of the Technische Universität München

ADDITIONAL
QUALIFICATIONS AND
INTERESTS

Languages: Native German and fluent written and spoken English (more than five years studying in the USA).

Programming: C/C++, MATLAB, Python, CUDA, cmake, Bash, L^AT_EX, GLSL

Software: vim, git, Linux/Unix Systems, Cadsoft Eagle, MS-Office.

Robotics: Microcontroller programming (6 years), electrical circuit and layout design as well as component selection and dimensioning (5 years), mechanical design, soldering (5 years). Platforms: Turtlebot V2, KUKA YouBot, five different self-built robots.

Interests: Endurance sports (Marathon 3:54:55h, backpacking (Torres del Paine), trail running (Presidential Traverse)), science fiction books.

REFERENCES

John W. Fisher III

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