

MST Review Academic Year 2022/23



Alexander W. Koch

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Team

Koch, Alexander W., Prof. Dr.-Ing. habil. Dr. h.c., Ordinarius

Jakobi, Martin, Dr.-Ing., Academic Director

Ott, Sabine, Dr.-Ing., Lecturer

Werthschulte, Kay, Prof. Dr.-Ing., Lecturer

Bierbaum, Rainer

von Grafenstein, Rita

Josipovic, Hrvoje (since 01 July)

Poplawski, Zbigniew

Baier, Valentin, M.Sc. *)

Bian, Qiang, M. Eng.

Brändle, Franziska, Dr.-Ing.

Buchfellner, Fabian, M.Sc. *)

Dong, Jie, Dr.-Ing. (until 31 March 2023)

Dong, Xingchen, Dr.-Ing. *) (until 30 June 2023)

Fink, Maximilian, M.Sc.

Haas, Lukas, M. Eng. *) (since 01 October 2022)

Haider, Arsalan, M. Eng. *)

Hoffmann, Marcel, Dr.-Ing.

Jiang, Zongze (until 30 September 2023)

Kienitz, Sascha, M.Sc. *)

Kurz, Wolfgang, M.Sc.

Stadler, Andrea, M.Sc. *)

Stemplinger, Anselm, B. Sc. (until 14 February 2023)

Wang, Kun, M. Eng.

Wang, Shuchao

*) External cooperation

Teaching and Research in Academic Year 2022/23

Teaching Courses

- Advanced Laboratory Training Course Optomechatronical Measurement Systems
- Basic Laboratory Course Electrical Engineering
- Electrical Measurement of Environmental Quantities
- Electrical Measurement Technology for Computer Scientists
- Electromagnetic Sensors and Measurement Systems Laboratory: Experiment Computer-Generated Holography
- Intellectual Property and Technopreneurship, Singapore
- Laboratory Course Measurement and Sensor Technology (teaching profession)
- Measurement Systems and Sensor Technology (MST)
- Measurement Systems and Sensor Technology, TUM Asia, Singapore
- Measurement Systems and Sensor Technology for Mathematicians
- Measurement Systems and Sensor Technology in Mechanical Engineering
- Measurement and Sensor Technology (teaching profession)
- Non-contact Techniques for Material Testing, Athens Course
- Optomechatronical Measurement Systems, TUM Asia, Singapore
- Optomechatronical Measurement Systems (OMS)
- Photonic Measurement Systems (PM)
- Sensor Electronics, TUM Asia, Singapore
- Space Electronics for Sensor Systems

Bachelor Theses

- Akgün, Olcay: Development of Image Processing and Segmentation Techniques for Improved Detection of Dendrites in Real Neural Network Images.
- Eickmann, Matthias: Versuchsanweisung des Praktikumsversuchs für Messbrücken.
- Jarvis Lim, Zhi U: Multiplex Labelling with Hyperspectral Imaging.
- Marasch, Samer: LiDAR-Based Multi-Region Object Detection of Hand Gestures.
- Melbert, Jonas: Simulative Optimization, Design and Implementation of a MEMS Microphone Array for Acoustic Imaging.
- Mohr, Johanna: Entwicklung und Aufbau einer Test- und Kalibrierbox für Klimasensoren.
- Ong, Zi Yu: Spectral Unmixing for Single-Cell Analysis using Hyperspectral Imaging.
- Pastor Martinez, Juan Luis: Influence of Board Geometry and Other Parameters on the Distribution of Light in Vertical Farming.
- Pfleger, Johanna: Untersuchung eines Messsystems zur photoakustischen Detektion von Konzentrationsänderungen gelöster Glucosemoleküle in Wasser.

Söllner, Dominik Michael: Influence of the Excitation Light Source Locations in the H-shaped Photoacoustic Gas Cells with Different Sizes on the Michelson Interferometer-Based Membrane-Less Optical Microphone-Photoacoustic Spectroscopy.

Tomasik, Jona: Design of an Automated Testbench for Laser Pulse Characterization.

Wang, David: Investigation of deep learning methods for multimode fiber image reconstruction.

Wong, Che Teng: Hyperspectral Imaging for Protein Detection.

Zhou, Xuanyu: Hyperspectral Unmixing and Single Cell Analysis.

Advanced Seminars

Meene, Benjamin: Vertical-Cavity Surface-Emitting Lasers and their Possible Applications.

Engineering Practice

Adä, Jan: Entwurf und Implementierung eines Sensor Boards für den Betrieb im Meshverbund.

Akgün, Olcay: Realisierung eines Überwachungsframeworks für HiL-Rechner.

Chen, Huanchen: Kalorimetrische Messbox zur Verlustleistungsmessung & Automatische Vermessung von Kühlkörper.

Friedl, Florian: Kapazitive planare Sensoren und Auswerteelektroniken.

Gao, Hanqi: Construction and Sound Simulation of Photoacoustic Gas Cell Using K-Wave Toolbox in Matlab.

Mazzaferro, Francesco: Einbindung der OPC UA Schnittstelle in die bestehende Softwareumgebung und Aufbau einer Testumgebung mit einer Simatic S7-1200.

Mohr, Johanna: Planung und Aufbau eines Schaltschranks für die Klimaregelung einer Kirche.

Pastor Martinez, Juan, Luis: Wirkung von unterschiedlichen Lichtspektren auf die Qualitätsparameter der Pflanzen.

Reiter, Tiago: Vermessung von Wireless-Charging-Ablagen in Fahrzeugen.

Roessler, Ogün Jan: Swelling Problem der Lithium Ionen Zellen und die Messungen.

Schlemmer, Matthias: Ingenieurspraxis bei Freudenberg Fuel Cell e-Power Systems GmbH.

Tomasik, Jona: Setting up in-house PCB assembly and soldering with a pick and place machine.

Wagner, Sophia: Schreiben eines Messprogramms für die Micro Vu Vertex mit dem Programm Inspec.

Wiechers, Eric: Validierung und Testen eines Wechselstrom-Inverters - Implementierung einer Bedienoberfläche zur Messung von Rohdaten auf Basis von MATLAB.

Worbis, Luca: Entwicklung und Inbetriebnahme einer Prüfeinrichtung für Schnittstellen von Aktuator-Sensor-Komponenten.

Research Practice

Aicher Alexander: Anregung einer Ultraschallschwingung mit moduliertem HF-Signal.

Ali, Noor Syed: Implementierung eines LiDAR-basierten Mapping-Algorithmus für Innenräume mit skaliertem Fahrzeug.

Asam, Christoph: Removal of imaging artifacts with neural networks.

Asthana, Alankrita: Two-Stage Segmentation for Point Cloud Refinement for Autonomous Driving.

Baur, Hannes: Verifikation eines Robotergoniometers zur Überwachung des Lichtstromerhalts im Dauertest.

Becker, Christian: Development of a Transmittance and Reflectance Measurement Setup for the Characterization of LiDAR System Parameters.

Chen Yichu: Kalibrierungsansätze für Stereokamerasysteme.

Flügge, Aaron: Inbetriebnahme und Kalibrierung eines Hyperspectral Imaging Mikroskops.

Gashi, Indrit: Entwicklung, Anpassung und Charakterisierung einer elektrischen Schaltung zur Auswertung eines MEMS-Sensors für elektrische Felder.

Hecht, Leon: Optimization of Latency Critical Neural Networks for Accelerated Embedded Devices.

Kariper, Emre: Verbesserung der Kalibrierbarkeit durch Individualisierung der Kinetik der Optiken eines membranlosen Mikrofons.

Nikolic, Stefan: Partikelanalyse im Aufbau von Kameramodulen für Fahrzeugkameras.

Perathoner, Fabian: Automatisiertes Testsystem für Power Supply Platinen.

Vasilescu, Sebastian: Exploring methods for cell classification using hyperspectral imaging.

Vauth, Bastian: Entwicklung eines Puls-Detektors zur Charakterisierung von LiDAR-Signalen.

Yan, Kevin Tong: Comparison of Neural Networks for Multimode Fiber Imaging.

Interdisciplinary Project for Computer Scientists

Kapeller, Julian: Device Management and Automatic Updates for LiDAR Sensor Fleets.

Master Theses

Asthana, Alankrita: Iterative Inference Methods for 3D Point Clouds.

Chen, Zhangyi: Influence of a Photoacoustic Gas Cell on the Michelson Interferometer-Based Membrane-less Optical Microphone-Photoacoustic Spectroscopy.

Colicchia, Ennio: Neural networks applied on multimode fiber imaging and the performance degradation due to external perturbations.

Doppelfeld, Christoph: Construction, Operation and Characterization of Helmholtz Coils for Satellite Attitude Control Testing.

Ejjalili, Mohammed Anas: Automated Lane Layer Generation of HD Maps based on Sparse Fleet Data using Convolutional Neural Networks.

Flügge Arus, Aaron: Setup and Calibration of a Hyperspectral Imaging Microscope for Single Cell Analysis.

Fuchs, Philipp: FPGA Development for Range Measurement and Data Processing in a Multichannel 3D-Scanning LiDAR Prototype.

Menz, Fabian: Measurement Assisted, Automated Assembly Setup for Precise Bonding Applications.

Neuhaus, Philipp: Volume Monitoring in Industrial Applications with Stationary 3D Solid-State Smart LiDARs.

Patriarca, Daniel: Hochauflösende Zeitmessung und Selbstdiagnose für einen magnetostriktiven Positionssensor.

Raupach, Andreas: Sensorbasierte Vibrationsüberwachung für ein intelligentes Zustandsüberwachungssystem.

Uzun, Aydin: Enhancing LiDAR-based 3D Object Detection through Simulation.

Wang, Zihao: Development and Implementation of the Hardware-in-the-Loop Architecture of an Automated System Test Bench.

Zibulewski, Leo: Aktive Optikdetektion mittels IR-Laser und die Abschätzung der Laser Cross Section des Zielobjektes.

Zouaghi, Achraf: Non-Contact in-Cabin Heart Rate Estimation.

Doctorates

Brändle, Franziska, Dr.-Ing.: (Exam on 19.01.2023) Polarization-Sensitive Speckle Interferometer for Roughness Measurement

1. Examiner: Prof. Alexander W. Koch
2. Examiner: Prof. Félix Salazar Bloise, Universidad Politécnica de Madrid, Spain

Dong, Jie, Dr.-Ing.: (Exam on 22.03.2023) Single-shot quantitative phase imaging with common-path interferometric systems.

1. Examiner: Prof. Alexander W. Koch
2. Examiner: Assoc. Prof. Shengjia Wang

Special Events

- On 04 November 2022, the European Patent Organisation (EPO) published the technology transfer case study "fos4X (measurement technology – Germany)" as a successful example: www.epo.org/en/learning/learning-resources-profile/business-and-ip-managers/innovation-case-studies/technology-transfer-case-studies.
- From 14 to 25 November 2022 Prof. Koch presented the lecture and the tutorial lecture "Optomechatronical Measurement Systems" in the framework of the master program "Green Electronics", TUM campus in Singapore, German Institute of Science and Technology, in cooperation with Nanyang Technological University, Singapore.
- From 6 to 17 February 2023 Prof. Koch presented the lecture and the tutorial lecture "Sensor Electronics" for the TUM Asia Bachelor Program "Electronics and Data Engineering" at the Singapore Institute of Technology, Singapore.
- From 8 to 13 May 2023 Prof. Koch presented the lecture and from 15 to 20 May 2023 Prof. Yetisen presented the tutorial lecture "Polymer Electronics" in the framework of the master program "Green Electronics", TUM campus in Singapore, German Institute of Science and Technology, in cooperation with Nanyang Technological University, Singapore.
- From 3 to 14 July 2023, Prof. Koch presented the course "Intellectual Property and Technopreneurship" at the Singapore Institute of Technology, Singapore.

Funding and Cooperation

- Since 1999 scientific cooperation with the Max Planck Institute for Plasma Physics (IPP), Garching, in the field of surface diagnostics
- Since 2009 cooperation with Klüber Lubrication, Munich, in the field of optical measurement technology
- Since 2012 cooperation with fos4X GmbH/Polytech Wind Power Technology Germany GmbH, Munich, in the field of fiber optical measurement technology
- Since 2017 cooperation with Blickfeld GmbH, Munich, in the field of fiber optical measurement technology

- Funding of the project "Development of a high-performance short-range LiDAR system based on multi-laser technology for autonomous vehicles" by the Federal Ministry of Economy and Energy (BMWi) due to a decision of the German Federal Parliament in the program "Central Innovation Program for SMEs (ZIM)" in cooperation with Blickfeld GmbH in the period 01.02.2020-31.10.2022
- Funding of the scholarships of Mr. Qiang Bian (01.10.19-30.09.23), Mr. Zongze Jiang (01.10.2021-30.09.2023), and Mr. Shuchao Wang (08.01.2022-07.01.2026) in the field of Optical Metrology, by the Chinese Ministry of Education under its funding organization China Scholarship Council (CSC)

Publications, Patents, and Conferences

Ahn, N.; Cichy, Y.; Haider, A.; Zeh, T.: GPU-based Lidar Simulation Realized with Open Interfaces. *ATZ Elektron* 18, 2023.

Bian, Q.; Bauer, C.; Stadler, A.; Buchfellner, F.; Jakobi, M.; Volk, W.; Koch, A.W.; Roths, J.: Monitoring strain evolution and distribution during the casting process of AlSi9Cu3 alloy with optical fiber sensors. *Journal of Alloys and Compounds* 935 (2), 2023.

Bian, Q.; Dutz, F.J.; Lindner, M.; Buchfellner, F.; Stadler, A.; Jakobi, M.; Koch, A.W.; Roths, J.: Regenerated Fiber Bragg Gratings in Large Mode Area Fibers for High-temperature Sensing. *Journal of Lightwave Technology*, 2023.

Brändle, F.: Polarization-Sensitive Speckle Interferometer for Roughness Measurement. Shaker Verlag, 2023.

Buchfellner, F.; Bian, Q.; Hu, W.; Hu, X.; Yang, M.; Koch, A.W.; Roths, J.: Temperature-decoupled hydrogen sensing with Pi-shifted fiber Bragg gratings and a partial palladium coating. *Optics Letters* 48 (1), 2023.

Buchfellner, F.; Bian, Q.; Moos, F.; Nicolai, J.; Zhang, F.; Hu, W.; Yang, M.; Koch, A.W.; Roths, J.: Intra-spectral temperature-compensated FBG sensors for hydrogen detection and beyond. *Optica Sensing Congress*, 2023.

Buchfellner, F.; Bian, Q.; Röhr, A.; Zhang, F.; Huc, W.; Yang, M.; W.; Koch, A.W.; Roths, J.: Simulation of a temperature-compensated palladium-based fiber optic hydrogen sensor and comparison with measurements. *European Workshop on Optical Fibre (EWOFS)*, 2023.

Buchfellner, F.; Stadler, A.; Bian, Q.; Hennesen, M.; Zeisberger, A.; Koch, A.W.; Roths, J.: Generalized and wavelength-dependent temperature calibration function for multipoint regenerated fiber Bragg grating sensors. *Opt. Express* 30, 2022.

Dong, J.: Single-Shot Quantitative Phase Imaging with Common-Path Interferometric Systems. Shaker Verlag, 2023.

Dong, X., Li, H., Wang, K., Menze, B., Jakobi, M., Yetisen, A.K., Koch, A.W.: Multispectral Microscopic Multiplexed (3M) Imaging of Atomically-Thin Crystals Using Deep Learning. *Advanced Optical Materials*, 2023.

Fink, M.; Jakobi, M.; Koch, A.W.: Forschung auf dem Gebiet der LiDAR-Sensorik. Annual Magazine Engineering Sciences Germany 2021/22 Measurement and Sensor Technology, Institute for Scientific Publications, 2022.

Fink, M.; Schardt, M.; Baier, V.; Wang, K.; Jakobi, M.; Koch, A.W.: Low-cost scanning LIDAR architecture with a scalable frame rate for autonomous vehicles. *Applied Optics* 62 (3), 675-682, 2023.

Haider, A.; Cho, Y.; Pigniczki, M.; Köhler, M.H.; Haas, L.; Kastner, L.; Fink, M.; Schardt, M.; Cichy, Y.; Koyama, S.; Zeh, T.; Poguntke, T.; Inoue, H.; Jakobi, M.; Koch, A.W.: Performance Evaluation of MEMS-Based Automotive LiDAR Sensor and Its Simulation Model as per ASTM E3125-17 Standard. *Sensors* 23 (6), 2023.

Haider, A.; Eryildirim, A.; Haas, L.; Zeh, T.: Modeling and Validation of Automotive RADAR MMIC Impairments by using the Standardized Interfaces for Closed-Loop Simulation. European Microwave Week (EuMW), oral presentation, 22.09.2023, Berlin, 2023.

Haider, A.; Köhler, M.; Haas, L.; Zeh, T.: Development and Validation of an Automotive LiDAR Sensor Model with Standardized Interfaces. European Microwave Week (EuMW), oral presentation, 22.09.2023, Berlin, 2023.

Haider, A.; Pigniczki, M.; Köhler, M.H.; Fink, M.; Schardt, M.; Cichy, Y.; Zeh, T.; Haas, L.; Poguntke, T.; Jakobi, M.; Koch, A.W.: Development of High-Fidelity Automotive LiDAR Sensor Model with Standardized Interfaces. *Sensors* 22 (19), 2022.

Haider, A.; Pigniczki, M.; Koyama, S.; Köhler, M.H.; Haas, L.; Fink, M.; Schardt, M.; Nagase, K.; Zeh, T.; Eryildirim, A.; Poguntke, T.; Inoue, H.; Jakobi, M.; A. W. Koch: A Methodology to Model the Rain and Fog Effect on the Performance of Automotive LiDAR Sensors. *Sensors* 23 (15), 2023.

Hoffmann, M.; Jiang, Z.; Koch, A. W.: Photoacoustic interferometry for gas concentration measurements. *tm - Technisches Messen* 90 (s1), pp. 55-60, 2023.

Hu, X.; Hu, W.; Dai, J.; Ye, H.; Zhang, F.; Yang, M.; Buchfellner, F.; Bian, Q.; Hopf, B.; Roths, J.: Performance of Fiber-Optic Hydrogen Sensor Based on Locally Coated π -Shifted FBG. *IEEE Sensors Journal* 22 (24), 2022.

Koch, A.W.: Measurement and Sensor Systems – A Comprehensive Guide to Principles, Practical Issues and Applications. Springer International Publishing, 2023.

Kurz, W.; Arus, A.F.; Kariper, E.; Akgün, O.; Adisoemarta, E.; Jakobi, M.; Koch, A.W.: Hyperspectral Imaging Microscopy for Single-Cell-Analysis. 9th International Conference on Sensors Engineering and Electronics Instrumentation Advances (SEIA' 2023), Funchal, Portugal, 2023.

Stadler, A.; Zeisberger, A.; Koch, A. W.; Roths, J.: Highly dense total temperature measurement of fast air streams with a 15-point RFBG sensor array. 15th European Turbomachinery Conference organized in collaboration with EVI-GTI, oral presentation, Budapest, April 2023.

Wang, K.; Mizuno, Y.; Lee, H.; Dong, X.; Kurz, W.; Fink, M.; Jakobi, M.; Koch, A.W.: Experimental demonstration of offset-induced sensitivity enhancement in SMS-based temperature and strain sensing. *Appl. Phys. Express* 16 (5), 2023.

Wang, K.; Mizuno, Y.; Kishizawa, K.; Toyoda, Y.; Lee, H.; Ichige, K.; Kurz, W.; Dong, X.; Jakobi, M.; Koch, A.W.: Temperature sensing based on multimode interference in polymer optical fibers: sensitivity enhancement by PC-APC connections. *Japanese Journal of Applied Physics* 61 (Brief Note), 2022.

Wang, K.; Mizuno, Y.; Su, X.; Dong, X.; Kurz, W.; Fink, M.; Lee, H.; Jakobi, M.; Koch, A.W.: Core diameter and numerical aperture dependencies on the performance of fiber-optic multimode interference sensing. *Applied Physics Express* 16 (1), 2022.

Wang, S.; Gao S.; Tang, H.; Xiong, W.; Yan, Y.; Geng, T.; Koch, A.W.; Salazar-Bloise, F.; Gao, Z.; Sun, W.: Super-compact shearography based on a single diffractive optical element with 3-in-1 phase mask. *Optics Letters* 47 (20), 2022.

Wang, S.; Hoffmann, M.; Yetisen, A.K.; Wang, K.; Brändle, F.; Kurz, W.; Jakobi, M.; Zhou, Q.; Koch, A.W.: Optical interferometer-based methods for photoacoustic gas sensing: a review. *Applied Spectroscopy Reviews*, 2023.

Wang, S.; Yetisen, A.K.; Jakobi, M.; Zhou, Q.; Koch, A.W.: High-Performance Sound Detection of Nanoscale-Thick and Large-Area Graphene Oxide Films in Liquids. *Advanced Engineering Materials* 2023 (202300962), 2023.

Wang, S.; Yetisen, A.K.; Wang, K.; Jakobi, M.; Koch, A.W.: Dependence of the Michelson Interferometer-Based Membrane-Less Optical Microphone-Photoacoustic Spectroscopy Gas-Sensing Method on the Fundamental Parameters of a Photoacoustic Gas Cell. *Photonics* 10 (8), 2023.

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