Michael Muma

Prof. Dr.-Ing. | CV

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Born April 28th 1981, Married, Two Children

University Education

2009-2014 **Dr.-Ing. (with honors)**.
Electrical Engineering and Information Technology, Technische Universität (TU) Darmstadt, Germany

2003-2009 **Dipl.-Ing.**.
Electrical Engineering and Information Technology, TU Darmstadt, Germany

Current Position

Since 2022 **Professor and Head of the Robust Data Science Group at TU Darmstadt, Germany**.

2017-2022 **Independent Junior Research Group Leader & Lecturer at TU Darmstadt, Germany**.

since 2020 **Researcher at LOEWE Center emergenCITY**.

Honors & Awards

2024 **Athene Preis für Gute Lehre**.
The "Athena Prize for Good Teaching" honors outstanding best practice models in the realm of teaching at TU Darmstadt.

2022 **ERC Starting Grant Project ScReeningData**.
Michael is Principal Investigator of the ERC Starting Grant Project "Scalable Learning for Reproducibility in High-Dimensional Biomedical Signal Processing: A Robust Data Science Framework (ScReeningData)".

2022-2025 **Elected Chair of Technical Area Committee (TAC) of the European Association For Signal Processing (EURASIP)**.
The TACs form the backbone of EURASIP's technical activities. The TAC members are leading scientists and technical experts in their field. The TACs support EURASIP's technical activities to ensure highest quality and relevant development of the areas. The Theoretical and Methodological Trends in Signal Processing TAC promotes activities related to theory and methods in signal processing.

2021 **Early Career Awardee of the European Association For Signal Processing**.
For his contributions to robust signal processing and statistical learning. It "is to be awarded to an outstanding researcher and engineer working within the technical scope of EURASIP at an early or mid-stage of their career whose current work shows not only significant scientific achievements but also high potential to advance scientific knowledge through novel, timely and significant endeavors."

2020 **Invited Tutorial Speaker at IEEE ICASSP**.
Tutorial together with Michael Fauß and Abdelhak M. Zoubir entitled "Robust Data Science: Modern Tools for Detection, Clustering and Cluster Enumeration" at the signal processing flagship conference IEEE International Conference on Acoustics, Speech, & Signal Processing (ICASSP)

2020 **IEEE Radar Conference Student Contest**.
Supervisor of the student contest winning paper entitled "An Unsupervised Approach for Graph-based Robust Clustering of Human Gait Signatures". Student author: Aylin Tastan, TU Darmstadt

2019 **Appointed Associate Editor for IEEE Transactions on Signal Processing**.

2019 **Elected Member EURASIP Technical Area Committee**.

Re-elected for 2nd term serving in the TAC on Theoretical and Methodological Trends in Signal Processing (TMTSP) in December 2020.

2017 **IEEE Signal Processing Magazine Best Paper Award**.

Abdelhak M. Zoubir, Visa Koivunen, Yacine Chakhchoukh and Michael Muma received the IEEE Signal Processing Magazine Best Paper Award for the article "Robust Estimation in Signal Processing: A tutorial-style treatment of fundamental concepts".

2017 **Appointed as Athene Young Investigator (AYI)**.

Winner of a university-wide competition at TU Darmstadt promoting the scientific independence of exceptionally qualified early career researchers. The AYI program is a five-year, quality-assured program in which the independent junior research group leaders obtain certain professorial rights, such as the privilege to supervise their own doctoral candidates, and receiving their own budget.

2015 **Winner of the IEEE Signal Processing Cup**.

Supervisor of the TU Darmstadt student team who achieved first place. The IEEE Signal Processing Cup is a prestigious competition in which more than 50 teams from around the world compete in a challenging signal processing task. The competition topic was "Heart Rate Monitoring During Physical Exercise Using Wrist-Type Photoplethysmographic (PPG) Signals"

2011 **Elected Chair of IEEE SPS Student Subcommittee**.

Elected Chair of the IEEE Signal Processing Society Signal Processing Theory and Methods (SPTM) Student Subcommittee

Publications Overview

2018 **Book Publication**.

"Robust Statistics for Signal Processing", with Abdelhak M Zoubir, Visa Koivunen & Esa Ollila, Cambridge University Press

2024 **Book Chapter**.

"Robust Bayesian Cluster Enumeration for RES Distributions", with Freweyni Teklehaymanot & Christian Schroth, Springer Nature Switzerland

2021–Present **Patents**.

2 US Patent App. related to estimating the blood pressure and the arterial stiffness based on photoplethysmographic (PPG) signals

2010–Present **Journal Publications**.

24 publications accepted in IEEE Transactions on Signal Processing, IEEE Signal Processing Magazine, IEEE Transactions on Biomedical Engineering, Frontiers in Psychology, Elsevier Signal Processing, IEEE Open Journal on Signal Processing, EURASIP Journal on Advances in Signal Processing, EURASIP Journal on Wireless Communications and Networking

2009–present **Conference Publications**.

56 accepted contributions to peer reviewed conferences, such as, IEEE ICASSP, EUSIPCO, IEEE MLSP, IEEE EMBC, IEEE SSP, IEEE Asilomar, IEEE CAMSAP and others.

2009–present **Selected Invited Talks**.

- "Robust High-Dimensional Signal Processing for Biomedical Applications", Plenary at GdR-IASIS Workshop in Paris, France on Robust Statistics and Applications, June 2025.
- "Recent Progress on Fast High-Dimensional Variable Selection with False Discovery Rate Control", Invited Lecture at Technische Universität München, May 2025.
- "The T-Rex Selector: Fast High-Dimensional Variable Selection with False Discovery Rate Control", Invited Lecture at Eberhard Karls Universität Tübingen, 2024.
- "The T-Rex Selector: Fast High-Dimensional Variable Selection with False Discovery Rate Control", Invited Lecture at Paul Scherrer Institute, 2023.
- "The T-Rex Selector: Fast High-Dimensional Variable Selection with False Discovery Rate Control", Invited Lecture at Inria, Parietal Team Univ. Paris Saclay, 2023.
- "Ultra-High Dimensional Signal Processing and Statistical Learning for Biomedical Data", Invited Lecture at Zhejiang University International Workshop on Intelligent Signal Processing (online), 2022.
- "Signal Processing Solutions for Vital Signs Monitoring Using Wearables and Radar", Invited Lecture at National Cheng Kung University (online), 2021.
- "Robust Data Science: Modern Tools for Detection, Clustering and Cluster Enumeration", Invited Tutorial (online, with M. Fauß and A. M. Zoubir) at the 45th IEEE International Conference on Acoustics, Speech, Signal Processing (ICASSP), 2020.
- "Robust Solution Path (RSP) Estimation for High-Dimensional Regression Problems", Invited Talk at the Statistical Learning for Signal and Image Processing (SLSIP) Workshop, 2019.
- "Robust Estimation and Signal Detection", Invited Online Workshop at University of Kansas, 2018.
- "Robust Estimation with Applications in Psycho-physiological and Biomedical Signal Processing", Invited Talk at 13th Meeting FGME of German Psychological Society (DGP), 2017.
- "Robust Signal Processing for Dependent Data with Applications in Biomedical Signal Processing", Invited Lecture at Joint IEEE SPS and EURASIP Summer School on Robust Signal Processing, 2016.
- "Robust Methods for Signal Processing", Invited Talk at École Polytechnique Fédérale de Lausanne (EPFL), 2015.

2009–present **Citation Metrics**.

Citations: 1650, h-index: 16, i10-index: 37 according to scholar.google.de visited on February 10th 2025.

Doctoral Thesis

Title *Robust Estimation and Model Order Selection for Signal Processing*

Overall Mark *Summa Cum Laude* (With Honors)

Supervisors Abdelhak M. Zoubir & Visa Koivunen

Description The research focus was on robust statistical signal processing with an emphasis on dependent data and model selection. The developed methods have been applied to a variety of biomedical and array signal processing problems.

Research Supervision

Supervision of PhD Students (7 completed, 3 ongoing, 2 best PhD thesis awards)

2025–Present **Christoph Löser**, *Joint Supervision*.
Radar-based FDR Controlled Localization and Contactless Vital Signs Monitoring

2023–Present **Fabian Scheidt**, *Joint Supervision*.
PhD Position within BMBF Cluster for Future "Cluster für Atherothrombose und Individualisierte Medizin (curATime)"

2022–Present **Taulant Koka**, *Supervision*.
Statistical Learning for High-Dimensional Data With Applications in Biomedicine

2024 (completed) **Jasin Machkour**, *Supervision*.
Development of Fast Machine Learning Algorithms for False Discovery Rate Control in Large-Scale High-Dimensional Data, Best PhD Thesis Award 2024 in Department of Electrical Engineering and Information Technology at TU Darmstadt.

2023 (completed) **Aylin Taştan**, *Co-Supervision*.
Robust Clustering and Graph Signal Processing

2021 (completed) **Dr.-Ing. Sergey Sukhanov**, *Co-supervision*.
Ensemble Methods in Classification and Clustering

2019 (completed) **Dr.-Ing. Freweyni Teklehaymanot**, *Supervision*.
Robust and Distributed Cluster Enumeration and Labelling

2018 (completed) **Dr.-Ing. Tim Schäck**, *Co-Supervision*.
Photoplethysmography-Based Biomedical Signal Processing

2018 (completed) **Dr. Marlene Dejà**, *Co-Supervision*.
Response Synchrony and Response Patterning of Psychophysiological Parameters in Emotion, Best PhD Thesis Award 2019 in Department of Human Sciences at TU Darmstadt.

2018 (completed) **Dr.-Ing. Lala Khadidja Hamaidi**, *Co-Supervision*.
Robust Distributed Multi-Source Detection and Labelling in Wireless Acoustic Sensor Networks

Other Supervision

2019 **Examiner for PhD Thesis of Olivier Flasseur**.
Object detection and characterization from faint signals in images, Université de Lyon, France with applications to astronomy and microscopy

2010-Present **Supervision of more than 50 Bachelors/Masters Projects**, *Among others: Supervisor of Ernst-Blickle Award Winning Master Thesis 2021 (Christian Schroth) and 2023 (Taulant Koka)*.

Teaching

2022–present **MSc. Lecture: Robust and Biomedical Data Science**.
Self-designed lecture that covers robust data science topics and selected biomedical applications. Overall grade grade on a scale from 1.0-5.0 of student evaluation WS 2023/24 based on 13 subjects: course 1.0, lecturer 1.0

2019–2022 **MSc. Lecture: Robust Signal Processing With Biomedical Applications**.
Self-designed lecture that covers robust signal processing topics and uses examples from biomedical applications. Overall grade grade on a scale from 1.0-5.0 of student evaluation SS 2021 based on 10 subjects: course 1.0, lecturer 1.0

2019–2022 **MSc. Project Seminar: Robust and Biomedical Signal Processing**.
Self-designed course that provides hands-on experiences to accompany the lecture. Overall grade on a scale from 1.0-5.0 of student evaluation WS 2019/2020 based on 12 subjects: course 1.08, lecturer 1.08

2009–2019 **Teaching Assistant for 8 Different Courses**.
Adaptive Filters, Advanced Topics in Statistical Signal Processing, Biomedical Signal Processing Lab, Digital Signal Processing Lab, Multirate Signal Processing, Speech and Audio Signal Processing, Signal Detection and Parameter Estimation, Stochastic Signals and Linear Systems

Selected Third Party Funding (more than 2 Million Euro since 2019)

2022-27 **ERC Starting Grant (as PI):**, *"ScReeningData" 1.500.000,- Euro*.

2025-28 **DFG Sachbeihilfe (as PI)**, *"Scalable Graph-learning with FDR Control" 376.434,- Euro*.

2024-2026 **LOEWE Center "emergenCITY Phase 2" (as PI):**, *Funding in subproject "Resilient monitoring, prediction and response with sensor and robotic systems" 78.527,- Euro for 2024*.

2023-26 **BMBF Cluster4Future (as PI):**, *"curATime" (total 15.000.000,- Euro) Funding in subproject "curAIsig" 113.235,- Euro*.

2022-23 **LOEWE Center "emergenCITY" (as PI):**, *Funding in subproject "T-Rex Methods for DoA estimation" 111.963,- Euro*.

2019-22 **DFG Sachbeihilfe (as PI)**, *"REFOCuS" 276.940,- Euro*.

2022-24 **Project on Lichtenberg High-Performance-Cluster (as PI)**, *"Ultra-High-Dimensional Variable Selection in Genome-Wide Association Studies" 18 Million core-hours CPU time*.

2017-22 **Athene Young Investigator (as PI):**, *"Robust Statistics for Advanced Signal Processing", approx. 50.000,- Euro, Right to Supervise PhD Students, Junior Group Leadership*.

2010-23 **Project Leader (but not PI)**, *various industry projects (automotive, speech, biomedicine), European and German Collaborative Research Projects (sensor networks, robust signal processing), Forum für Interdisziplinäre Forschung (with Dept. Psychology)*.

Professional Experience

since 2020 **Researcher for emergenCITY**.
In charge of developing robust algorithms for through-wall-radar to be used in Cyber-Physical Systems (CPS) for emergency response and recovery in very complex environments. The LOEWE center emergenCITY is researching resilient infrastructures of digital cities that can withstand crises and disasters. emergenCITY is organized as an interdisciplinary and multi-site cooperation funded by the state of Hesse.

since 2019 **Appointed Lecturer at TU Darmstadt**.
For the self-designed lecture "Robust Signal Processing With Biomedical Applications" and the Project Seminar "Robust and Biomedical Signal Processing"

since 2017 **Appointed Independent Junior Research Group Leader at TU Darmstadt**.
Leading the Robust Data Science Group under the Athene Young Investigator Program. Supervisor/Co-Supervisor of 8 PhD students (4 completed)

2014–2017 **Post Doctoral Researcher at the Signal Processing Group (SPG)**.
In charge of the research cluster on robust statistical signal processing at the SPG. The research focus was on robust signal processing and data analysis with various applications in biomedicine, acoustic sensor, and camera networks.

2013–2016 **Work Package Leader within EU FET Project HANDiCAMS**.
In charge of the WP "Robust Distributed Multi-Source Detection and Labelling" of the EU Future and Emerging Technologies (FET) project HANDiCAMS (Heteregenous Ad-Hoc Networks for Distributed, Cooperative, and Adaptive Multimedia Signal Processing). The project established a novel paradigm "Coalitional Signal Processing and Learning", where heterogeneous devices with different interests form coalitions based on local cooperation.

2009–2014 **Research Associate at the Signal Processing Group (SPG)**.
PhD student with the SPG of Prof. Zoubir at TU Darmstadt.

2003 **Mechatronic in the Area of Dental CAD/CAM Systems**.
Sirona the Dental Company, Bensheim, Germany

2001-2003 **Apprenticeship as Mechatronic**.
Sirona the Dental Company, Bensheim, Germany

2000-2001 **Civillian Service**.
AWO Nursing Home, Bensheim, Germany

Professional Service

Editorship

2022–present **Associate Editor IEEE Open Journal of Signal Processing**.

2019–2024 **Associate Editor IEEE Transactions on Signal Processing**.

2019 **Managing Guest Editor of Elsevier Signal Processing Special Issue**.
"Statistical Signal Processing Solutions and Advances for Data Science: Complex, Dynamic and Large-scale Settings", with Frédéric Pascal and Esa Ollila

2015–2018 **Associate Editor IEEE SPS Inside Signal Processing eNewsletter**.

Conference Organization

2027 **EUSIPCO General Co-Chair**.
35th European Signal Processing Conference, August 30th - September 3rd 2027, Darmstadt, Germany

2023 **EUSIPCO Student Activities Co-Chair**.
31st European Signal Processing Conference, September 4-8th 2023, Helsinki, Finland

2022 **SLSIP Workshop Co-Organizer**.
4th-6th Statistical Learning for Signal and Image Processing (SLSIP) Workshop (Spain, France, Finland)

2021 **SLSIP Workshop Organizer**.
3rd Statistical Learning for Signal and Image Processing (SLSIP) Workshop, Rüdesheim (Rhine), Germany, July 15th-7th 2021

2016 **IEEE SPS and EURASIP Seasonal School Organizer**.
Joint IEEE SPS and EURASIP Summer School on Robust Signal Processing (RoSiP), Rüdesheim (Rhine), Germany, Sept. 19th-24th 2016

2017 **Special Session Organizer at EUSIPCO 2017**, *"Cooperative and Distributed Algorithms for Signal Processing and Self-Organization over Wireless Ad-Hoc/Sensor Networks"*.

2014 **Special Session Organizer at IEEE SSP 2014**, *"Advances in Robust Statistical Signal Processing"*.

Elected Society Services

2019 **Elected Member EURASIP Technical Area Committee**.
Re-elected for 2nd term serving in the TAC on Theoretical and Methodological Trends in Signal Processing (TMTSP) in December 2020.

2011 **Elected Chair of IEEE SPS Student Subcommittee**.
Elected Chair of the IEEE Signal Processing Society Signal Processing Theory and Methods (SPTM) Student Subcommittee

Reviews

2009–present **Journal Reviews**.
Among others for IEEE Transactions on Signal Processing, IEEE Transactions on Information Theory, Elsevier Signal Processing, IEEE Signal Processing Letters, IEEE Transactions on Aerospace and Electronic Systems, IEEE Transactions on Geoscience and Remote Sensing, IEEE Transactions on Biomedical Engineering, EURASIP Journal on Advances in Signal Processing

2019 **TPC Member**.
IEEE ICASSP (2021,2022,2023,2024,2025), EUSIPCO (2019, 2020,2021,2022,2023,2024), IEEE Asilomar (2020), IEEE SSP (2014, 2016), IEEE ICSigSys (2018, 2019), IEEE IoTaIS (2018)

2015 **Best Paper Award Committee Member**.
IEEE Global SIP (2015)

University Services

2020-present **emergenCITY Graduate School**.
Head of the Graduate School of emergenCITY.

2018 **Invited Member of the Exzellenzuniversität Team**.
Invited by the President of TU Darmstadt to participate in the working group promoting young academics (AG Nachwuchsförderung)

2012-2013 **Appointment Committee Member**.
Research Associate Representative in the Appointment Committee Nachrichtentechnische Systeme at TU Darmstadt

2007-2008 **Audio Engineering Society Student Section, Darmstadt**.
Organization of projects and talks

Software

2012-present **Selected Implemented Open Source Matlab, Python, R Toolboxes**.
Terminating-Random Experiments Selector: Fast FDR Controlled High-Dimensional Variable Selection (R), (more than 12.000 downloads)
The T-LARS Algorithm: Early-Terminated Forward Variable Selection (R), (more than 12.000 downloads)
Robust Signal Processing Toolbox (Matlab, Python, R)
Fast and Sample Accurate R-Peak Detection for Noisy ECG Using Visibility Graphs (Python)
Robust Cluster Enumeration Algorithms (Matlab, Python, R)
ECG Motion Artifact Removal (Matlab)

Ten Most Important Publications

J. Machkour, M. Muma, and D. P. Palomar, "The Terminating-Random Experiments Selector: Fast High-Dimensional Variable Selection with False Discovery Rate Control," *Signal Processing*, vol. 231, p. 109894, 2025.

J. Machkour, M. Muma, and D. P. Palomar, "High-Dimensional False Discovery Rate Control for Dependent Variables," *Signal Processing* (to appear), preprint: `https://doi.org/10.48550/arXiv.2401.15796` 2025.

C. A. Schroth, C. Eckrich, I. Kakouche, S. Fabian, O. von Stryk, A. M. Zoubir, and M. Muma, "Emergency response person localization and vital sign estimation using a semi-autonomous robot mounted SFCW radar," *IEEE Trans. Biomed. Eng.*, vol. 71, no. 6, pp. 1756–1769, 2024.

C. A. Schroth, and M. Muma, "Real elliptically skewed distributions and their application to robust cluster analysis," *IEEE Trans. Signal Process.*, vol. 69, no. 1, pp. 3525–3540, 2021.

C. A. Schroth, and M. Muma, "Robust M-estimation based Bayesian cluster enumeration for real elliptically symmetric distributions," *IEEE Trans. Signal Process.*, vol. 69, no. 1, pp. 3947–3962, 2021.

A. M. Zoubir, V. Koivunen, E. Ollila, and M. Muma, *Robust Statistics for Signal Processing*, Cambridge University Press, 2018.

F. K. Teklehaymanot, M. Muma, and A. M. Zoubir, "Bayesian cluster enumeration criterion for unsupervised learning," *IEEE Trans. Signal Process.*, vol. 66, no. 20, pp. 5392–5406, 2018.

M. Muma and A. M. Zoubir, "Bounded influence propagation τ-estimation: A new robust method for ARMA models," *IEEE Trans. Signal Process.*, vol. 65, no. 7, pp. 1712–1727, Dezember 2016.

A. M. Zoubir, V. Koivunen, Y. Chakhchoukh, and M. Muma, "Robust estimation in signal processing: A tutorial-style treatment of fundamental concepts," *IEEE Signal Process. Mag.*, vol. 29, no. 4, pp. 61–80, 2012.

M. Muma, D. R. Iskander, and M. J. Collins, "The role of cardiopulmonary signals in the dynamics of the eye' s wavefront aberrations," *IEEE Trans. Biomed. Eng.*, vol. 57, no. 2, pp. 373–383, 2010.