Tobias Feigl

Ph.D., Friedrich-Alexander University Erlangen-Nuremberg (FAU), Germany
Research Assistant at Fraunhofer Institute for Integrated Circuits (IIS) Nuremberg, Germany
Guest Lecturer at Friedrich-Alexander University Erlangen-Nuremberg (FAU), Germany

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91466 Gerhardshofen
German citizen

Date: June 13th, 1984
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ABOUT

Tobias Feigl received his Ph.D. degree in Computer Science from the Friedrich-Alexander-University Erlangen-Nuremberg (FAU) in 2021 and his Masters degree from the University of Applied Sciences Erlangen-Nuremberg, Germany, in 2017. He joined the Machine Learning & Information Fusion lab at the Fraunhofer Institute for Integrated Circuits (IIS) Nuremberg, Germany, in 2017. He switched to the Hybrid Positioning & Information Fusion lab at the IIS Nuremberg, Germany, in 2020. In parallel, since 2017 he is a lecturer at the Computer Science department (Programming Systems lab) at FAU, where he gives courses on machine and deep learning.

His research interests are on AI-driven signal processing, human computer interaction, localization, and model- and data-driven hybrid filter techniques. He focuses on the improved, machine learning-driven mapping of human motion behavior in immersive virtual environments on a large scale with inertia and radio sensors.

EDUCATION

2021 **Ph.D., Computer Science**
Friedrich-Alexander-University Erlangen-Nuremberg, Germany
Computer Science Department
THESIS "Data-driven methods for determining position and orientation in radio- and inertial-based dead reckoning systems"
FOCUS Long-short-term memory cells to improve pedestrian dead reckoning and recurrent neural networks for orientation and localization
ADVISORS Prof. Dr. Michael Philippsen, PD Dr.-Ing. habil. Thomas Wittenberg, Prof. Dr. Georg Fischer, and Prof. Dr. Klaus Meyer-Wegener
GRADES Thesis: 1.0 (summa cum laude) [*]

2017 **M.Sc., Computer Science**
University of Applied Science Erlangen-Nuremberg, Germany
Computer Science Department
THESIS "Immersion-optimized sensor fusion for low-cost realtime locating systems in Virtual Reality applications"
FOCUS Digital Signal-Processing and Machine Learning to improve Augmented and Virtual Reality and Pedestrian Localization
ADVISORS Prof. Dr. Timo Götzelmann and Prof. Dr. Friedhelm Stappert
GRADES Thesis: 1.0 (A, GPA 4.0), total: 1.4 (A, GPA 3.6) [*]

2013 **B.Sc., Computer Science**
University of Applied Science, Erlangen-Nuremberg, Germany
Computer Science Department
THESIS "Conceptual design and implementation of a system configuration tool for a radio-based localization system"
ADVISORS Prof. Dr. rer. nat. Friedhelm Stappert
GRADES Thesis: 1.0 (A, GPA 4.0), total: 2.3 (A, GPA 2.7) [*]

2006 **German High School Diploma**
Erlangen, Germany

[*] GRADES range from 1.0 to 4.0, with 1.0 is best and from level A to E, with A is best 10%, B is next 25% and GPA 4.0 to 1.0 with 4.0 is best

ACADEMIC POSITIONS

2021–today	**Postdoc (Habilitation candidate), Computer Science, Ph.D.** Friedrich-Alexander-University Erlangen-Nuremberg, Germany Computer Science Department
Project	"Generalization of AI-based Localization Methods"
Advisors	Prof. Dr. Michael Philippsen, PD Dr.-Ing. habil. Thomas Wittenberg, and Prof. Dr.-Ing. habil. Andreas Paul Fröba.
2017–2021	**Research Assistant (Ph.D. candidate), Computer Science, M.Sc.** Friedrich-Alexander-University (FAU) Erlangen-Nuremberg, Germany Computer Science Department - Programming Systems Group
Project	"RuNN - Recurrent Neuronal Networks (RNNs) for Real-Time Estimation of Nonlinear Motion Models"
Advisors	Prof. Dr. Michael Philippsen
2015	**Research Intern, Computer Science, B.Sc.** University of Applied Sciences (TH) in Nuremberg, Germany, Reverse Engineering Lab
Project	"Development and publication of the first mobile anti-phishing device for smartphone-based online banking"
Advisor	Prof. Dr. Peter Trommler
2013-2015	**Visiting Student, Computer Science, B.Sc.** Friedrich-Alexander-University Erlangen-Nuremberg, Germany Computer Science Department
Focus	Machine Learning, Human-Computer-Interaction, Computer Graphics, Reverse Engineering
2007-2009	**Visiting Student, Electrical Engineering and Information Technology** University of Applied Science in Erlangen-Nuremberg, Germany Electrical Engineering Department
Focus	Signal processing, Embedded systems, Hardware reverse engineering

TEACHING EXPERIENCE

Courses

2021 **Lecturer (course instructor)**
CS3856999 Machine Learning: Introduction (B.Sc. [5 ECTS]), FAU.
CS3856998 Machine Learning: Advances (M.Sc. [5 ECTS]), FAU.
Supervisor, CS3448533 Parallel and Functional Programming, FAU.
Supervisor, CS3448488 Algorithms and Data Structures, FAU.

2020 **Lecturer (course instructor)**
CS3856999 Machine Learning: Introduction (B.Sc., [5 ECTS]), FAU.
CS3856998 Machine Learning: Advances (M.Sc. [5 ECTS]), FAU.
Supervisor, CS3448533 Parallel and Functional Programming, FAU.
Supervisor, CS3448488 Algorithms and Data Structures, FAU.

2019 **Lecturer (course instructor)**
Machine Learning course (B.Sc., M.Sc., [5 ECTS]), FAU.
Supervisor, CS3448533 Parallel and Functional Programming, FAU.
Supervisor, CS3448488 Algorithms and Data Structures, FAU.

2018 **Supervisor**
Machine Learning course (B.Sc., M.Sc., [2.5, 5 ECTS]), FAU.
CS3448533 Parallel and Functional Programming, FAU.
CS3448488 Algorithms and Data Structures, FAU.

2017 **Supervisor**
Machine Learning course (B.Sc., [2.5, ECTS]), FAU.
Machine Learning course (M.Sc., [5 ECTS]), FAU.
CS3448533 Parallel and Functional Programming, FAU.
CS3448488 Algorithms and Data Structures, FAU.

Qualification Theses

[1] Einfluss verschiedener Inertial- und Funksensordaten auf die Posenschätzung von Menschen mittels Rekurrenter Neuronaler Netze
Andreas Porada
Masters Thesis, Technische Hochschule Nürnberg (TH), 2021, published.

[2] Radio Localization to Enable Robust People Tracking in High-Resolution Images
Stephanie Mehltretter
Bachelor Thesis, Friedrich-Alexander-University Erlangen-Nuremberg (FAU), 2020, published.

[3] Einfluss verschiedener Inertial- und Funksensordaten auf die Posenschätzung von Menschen mittels Rekurrenter Neuronaler Netze
Peter Bauer
Masters Thesis, Technische Hochschule Nürnberg (TH), 2020, published.

[4] Application of Deep Learning Methods to Process Natural Phenomena
Thomas Altstidl
Bachelor Thesis, Friedrich-Alexander-University Erlangen-Nuremberg (FAU), 2019, published.

[5] Feature Extraction of a Radio Frequency based Localization System Using Beta-VAE
Oskar Herrmann
Bachelor Thesis, Friedrich-Alexander-University Erlangen-Nuremberg (FAU), 2019, published.

[6] How far is far? Evaluation, Visualization, and Interpretation of RNNs on Physically Correct Movements
Lukas Schmidt
Masters Thesis, Friedrich-Alexander-University Erlangen-Nuremberg (FAU), 2019, published.

[7] Komplementieren Relativer und Absoluter Eigenlokalisierungsverfahren
Felix Ott
Masters Thesis, Friedrich-Alexander-University Erlangen-Nuremberg (FAU), 2019, published.

[8] Avatar Synchronisation zur Analyse von Bewegungswahrnehmung der unteren Extremitäten in VR
Lisa Gruner
Bachelor Thesis, Technische Hochschule Nürnberg (TH), 2019, published.

[9] Eine explorative Untersuchung zu Textverständnis und Lerneffekt im Medium Virtuelle Realität - Lohnt sich der Implementierungsaufwand für die Anwendung im Fraunhofer IIS?
Lea Otte
Bachelor Thesis, Technische Hochschule Nürnberg (TH), 2019, published.

[10] Evaluation of Distributed Neural Networks for Indoor Radio Positioning Utilizing Efficient Embedded Hardware
Jan Niklas Bauer
Masters Thesis, Friedrich-Alexander-University Erlangen-Nuremberg (FAU), 2019, published.

[11] Analyse und Evaluierung aktueller MR Tracking Systeme am Beispiel ARKit
Andreas Porada
Bachelor Thesis, Georg-Simon-Ohm Hochschule Nürnberg (GSOHM), 2018, published.

[12] Einfluss dynamischer Objekttransformationen auf die Bewegungswahrnehmung in VR
Felix Gruber
Bachelor Thesis, Technische Hochschule Nürnberg (TH), 2018, published.

[13] Robustes Inside-Out Tracking für großflächige Mehrnutzer VR Systeme
Christian Daxer
Masters Thesis, Technische Hochschule Nürnberg (TH), 2018, published.

[14] Robuste Posenschätzung durch Identifikation von Kalibriermomenten mittels Maschine Learning
Frank Brendel
Masters Thesis, Technische Hochschule Nürnberg (TH), 2018, published.

[15] Virtual-Reality-optimierte Sensor Fusion für eine langzeitstabile Gestenerkennung der oberen Extremität
Christian Jakob
Masters Thesis, Technische Hochschule Nürnberg (TH), 2018, published.

INDUSTRIAL POSITIONS

2021–today	**Postdoctoral Research Assistant, Ph.D.** Fraunhofer Institute for Integrated Circuits (IIS) Nuremberg, Germany Hybrid Positioning and Information Fusion Group Full-time
Tasks	Administer research and industry projects with strong focus on AI-based localization
2017–2021	**Research Assistant, M.Sc.** Fraunhofer IIS in Nuremberg, Germany Machine Learning and Information Fusion Group Full-time
Tasks	Administer research and industry projects with strong focus on AI-based signal processing
2015	**Co-Founder, B.Sc.** HolodeckVR GmbH (Spree), Nuremberg, Germany Part-time
Tasks	Data-analytics and development of an immersive low-cost tracking system for virtual reality applications
2009-2017	**Working Student** Fraunhofer IIS in Nuremberg, Germany Precise Localization and Analytics Department Part-time
Tasks	Software development, design of graphical user interfaces, hardware engineering
2001	**Working Scholar** Weilburger Graphics GmbH, Gerhardshofen, Germany Leading manufacturer in the international graphic industry Vacation job
Tasks	Office job
2000-2009	**Working Scholar** RWG Germany GmbH, Dachsbach, Germany Leading manufacturer in the international aviation industry Vacation job
Tasks	Optimization of sandblasting procedures

HONORS AND AWARDS

2021	Fraunhofer Price (Research).
2020	Schmidt Science Fellows 2021 Nomination. FAU Research Grant: ”Pioneering research in the field of AI-based localization for VR”.
2019	FAU Research Grant: ”Pioneering research in the field of AI-based localization”. FAU Award: ”Best seminar of the year”.
2018	FAU Research Grant: ”Pioneering research in the field of AI-driven VR systems”.
2017	University of Applied Science Award: ”Best thesis of the year”.

ACADEMIC SERVICE

2021 **Member of**

Review Committee, Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN).
Review Committee, Intl. Symp. on Mixed and Augmented Reality (ISMAR).
Review Committee, Intl. Conf. on Virtual Reality and 3D User Interface (IEEE VR).
Review Committee, MDPI Sensors Journal (MDPI).
Session Chair, Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN).
Review Committee, Wireless Communications and Networking Conference (WCNC).

2020 **Member of Review Committee**

Intl. Symp. on Mixed and Augmented Reality (ISMAR).
Springer Journal on Virtual Reality (VIRE).
IEEE Sensors Journal (IEEE).
Intl. Conf. on Virtual Reality and 3D User Interface (IEEE VR).
Conf. on Artificial Intelligence (AAAI).
IEEE Transactions on Signal Processing (IEEE TSP).
MDPI Sensors Journal (MDPI).
Conf. on Neural Information Processing Systems (NeurIPS).

2019 **Member of Review Committee**

Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN).
Intl. Conf. of Human-Computer Interaction (CHI).
European Conf. on Artificial Intelligence (ECAI).
Intl. Conf. on Virtual Reality and 3D User Interface (IEEE VR).

2018 **Member of Review Committee**

Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN).
Virtual Reality Software and Technology (VRST).
Intl. Symp. on Mixed and Augmented Reality (ISMAR).

2017 **Member of Review Committee**

Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN).
Special Interest Group on Graphics and Interactive Techniques (SIGGRAPH).
Intl. Conf. on Virtual Reality and 3D User Interface (IEEE VR).

2016-today **Member of**

Verein Deutscher Ingenieure (VDI).
Graduate Student Member, Institute of Electrical and Electronics Engineers (IEEE).
Graduate Student Member, Association for Computing Machinery (ACM).

ACADEMIC PUBLICATIONS

Articles in Double-blind Peer-reviewed Journals

[1] PDRNN: Data-driven Pedestrian Dead Reckoning on Loosely Coupled Radio- and Inertial-Signalstreams
Tobias Feigl, Schmidt Lukas, Bauer Peter, Ott Felix, Michael Philippsen, Christopher Mutschler
IEEE Sensors Journal (Jan. 2022) pp. 1–22.

[2] Datengetriebene Methoden zur Bestimmung von Position und Orientierung in funk- und trägheitsbasierter Koppelnavigation
Tobias Feigl
Friedrich-Alexander-Universität Erlangen-Nürnberg (Sept. 2021). DOI: https://nbn-resolving.org/urn:nbn:de:bvb:29-opus4-173550.

[3] Estimating TOA Reliability with Variational Autoencoders
Maximilian Stahlke, Sebastian Kram, Felix Ott, Tobias Feigl, Christopher Mutschler
IEEE Sensors Journal (Sept. 2021) pp. 1–6. DOI: 10.1109/JSEN.2021.3101933.

[4] RNN-aided Human Velocity Estimation from a Single IMU
Tobias Feigl, Sebastian Kram, Philipp Woller, Ramiz H. Siddiqui, Michael Philippsen, Christopher Mutschler
Sensors J. 13.4512 (May 2020) pp. 1–31. DOI: 10.3390/s20133656.

[5] UWB Channel Impulse Responses for Positioning in Complex Environments: A Detailed Feature Analysis
Sebastian Kram, Maximilian Stahlke, Tobias Feigl, Jochen Seitz, Jörn Thielecke
Sensors J. 24.5547 (Dec. 2019) pp. 1–26. DOI: 10.3390/s19245547.

[6] Sick Moves! Motion Parameters as Indicators of Simulator Sickness
Tobias Feigl, Daniel Roth, Stefan Gradl, Markus Wirth, Marc Erich Latoschik, Björn Eskofier, Michael Philippsen, Christopher Mutschler
Trans. on Visualization and Computer Graphics (TVCG) 25.11 (Aug. 2019) pp. 3146–3157. DOI: 10.1109/TVCG.2019.2932224.

Articles in Double-blind Peer-reviewed Conferences

[1] Accuracy-Aware Compression of Channel Impulse Responses using Deep Learning
Thomas Robert Altstidl, Sebastian Kram, Oskar Herrmann, Maximilian Stahlke, Tobias Feigl, Christopher Mutschler
Proc. Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), 2021.

[2] Robust ToA-Estimation using Convolutional Neural Networks on Randomized Channel Models
Tobias Feigl, Ernst Eberlein, Sebastian Kram, Christopher Mutschler
Proc. Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), 2021.

[3] Contact Tracing with the Exposure Notification Framework in the German Corona-Warn-App
Steffen Meyer, Thomas Windisch, Adrian Perl, Daniel Dzibela, Robert Marzilger, Nicolas Witt, Justus Benzler, Göran Kirchner, Tobias Feigl, Christopher Mutschler
Proc. Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), 2021.

[4] Real-Time Gait Reconstruction For Virtual Reality Using a Single Sensor
Tobias Feigl, Lisa Gruner, Christopher Mutschler, Daniel Roth
Proc. Intl. Symp. on Mixed Reality and Augmented Reality (ISMAR), 2020, Pernambuco, Brasil, DOI: 10.1109/ISMAR-Adjunct51615.2020.00037.

[5] A Sense of Quality for Augmented Reality Assisted Process Guidance
Anes Redzepagic, Christoffer Löfler, Tobias Feigl, Christopher Mutschler
Proc. Intl. Symp. on Mixed Reality and Augmented Reality (ISMAR), 2020, Pernambuco, Brasil, DOI: 10.1109/ISMAR-Adjunct51615.2020.00046.

[6] ViPR: Visual-Odometry-aided Pose Regression for 6DoF Camera Localization
Felix Ott, Tobias Feigl, Christoffer Löfler, Christopher Mutschler
Proc. Intl. Conf. on Computer Vision and Patter Recognition (CVPR), 2020, Seattle, Washington, DOI: 10.1109/CVPRW50498.2020.00029.

[7] Localization Limitations of ARCore, ARKit, and Hololens in Dynamic Large-Scale Industry Environments
Tobias Feigl, Andreas Porada, Steve Steiner, Christoffer Löffler, Christopher Mutschler, Michael Philippsen

Proc. Intl. Conf. on Computer Vision, Imaging and Computer Graphics Theory and Applications (GRAPP), 2020, Valletta, Malta, DOI: 10.5220/0008989903070318.

[8] ViPR: Visual-Odometry-aided Pose Regression for 6DoF Camera Localization
Felix Ott, Tobias Feigl, Christoffer Löffler, Christopher Mutschler
arXiv 1912.08263 cs.CV, 2019.

[9] A Bidirectional LSTM for Estimating Dynamic Human Velocities from a Single IMU
Tobias Feigl, Sebastian Kram, Philipp Woller, Ramiz H. Siddiqui, Michael Philippsen, Christopher Mutschler
Proc. Intl. Conf. Indoor Positioning and Indoor Navigation (IPIN), 2019, Pisa, Italy, DOI: 10.1109/IPIN.2019.8911814.

[10] A Social Interaction Interface Supporting Affective Augmentation Based on Neuronal Data
Daniel Roth, Larrissa Brübach, Franziska Westermeier, Christian Schell, Tobias Feigl, Marc Erich Latoschik
Proc. Symp. on Spatial User Interaction (SUI), 2019, New Orleans, USA, DOI: 10.1145/3357251.3360018.

[11] A Framework for Location-Based VR Applications
Jean-Luc Lugrin, Florian Kern, Constantin Kleinbeck, Daniel Roth, Christian Daxer, Tobias Feigl, Christopher Mutschler, Marc Erich Latoschik
Virtuelle und Erweiterte Realitat: 16. Workshop der GI-Fachgruppe VR/AR (Berichte aus der Informatik), 2019, Fulda, Germany.

[12] Brain 2 Communicate: EEG-based Affect Recognition to Augment Virtual Social Interactions
Daniel Roth, Franziska Westermeier, Larissa Brübach, Tobias Feigl, Christian Schell, Marc Erich Latoschik
Mensch und Computer - Workshopband, 2019, Hamburg, Germany, DOI: 10.18420/muc2019-ws-571.

[13] Supervised Learning for Yaw Orientation Estimation
Tobias Feigl, Christopher Mutschler, Michael Philippsen
Proc. Intl. Conf. Indoor Positioning and Indoor Navigation (IPIN), 2018, Nantes, France, DOI: 10.1109/IPIN.2018.8533811.

[14] Recurrent Neural Networks on Drifting Time-of-Flight Measurements
Tobias Feigl, Thorsten Nowak, Michael Philippsen, Thorsten Edelhäußer, Christopher Mutschler
Proc. Intl. Conf. Indoor Positioning and Indoor Navigation (IPIN), 2018, Nantes, France, DOI: 10.1109/IPIN.2018.8533813.

[15] A Location-Based VR Museum
Jean-Luc Lugrin, Florian Kern, Ruben Schmidt, Constantin Kleinbeck, Daniel Roth, Christian Daxer, Tobias Feigl, Christopher Mutschler, Marc Erich Latoschik
Proc. Intl. Conf. Virtual Worlds for Serious Applications (VS-Games), 2018, Würzburg, Germany, DOI: 10.1109/VS-Games.2018.8493404.

[16] Head-to-Body-Pose Classification in No-Pose VR Tracking Systems
Tobias Feigl, Christopher Mutschler, Michael Philippsen
Proc. Intl. Conf. Virtual Reality and 3D User Interfaces (IEEE VR), 2018, Tuebingen/Reutlingen, Germany, DOI: 10.1109/VR.2018.8446495.

[17] Human Compensation Strategies for Orientation Drifts
Tobias Feigl, Christopher Mutschler, Michael Philippsen
Proc. Intl. Conf. Virtual Reality and 3D User Interfaces (IEEE VR), 2018, Tuebingen/Reutlingen, Germany, DOI: 10.1109/VR.2018.8446300.

[18] Beyond Replication: Augmenting Social Behaviors in Multi-User Social Virtual Realities
Daniel Roth, Constantin Kleinbeck, Tobias Feigl, Christopher Mutschler, Marc-Erich Latoschik
Proc. Conf. Virtual Reality and 3D User Interfaces (IEEE VR), 2018, Tuebingen/Reutlingen, Germany, DOI: 10.1109/VR.2018.8447550.

[19] Acoustical manipulation for redirected walking
Tobias Feigl, Eliise Kõre, Christopher Mutschler, Michael Philippsen
Proc. Intl. Symp. on Virtual Reality Software and Technology (VRST), 2017, Gothenburg, Sweden, DOI: 10.1145/3139131.3141205.

[20] Social Augmentations in Multi-User Virtual Reality: A Virtual Museum Experience
Daniel Roth, Constantin Kleinbeck, Tobias Feigl, Christopher Mutschler, Marc-Erich Latoschik
Proc. Intl. Symp. on Mixed and Augmented Reality (ISMAR), 2017, Nantes, France, DOI: 10.1109/ISMAR-Adjunct.2017.28.

Patents

[1] Methods and Apparatuses for Positioning in a Wireless Communications Network
Mohammad Alawieh, Ernst Eberlein, Tobias Feigl, Thomas Grün
WO/2021/089258, Patent Cooperation Treaty, 2021, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2021089258.

[2] Methods and Apparatuses for Positioning in a Wireless Communications Network
Mohammad Alawieh, Ernst Eberlein, Tobias Feigl, Thomas Grün
EP3819657, European Patent Office, 2021, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=EP323759835.

[3] Method to Determine a Present Position of an Object, Positioning System, Tracker and Computer Program
Stephan Otto, Tobias Feigl, Christian Daxer, Alexander Bruckmann, Christoffer Loeffler, Christopher Mutschler, Marc Faßbinder
US20200371226, United States of America Patent Office, 2020, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=US311580591.

[4] Method for Predicting a Motion of an Object, Method for Calibrating a Motion Model, Method for Deriving a Predefined Quantity and Method for Generating a Virtual Reality View
Tobias Feigl, Christopher Mutschler
EP3732549, European Patent Office, 2020, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=EP310552140.

[5] Method to Determine a Present Position of an Object, Positioning System, Tracker and Computer Program
Stephan Otto, Tobias Feigl, Christian Daxer, Alexander Bruckmann, Christoffer Loeffler, Christopher Mutschler, Marc Faßbinder
EP3724744, European Patent Office, 2020, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=EP309422132.

[6] Method for Predicting a Motion of an Object, Method for Calibrating a Motion Model, Method for Deriving a Predefined Quantity and Method for Generating a Virtual Reality View
Tobias Feigl, Christopher Mutschler
US20200334837, United States of America Patent Office, 2020, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=US309415935.

[7] Method to Determine a Present Position of an Object, Positioning System, Tracker and Computer Program
Stephan Otto, Tobias Feigl, Christian Daxer, Alexander Bruckmann, Christoffer Loeffler, Christopher Mutschler, Marc Faßbinder
CN111512269, Chinese Patent Office, 2020, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=CN302932485.

[8] Method for Predicting a Motion of an Object, Method for Calibrating a Motion Model, Method for Deriving a Predefined Quantity and Method for Generating a Virtual Reality View
Tobias Feigl, Christopher Mutschler
CN111527465, Chinese Patent Office, 2020, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=CN302978646.

[9] Apparatuses and Methods for Correcting Orientation Information from one or more Inertial Sensors
Tobias Feigl, Christopher Mutschler
US20190346280, United States of America Patent Office, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=US276400006.

[10] Apparatuses and Methods for Correcting Orientation Information from one or more Inertial Sensors
Tobias Feigl, Christopher Mutschler
EP3568801, European Patent Office, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=EP276893927.

[11] Vorrichtung und Verfahren zur Effizienten Zustandsbestimmung und Lokalisierung zwischen mobilen Plattformen
Christopher Mutschler, Sebastian Kram, Christian Nickel, Tobias Feigl Seitz, Niels Hadaschik
WO/2019/197006, Patent Cooperation Treaty, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019197006.

[12] Apparatuses and Methods for Correcting Orientation Information from one or more Inertial Sensors
Tobias Feigl, Christopher Mutschler

CN250178436, Chinese Patent Office, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=CN250178436.

[13] Method for Predicting a Motion of an Object, Method for Calibrating a Motion Model, Method for Deriving a Predefined Quantity and Method for Generating a Virtual Reality View
Tobias Feigl, Christopher Mutschler
WO/2019/129355, Patent Cooperation Treaty, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019129355.

[14] Method for Setting a Viewing Direction in a Representation of a Virtual Environment
Christopher Mutschler, Tobias Feigl, Christian Daxer, Stephan Otto, Bercea Cosmin-Ionut
US243321209, United States of America Patent Office, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=US243321209.

[15] Method to Determine a Present Position of an Object, Positioning System, Tracker and Computer Program
Stephan Otto, Tobias Feigl, Christian Daxer, Alexander Bruckmann, Christoffer Loeffler, Christopher Mutschler, Marc Faßbinder
WO/2019/114925, Patent Cooperation Treaty, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019114925.

[16] Method for Setting a Viewing Direction in a Representation of a Virtual Environment
Christopher Mutschler, Tobias Feigl, Christian Daxer, Stephan Otto, Bercea Cosmin-Ionut
EP3458935, European Patent Office, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=EP239836478.

[17] Method for Setting a Viewing Direction in a Representation of a Virtual Environment
Christopher Mutschler, Tobias Feigl, Christian Daxer, Stephan Otto, Bercea Cosmin-Ionut
CN237677091, Chinese Patent Office, 2019, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=CN237677091.

[18] Vorrichtung und Verfahren zur Effizienten Zustandsbestimmung und Lokalisierung zwischen mobilen Plattformen
Tobias Feigl, Christopher Mutschler
DE223815006, Deutsches Patent- und Markenamt (DPMA), 2018, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=DE223815006.

[19] Apparatuses and Methods for Correcting Orientation Information from one or more Inertial Sensors
Tobias Feigl, Christopher Mutschler
WO/2018/130446, Patent Cooperation Treaty, 2018, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2018130446.

[20] Verfahren zum Einstellen einer Blickrichtung in einer Darstellung einer virtuellen Umgebung
Christopher Mutschler, Tobias Feigl, Christian Daxer, Stephan Otto, Bercea Cosmin-Ionut
DE206581508, Deutsches Patent- und Markenamt (DPMA), 2017, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=DE206581508.

[21] Method for Setting a Viewing Direction in a Representation of a Virtual Environment
Christopher Mutschler, Tobias Feigl, Christian Daxer, Stephan Otto, Bercea Cosmin-Ionut
WO/2017/198441, Patent Cooperation Treaty, 2017, URL: https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2017198441.

ACADEMIC TALKS

2021 **Machine Learning for Indoor Localization: Special Session**
Tobias Feigl et al.
Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), Nantes, France.

Machine Learning for Sensor Fusion: Special Session
Tobias Feigl et al.
Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), Nantes, France.

Robust ToA-Estimation using Convolutional Neural Networks on Randomized Channel Models
Tobias Feigl et al.
Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), Nantes, France.

Datengetriebene Methoden zur Bestimmung von Position und Orientierung in funk- und trägheitsbasierter Koppelnavigation
Tobias Feigl et al.
Friedrich-Alexander-Universität (FAU), Erlangen, Germany.

2020 **Real-Time Gait Reconstruction For Virtual Reality Using a Single Sensor**
Tobias Feigl et al.
Symp. on Mixed and Augmented Reality (ISMAR), Pernambuco, Brasil.

A Sense of Quality for Augmented Reality Assisted Process Guidance
Tobias Feigl et al.
Symp. on Mixed and Augmented Reality (ISMAR), Pernambuco, Brasil.

Localization Limitations of ARCore, ARKit, and Hololens in Dynamic Large-Scale Industry Environments
Tobias Feigl et al.
Intl. Conf. on Computer Graphics Theory and Applications, Valletta, Malta.

2019 **Machine learning for positioning**
Tobias Feigl et al.
Symp. on Big Data Allianz, Stuttgart, Germany.

Sick Moves! Motion Parameters as Indicators of Simulator Sickness
Tobias Feigl et al.
Intl. Symp. on Mixed and Augmented Reality (ISMAR), Beijing, China.

Challenges of data-driven Localization
Tobias Feigl et al.
ADA Lovelace Center for Analytics, Data and Applications, Nuremberg, Germany.

A Bidirectional LSTM for Estimating Dynamic Human Velocities from a Single IMU
Tobias Feigl et al.
Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), Pisa, Italy.

Generative models for the detection of destructive radio environments
Tobias Feigl et al.
Intl. Symp. on Horizon 2020 - ICT-52, Valencia, Spain.

2018 **Human Compensation Strategies for Orientation Drifts**
Tobias Feigl et al.
Intl. Conf. on Virtual Reality and 3D User Interfaces (IEEE VR), Tuebingen/Reutlingen, Germany.

Head-to-Body-Pose Classification in No-Pose VR Tracking Systems
Tobias Feigl et al.
Intl. Conf. on Virtual Reality and 3D User Interfaces (IEEE VR), Tuebingen/Reutlingen, Germany.

Recurrent Neural Networks on Drifting Time-of-Flight Measurements
Tobias Feigl et al.
Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), Nantes, France.

Supervised Learning for Yaw Orientation Estimation
Tobias Feigl et al.
Intl. Conf. on Indoor Positioning and Indoor Navigation (IPIN), Nantes, France.

Machine learning methods for human-centered multisensory localization
Tobias Feigl et al.
Workshop on Machine Learning, Bilkent University, Ankara, Turkey.

2017 **Hacking human sensors - Augmented Reality, Mixed Reality, Virtual Reality optimized visualization**
Tobias Feigl et al.
Eingebettete Systeme für Sport, Fitness und Gesundheit (ESI), Nuremberg, Germany.

Acoustical manipulation for redirected walking
Tobias Feigl et al.
Intl. Symp. on Virtual Reality Software and Technology (VRST), Gothenburg, Sweden.

RESEARCH FUNDING & GRANT APPLICATION

List of accompanied inter/national research proposals in Germany and Europe **):

2021

BMBF-6G-Hub - 6G-RIC
Generalization of unsupervised Channel Charting for robust localization
Task lead: proposal writing, (accepted).

STMWI-LuFo VI - A^{2}D
Advancing Autonomous Drones
Task lead: collaboration with other depts., proposal writing, (rejected).

BMBF 2020/21 "InnoPush" - 5G-Sentinel
Six-G Enablers: Flexible Networks, THz Technology and Integration, Non-Terrestrial Networks, SidElink, and Localization
Task lead, proposal writing,(accepted).

BMBF-2876 - TRAICT
Trusted Resource Aware Information and Communication Technology
Task lead, proposal writing, (accepted).

STMWI-LuFo VI - D4I4
Autonomous swarms of drones for Industry 4.0
Task lead, proposal writing, collaboration with other depts., (rejected).

BMBF 2020/21 "InnoPush" - TEN-G
Technology Enablers for Disaggregated Networks
Task lead, proposal writing, (accepted).

2020

BMBF-2912 - REKOVAR
Responsive interactive sensor fusion using DL
Technical lead, project conception, collaboration with other depts., finding funding, program development, proposal writing, budget development, (rejected).

BMBF-2912 - MuViK
Development of a multi-user VR environment with multi-sensory access to barrier-free cultural participation
Technical lead, project conception, collaboration with other depts., finding funding, proposal writing, budget development, (rejected).

BMBF-3068 - KEOTGOI
Artificial generation and optimization of training data for the extraction of location information from inertial data
Consortium lead, project conception, collaboration with other depts., proposal writing, (rejected).

BMBF-3068 - DyKoSKIS
Dynamically configured simulation models for AI-based signal processing
Consortium lead, project conception, collaboration with other depts., finding funding, proposal writing, budget development, (rejected).

H2020-ICT-52-5GPPP - KAIROS
Smart Connectivity Beyond 5G
Task lead, collaboration with other depts., finding funding, proposal writing, (rejected).

2019 **BMBF-1624 - Writing Trainer**
Handwriting training and writing digitization using context-sensitive pens
Consortium lead, project conception, collaboration with other depts., finding funding, proposal writing, budget development, (accepted).

BMBF-2022 - AI3oT
AI Industrial IoT Artificial intelligence for self-positioning and communication in the industrial IoT context
Consortium lead, project conception, collaboration with other depts., finding funding, proposal writing, budget development, (rejected).

BayWi-1353 - Movement Analytics
AI-based process analysis and optimization using mixed reality
Technical lead, proposal writing, (rejected).

2018 **BMBF-1566 - EsReal**
Essential reality through selective information filtering with immersive media in the tender "Interactive systems in virtual and real spaces
Technical lead, project conception, collaboration with other depts., finding funding, proposal writing, budget development, (rejected).

2017 **BMBF-1353 - HoloCare**
Mixed reality assistance system for care
Consortium lead, project conception, collaboration with other depts., finding funding, proposal writing, budget development, (accepted).

**) Advisors: Dr.-Ing. C. Mutschler, Prof. Dr. D. Roth, Prof. Dr. M. E. Latoschik, and Prof. Dr. B. Eskofier
Bundesministerium für Bildung und Forschung (BMBF)
Bayerisches Wirtschaftsministermium (BayWi)
Horizont 2020 (H2020).

CONSULTING AND SIGNIFICANT PROJECTS

2021-2022 **HUAWEI GmbH**
AI-based Positioning.
Project lead, Research assistant.

IMBUS GmbH
Qualitative and quantitative interpretability of AI in the wild.
Scientific lead, Supervisor.

Elektrobit GmbH
AI-based sensor fusion and hybrid positioning.
Scientific lead, Supervisor.

2020-2022 **STABILO International GmbH**
AI-based letter recognition
Technical lead, Research assistant.

2019 **Deutsche Bundeswehr**
AI-based Immersive localization
Research assistant.

2018 **ROOQ GmbH**
AI-based motion recognition
Technical lead, Research assistant.

2017 **Holodeck VR GmbH**
Development and launch of the start-up company

Co-founder, senior data-scientist.

ESI Fitness
Immersive AI-based human motion visualization in VR
Task lead, Research assistant.

2016 **Spree Interactive GmbH**
AI-based large scale tracking for VR
Co-founder, senior data-scientist.

2015-2017 **Fraunhofer Holodeck VR**
Immersive large scale localization in VR
Technical lead, Research assistant.

2014 **RedFIR (JOGMO GmbH)**
Human-sport-event-observer application
Working student.

2013 **ORAL-B GmbH**
Application programming interface for a smart tooth brush
Working student.

2009-2012 **RedFIR (JOGMO GmbH)**
Event-based graphical user interface for real-time sports tracking applications
Working student.

SKILLS AND INTERESTS

Skills

Coding

+10 years objective-C/C/C++/C#, MATLAB, Qt, boost C++, OpenCV, IDA disassembler, java/script, batch, bash/shell, iOS, macOS, unix (Ubuntu), ..

+5 years Python, scikit-learn, TensorFlow, PyTorch, Theano, Keras, ROS, Unity3D, Unreal Engine, Android, JDK, NDK, swift, IDA/Ghidra/Hopper disassembler, arduino, assembler (x86, arm32, arm64, amd64, x86_64), OCaml, ruby, coq, Haskell, Lua, php, perl, ..

git /OSS (+100k loc) eyeTVCamd, OSCam, iDirStat, ..

Languages

German	Native speaker;	Latin	Independent user, B2;
English	Proficient user, C2;	Spanish	Basic user, A1.

Interests

Professional Time- and context-sensitive algorithms, support vector machines, recurrent and convolutional neural networks, variational autoencoder, human-computer-interaction, social-interaction and -behavior, virtual- and augmented-reality, simulator sickness, sensor fusion, digital signal processing, localization, and positioning.

Private Family and friends, music, nutrition, and fitness/cardio sports.

CIVIL SERVICE

2006–2007 **Community Service**
Blaukreuz Haus Rauschenberg in Dachsbach, Germany
Tasks Supervision of the IT infrastructure; driver assistant for hospital trips

THESES

2021	**Data-driven methods for determining position and orientation in radio- and inertial-based dead reckoning systems** Tobias Feigl Ph.D. Thesis, Friedrich-Alexander-University Erlangen-Nuremberg, Germany
Advisor	Prof. Dr. Michael Philippsen
2017	**Immersion-optimized sensor fusion for low-cost realtime locating systems in Virtual Reality applications** Tobias Feigl Masters Thesis, University of Applied Science Erlangen-Nuremberg, Germany
Advisor	Prof. Dr. Timo Götzelmann
2013	**Conceptual design and implementation of a system configuration tool for a radio-based localization system** Tobias Feigl Bachelor Thesis, University of Applied Science Erlangen-Nuremberg, Germany
Advisor	Prof. Dr. rer. nat. Friedhelm Stappert
2011	**Analysis of a radio system configuration framework** Tobias Feigl Studienarbeit, University of Applied Science Erlangen-Nuremberg, Germany
Advisor	Prof. Dr. Reinhard Eck