



Publications, Patents, Talks

2024

Lehrstuhl für Medizinische Informationstechnik
Helmholtz-Institut für Biomedizinische Technik
Rheinisch-Westfälische Technische Hochschule Aachen

*Chair for Medical Information Technology
Helmholtz-Institute for Biomedical Engineering
RWTH Aachen University*

Director:

**Univ.-Prof. Dr.-Ing. Dr. med. Dr. h.c.
Steffen Leonhardt**

**Artikel in Zeitschriften
mit anonymem Gutachterwesen 2024 /
*Papers in peer-reviewed Journals 2024***

1. Carl-Friedrich Benner, Nikolai Weber, Steffen Leonhardt, Marian Walter, „Model predictive control of blood glucose in critically ill patients using Gaussian processes”, at - *Automatisierungstechnik* 2024; 72(5): 399–407, <https://doi.org/10.1515/auto-2024-0211>
2. Gleb Koginov, Lukas Bergmann, Michele Xiloyannis, Neala Rohner, Chuong Ngo, Jaime E. Duarte, Steffen Leonhardt, Robert Riener, “Human-in-the-Loop Personalization of a Bi-Articular Wearable Robot’s Assistance for Downhill Walking”, *IEEE Transactions on Medical Robotics and Bionics*, 6(1):328-339, 10.1109/TMRB.-2023.3328654.
3. Matthias Manfred Deininger, Dmitrij Ziles, Annegret Borleis, Teresa Seemann, Fabian Erlenkoetter, Christian Bleilevens, Arnhold Lohse, Carl-Friedrich Benner, Steffen Leonhardt, Marian Walter, Thomas Breuer, “Breath-by-breath comparison of a novel percutaneous phrenicnerve stimulation approach with mechanical ventilation in juvenile pigs: a pilot study”, *Nature Scientific Reports* | (2024) 14:10252, pp. 1-11,| <https://doi.org/10.1038/s41598-024-61103-5>
4. Lavinia Goldermann, Stefan Rakel, Mateusz Buglowski, Armin Mokhtarian, Alexandru Kampmann, Armin Janß, Okan Yilmaz, Frank Beger, Marian Walter, Steffen Leonhardt, Stefan Kowalewski, André Stollenwerk, “Designing the user interface of a ventilator under the constraints of a pandemic”, at - *Automatisierungstechnik* 2024; 72(5): 484–495, <https://doi.org/10.1515/auto-2023-0205>
5. Alfred Christian Hülkenberg, Chuong Ngo, Robert Lau, Steffen Leonhardt, “Separation of ventilation and perfusion of electrical impedance tomography image streams using multi-dimensional ensemble empirical mode decomposition”, *Physiol. Meas.* 45 (2024) 075008, pp 1-20, <https://doi.org/10.1088/1361-6579/ad5c39>
6. Arnhold Lohse, Matthias Manfred Deininger, Johannes Loeser, Felix Roehren, Dmitrij Ziles, Thomas Breuer, Steffen Leonhardt, Marian Walter, “ A physiological model of phrenic nerve excitation by electrical stimulation”, *Biomedical Physics & Engineering Express*, 10(2) 025017 (2024), <https://doi.org/10.1088/2057-1976/ad1fa3>.
7. Arnhold Lohse, Philip von Platen, Steffen Leonhardt, Marian Walter, “Robust Control of Oxygen Saturation during mechanical Ventilation”, *Lekar a tehnika – Clinician and Technology* 2024, vol. 54(1):5–11, DOI: [10.14311/CTJ.2024.1.01](https://doi.org/10.14311/CTJ.2024.1.01).
8. Philip von Platen, Lennard Lesch, Arnhold Lohse, Steffen Leonhardt, Marian Walter, „Physiological hardware-in-the-loop test bench for mechanical ventilation”, at - *Automatisierungstechnik* 2024; 72(5):429–439, <https://doi.org/10.1515/auto-2023-0215>

9. Philip von Platen, Adel Abdelsamed, Arnhold Lohse, Martin Russ, Celina Wolters, Philipp A. Pickerodt, Roland C.E. Francis, Steffen Leonhardt, Marian Walter, "Robust closed-loop control of systemic oxygenation in acute lung injury", *Biomedical Signal Processing and Control* (2024) 87, 105532, pp.1-9, <https://doi.org/10.1016/j.bspc.2023.105532>.
10. Felix Röhren, Philip von Platen, Arnhold Lohse, Alexander Kniesburges, Robin Brütt, Steffen Leonhardt, Marian Walter, „An open-source research platform for mechanical ventilation based on Simulink® and STM32 nucleo”, at - *Automatisierungstechnik* 2024; 72(5): pp 476–483, <https://doi.org/10.1515/auto-2023-0209>.
11. Gaetano Scaramuzzo, Bertrand Pavlovsky, Andy Adler, Walter Baccinelli, Dani L. Bodor, L. Felipe Damiani, Guillaume Franchineau, Juliette Francovich, Inéz Frerichs, Juan A. Sánchez Giral, Bartłomiej Grychtol, Huaiwu He, Bhushan H. Katira, Alette A. Koopman, Steffen Leonhardt, Luca S. Menga, Amne Mousa, Mariangela Pellegrini, Thomas Piraino, Paolo Priani, Peter Somhorst, Elena Spinelli, Claas Händel, Fernando Suárez-Sipmann, Jantine J. Wisse, Tobias Becher, Annemijn H. Jonkman, „Electrical impedance tomography monitoring in adult ICU patients: state-of-the-art, recommendations for standardized acquisition, processing, and clinical use, and future directions”, *Critical Care* 28(1), pp 1-15, DOI: [10.1186/s13054-024-05173-x](https://doi.org/10.1186/s13054-024-05173-x).
12. Diogo F. Silva, Steffen Leonhardt, "The gamma-variate in contrast-enhanced imaging: a unified view and method from computed to electrical impedance tomography", *Physics in Medicine & Biology*, 69(11) 115004. DOI: [10.1088/1361-6560/ad40f4](https://doi.org/10.1088/1361-6560/ad40f4).
13. Diogo Silva, Thomas Muders, Karin Wodack, Christian Putensen, Steffen Leonhardt, Robert Siepmann, Benjamin Hentze, Sebastian Reinartz, „Pulmonary CT perfusion robustly measures cardiac output in the context of multilevel pulmonary occlusion: a porcine study”, *European Radiology Experimental* (2024) 8:51, pp 1-12, <https://doi.org/10.1186/s41747-024-00431-7>.
14. Daniel Voss, Clara Wemmer, Steffen Leonhardt, Marian Walter, "Time-variant left ventricle models for intracardiac impedance analysis", *Electr Bioimp*, vol. 15, pp. 130–136, 2024, <https://doi.org/10.2478/joeb-2024-0015>.
15. Florian Voss, Philipp Grünter, Johannes Wolski, Steffen Leonhardt, Markus Lüken, „Hardware-in-the-loop setup for contactless skin servo control of neonatal incubators“, *Biomedical Signal Processing and Control* 88, 105628, 2024. <https://doi.org/10.1016/j.bspc.2023.105628>.
16. Christoph Weiss, Inka Hiß, Benjamin Clemens, Ute Habel, Ulrich Canzler, Jarek Krajewski, Steffen Leonhardt, Markus Lüken, "Feasibility of unobtrusive camera-based heart rate extraction in a clinical interview scenario", *Biomedical Signal Processing and Control* 96 (2024) 106582. <https://doi.org/10.1016/j.bspc.2024.106582>.

Online first 2024

1. Lukas Bergmann, Lea Hansmann, Philip von Platen, Steffen Leonhardt, Chuong Ngo, "Fatigue Assessment and Control With Lower Limb Exoskeletons", *IEEE Transactions on Human-Machine Systems*, 55(1):10–22, 2025. <https://doi.org/10.1109/THMS.-2024.3503473>.

Editorials 2024

1. Richard Bayford, Rosalind Sadleir, Inéz Frerichs, Tong In Oh, Steffen Leonhardt, "Progress in electrical impedance tomography and bioimpedance", *Physiol. Meas.* **45** (2024) 080301, pp. 1-5. DOI <https://doi.org/10.1088/1361-6579/ad68c1>.
2. Wenjin Wang, Caifeng Shan, Steffen Leonhardt, Ramakrishna Mulkamala, Ewa Nowara, "Camera-Based Health Monitoring in Real-World Scenarios", *IEEE Journal of Biomedical and Health Informatics*, 28(2):595-597, 2024. DOI 10.1109/JBHI.-2023.3348248.

Konferenzbeiträge mit Beteiligung des Lehrstuhls 2024 / *Conference Proceedings 2024*

WORKSHOP BIOSIGNAL 2024, February 28 - March 1, 2024, Göttingen, Germany

1. Idoia Badiola, Jan Seleng, Christoph Weiss, Stefan Borik, Vladimir Blazek, Steffen Leonhardt, Markus Lüken, "Mapping of peripheral venous hemodynamics using a low-cost camera: a proof-of-concept", *Proceedings of the Workshop Biosignal*, pp 1-3, 10.47952/gro-publ-206.
2. Nico Blass, Simon Lyra, Steffen Leonhardt, Markus Lüken, "Real-time Neonatal Respiratory Rate Extraction using Deep Learning and Domain Transfer", *Proceedings of the Workshop Biosignal*, pp 1 -3, 10.47952/gro-publ-210.
3. Florian Voss, Katharina Kösseler, Steffen Leonhardt, Markus Lüken, „Camera Fusion for Improving Body Part Segmentation of Preterm Infants“, *Proceedings of the Workshop Biosignal*, pp 1 -3, 10.47952/gro-publ-200.

VDI Mechatroniktagung 2024, Technische Universität Dresden, 14. - 15. März 2024, Dresden, Germany

1. Arnhold Lohse, Farid Hamidov, Junxiao Bing, Philip von Platen, Steffen Leonhardt, Marian Walter, „Entwicklung einer Mechatronischen Testlunge mit Zwerchfellfunktion (Development of a Mechatronic Test Lung with Diaphragm Function)“, *Tagungsband VDI Mechatroniktagung 2024*, pp 190 – 193, <https://www.vdi-mechatroniktagung.rwth-aachen.de/cms/vdi-mechatroniktagung/Teilnehmende/~zfbxp/Tagungsband-und-vorherige-Tagungen/>.

28th International Student Conference on Electrical Engineering (POSTER 2024), Faculty of Electrical Engineering, CTU Prague, May 23th, 2024

1. Daniel Blase, Pu Xie, "Body Surface Region Detection in Wound Images using Deep Learning", *28th International Student Conference on Electrical Engineering (POSTER 2024)*, Faculty of Electrical Engineering, CTU Prague, May 23, 2024, pp 1-4, ISBN 978-80-01-07299-8, <https://poster.fel.cvut.cz/poster2024/>.
2. Raphael Hoffmann, "Validation of a Drivetrain Model for Exoskeletons using MuJoCo", *28th International Student Conference on Electrical Engineering (POSTER 2024)*, Faculty of Electrical Engineering, CTU Prague, May 23, 2024, pp 1-4, ISBN 978-80-01-07299-8, <https://poster.fel.cvut.cz/poster2024/>.
3. Jannik Prüßmann, "Simulation of Physiological Motion Artifacts in Capacitive Electrocardiography", *28th International Student Conference on Electrical Engineering (POSTER 2024)*, Faculty of Electrical Engineering, CTU Prague, May 23, 2024, pp 1-4, ISBN 978-80-01-07299-8, <https://poster.fel.cvut.cz/poster2024/>.

4. Nico Blass, "Fostering Success: The History of Incubators", 28th *International Student Conference on Electrical Engineering (POSTER 2024)*, Faculty of Electrical Engineering, CTU Prague, May 23, 2024, ISBN 978-80-01-07299-8, <https://poster.fel.cvut.cz/poster2024/>.

18th IEEE Medical Measurements & Applications (MeMeA 2024), Eindhoven, Netherlands June 26 - 28th, 2024

1. Idoia Badiola, Fatih Kaya, Vladimir Blazek, Steffen Leonhardt, Markus Lueken, "Simultaneous arterial and venous oximetry with a novel flexi-frequency cuff actuator", *IEEE International Symposium on Medical Measurements and Applications (MeMeA)*, pp. 1-6, 979-8-3503-0799-3/24, DOI: 10.1109/MEMEA60663.2024.10596869.

24th International Conference on Biomedical Applications of Electrical Impedance Tomography (EIT 2024), Hangzhou, China, June 27th-30th, 2024

1. Diogo F. Silva, Steffen Leonhardt, "Beyond Simplism: Unveiling Bias in EIT Perfusion Models", *Proceedings of the 24th International Conference on Biomedical Applications of Electrical Impedance Tomography (EIT 2024)*, p. 24, [https://opensz.oss-cn-beijing.aliyuncs.com/web2024/EIT2024/file/Proceedings%20of%20EIT%202024\(2\).pdf](https://opensz.oss-cn-beijing.aliyuncs.com/web2024/EIT2024/file/Proceedings%20of%20EIT%202024(2).pdf)

46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), Orlando, Florida, USA, July 15-19, 2024

1. Idoia Badiola, Stefan Noppeney, Vladimir Blazek, Steffen Leonhardt, Markus Lüken, "Development of an electro-pneumatic calf muscle actuator to estimate peripheral venous oxygen saturation using photoplethysmography", *46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp 1-4, 979-8-3503-7149-9/24, DOI: 10.1109/EMBC53108.2024.10782659.
2. Daniel Blase, Oussama Chayeb, Peter Y. Chan, Steffen Leonhardt, Markus Lüken, „A Deep-Learning-Based Approach for Delirium Monitoring in ICU Patients Using Thermograms”, *46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp 1-4, 979-8-3503-7149-9/24, DOI: 10.1109/EMBC53108.-2024.10782138.
3. Alfred Hülkenberg, Niko Strotmann, Amine Mokni, Steffen Leonhardt, Philip von Platen, „The Influence of Muscle Contraction Intensity on Electrical Impedance Myography”, *46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp 1-4, 979-8-3503-7149-9/24, DOI: 10.1109/EMBC53108.2024.-10782074.
4. Chenglin Lyu, Georgios Panteli, L. Cornelius Bollheimer, Steffen Leonhardt, Philip von Platen, „Evaluation of FES-induced Muscle Fatigue and Recovery using Torque and Surface Electromyography”, *46th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp 1-4, 979-8-3503-7149-9/24, DOI: 10.1109/EMBC53108.2024.10782626.

2024 IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM), July 15-19, 2024. Boston, MA, USA

1. Arnhold Lohse, Farid Hamidov, Patrick Borchers, Philip von Platen, Steffen Leonhardt, Marian Walter, "Robust Flow Control in a mechatronic Test Lung with Spontaneous Breathing", 2024 IEEE/ASME *International Conference on Advanced Intelligent Mechatronics* (AIM), pp. 873 - 878, 979-8-3503-5536-9/24,| DOI: 10.1109/AIM55361.-2024.10637140.

51st Computing in Cardiology (CincC), Karlsruhe, Germany, September 8-11, 2024

1. Lara J. Reichelt, Idoia Badiola, Vladimir Blazek, Steffen Leonhardt, Markus Lüken, „Development of a Ring-Shaped Pulse Oximeter to Analyse Angle Dependency in SpO2 Estimation”, *Computing in Cardiology* 2024; Vol 51, pp 1-4, ISSN: 2325-887X DOI: 10.22489/CinC.2024.260.
2. Markus Lüken, Matthias D Zink, Steffen Leonhardt, „Changes in Signal Morphology of Hand-held ECG Devices with Dry Electrodes”, *Computing in Cardiology* 2024; Vol 51, pp 1-4, ISSN: 2325-887X, DOI: 10.22489/CinC.2024.434.
3. Onno Linschmann, Steffen Leonhardt, Markus Lüken, „Investigation of the Influence of the Moisture Content of Clothes on Capacitive Electrocardiography”, *Computing in Cardiology* 2024; Vol 51, pp 1-4, ISSN: 2325-887X, DOI: 10.22489/CinC.2024.252.

50th ESAO (European Society for Artificial Organs) Congress, September 08 – 11, 2024, Aachen, Germany

1. Patrick Borchers, Steffen Leonhardt, Marian Walter, „An Optical Sensor for Continuous Hemolysis Measurement”, *The International Journal of Artificial Organs*, Volume 47, Issue 7: Abstracts submitted to 50th ESAO Congress, p. 526, <https://journals.sagepub.com/doi/epdf/10.1177/03913988241279540>
2. Daniel Voss, Steffen Leonhardt, Marian Walter, „Automated Test Bench for Catheter-based Electrical Impedance Measurements of blood”, *The International Journal of Artificial Organs*, Volume 47, Issue 7: Abstracts submitted to 50th ESAO Congress, p. 534, <https://journals.sagepub.com/doi/epdf/10.1177/03913988241279540>.

12th IFAC Symposium on Biological and Medical Systems" und "17th Interdisciplinary Symposium Automed", September 11-13, 2024, Villingen-Schwenningen, Germany

1. Patrick Borchers. Steffen Leonhardt. Marian Walter, „Modeling and Control of an Automated Hemolysis Test Bench”, *IFAC PapersOnLine* 58-24 (2024) 61–65, ISSN 2405-8963.

2. Chenglin Lyu, Marlon Nievenheim, L. Cornelius Bollheimer, Steffen Leonhardt, Philip von Platen, „ FES- and Camera Sensor- Based Estimation of Knee and Ankle Stiffness“, *IFAC PapersOnLine* 58-24 (2024) , ISSN 2405-8963.
3. Jannik Prüßmann, Steffen Leonhardt, Markus Lüken, „Test Bench for Measuring the Effects of Contact Pressure in cECG Measurements“, *IFAC PapersOnLine* 58-24 (2024) 106–110, ISSN 2405-8963.
4. Florian Voss, Steffen Leonhardt, Markus Lüken, “Skin Servo Control for Neonatal Incubators: A Novel Approach using Infrared Thermography”, *IFAC PapersOnLine* 58-24 (2024) 620–624, ISSN 2405-8963.
5. Marc Wiartalla, Moritz Hüllmann, Michael Lamberti, Cavan Lübke, Rüdger Kopp, Steffen Leonhardt, Marian Walter, André Stollenwerk, „A robust and semi-automated method for the quantification of recirculation in artificial lung support “, *IFAC PapersOnLine* 58-24 (2024) 135–140, ISSN 2405-8963.

58th Annual Meeting of the German Society of Biomedical Engineering (BMT), Stuttgart, Germany, September 18 - 20, 2024

1. Idoia Badiola, Steffen Leonhardt, and Markus Lueken, “Real-time PPG signal quality assessment: a fair comparison of deep learning-based algorithms on public data”, 58th *Annual Meeting of the German Society of Biomedical Engineering*, 18 – 20 September 2024, Stuttgart, p. 28, [Biomedical Engineering / Biomedizinische Technik, https://doi.org/10.1515/bmt-2024-1002](https://doi.org/10.1515/bmt-2024-1002).
2. Felix Röhren, Ines Groß-Weege, Steffen Leonhardt, Marian Walter, “Evaluation of Hysteresis Models for Estimating the Characteristics of High Pressure Solenoid Valves for Mechanical Ventilation”, *Current Directions in Biomedical Engineering* 2024, 10(4): 535-538, 58th *Annual Meeting of the German Society of Biomedical Engineering* (18 – 20 September 2024, Stuttgart), <https://doi.org/10.1515/cdbme-2024-2131>.

11th International Conference on Customization and Personalization MCP 2024, The Power of Customization and Personalization in the Digital Age, September 25-26, 2024, Novi Sad, Serbia

1. Paul Blazek, Vladimir Blazek, „Customized Medicine: Re-Thinking Healthcare”, Proceedings of the *MCP 2024 Conference*, pp 39-42, ISBN 978-86-6022-686-2, https://mcp-ce.org/wp-content/uploads/2024/11/7_Blazek.pdf

IEEE-EMBS International Conference on Body Sensor Networks (IEEE BSN 2024), Chicago, Illinois, USA • 15th – 17th October 2024

1. Markus Lüken, Steffen Leonhardt, “Multimodal Sensor Integration for Unobtrusive Measurement of Blood Pressure-related Parameters”, 2024 *IEEE 20th International Conference on Body Sensor Networks (BSN)*, 979-8-3315-3014-3/24, DOI: 10.1109/BSN63547.2024.10780712.

Eingeladene Vorträge 2024 /

Invited Talks and Lectures 2024

Physical Talks

1. Steffen Leonhardt, “*Future Visions for EIT*“, Masterclass EIT during mechanical ventilation: a standardized innovative workflow, 22 - 26 April 2024, Lorentz Center@Snellius, Leiden, The Netherlands
2. Steffen Leonhardt, “*Unlocking the Secrets of Vital Signs in your Car Seat – A Journey into unseen Monitoring Techniques*“, INCABIN.SENSING: Next-Gen In-Cabin Monitoring & Interior Sensing Systems, Hotel Titanic Chaussee, Berlin, June 27, 2024.
3. Steffen Leonhardt, “*Bioimpedance Myography - a game changer for quantifying muscle condition?*“, in: S. Leonhardt, T. J. Freeborn, S. B. Rutkove, A. C. Hülkenberg, and P. Xu, Mini-Symposium “*Recent Advances in Bioimpedance as a Tool for Assessment of Muscle Condition*“, IEEE EMBC 2024, Orlando, FL, USA, 16 July 2024.
4. Steffen Leonhardt, „*Driving while sick or intoxicated*“, 22. Aachener Interdisziplinäres Verkehrssymposium, Aula I, RWTH Aachen, 25. Oct. 2024.
5. Steffen Leonhardt, „*Unobtrusive Driver Health Monitoring*“, Dept. of Medical Science & Technology, IIT Madras, Chennai, India, Nov. 21st, 2024.

Digital Talks

6. Steffen Leonhardt, “*Bioimpedance and Applications*“, Keynote lecture @ BioHabana 2024, April 3rd, 2024, 3 pm CET, Havana, Cuba (digital, per ZOOM).
7. Steffen Leonhardt, “*An Introduction to Electrical Impedance Tomography – Color me beautiful*“, Ärztliche Fortbildung am Institut für diagnostische und interventionelle Radiologie der Universitätsklinik Jena, 13. Dez. 2024 (digital, per ZOOM).