



## **Publications, Patents, Talks**

**2020**

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

*Philips 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**

## **Bücher 2020 / Books 2020**

### **Buchbeiträge mit anonymem Gutachterwesen 2020 / Peer-reviewed book chapters 2020**

1. M. Ulbrich, M. Lüken, J. Mühlsteff and S. Leonhardt, "Wearable bioimpedance systems for home-care monitoring using BSNs", in: Edward Sazonov (ed.), "*Wearable Sensors*", 2<sup>nd</sup> edition, chap. 19, pp 519 – 538, Academic Press Inc, 2020. ISBN 978-0-12-819246-7.

### **Patentanträge und erteilte Patente mit Beteiligung des Lehrstuhls 2020 / *Granted Patents and filed Patent Applications 2020***

1. J. Weyer, S. Leonhardt, C. Hoog Antink, S. Lyra, "Vorrichtung für die Wärmetherapie und Verfahren zum Betrieb einer Vorrichtung für die Wärmetherapie", EP129886, eingereicht am 20.07.2020, in Prüfung.

**Artikel in Zeitschriften  
mit anonymem Gutachterwesen 2020 /  
*Papers in peer-reviewed Journals 2020***

1. S. Borik, S. Lyra, M. Paul, C. Hoog Antink, S. Leonhard, "Photoplethysmography imaging: camera performance evaluation by means of an optoelectronic skin perfusion phantom", *Physiol. Meas.*, vol. 41, no. 5 (2020), pp 1-17, June 2020, doi: doi.org/10.1088/1361-6579/ab87b3.
2. M. Paul, S. Karthik, J. Joseph, M. Sivaprakasam, J. Kumutha, S. Leonhardt, and C. Hoog Antink, "Non-contact sensing of neonatal pulse rate using camera-based imaging: a clinical feasibility study," *Physiol. Meas.*, vol. 41, no. 2, p. 024001, 2020, doi: 10.1088/1361-6579/ab755c.
3. C. Hoog Antink, J.C. Mesquita Terreira, M. Paul, S. Lyra, K. Heimann, S. Karthik, J. Joseph, K. Jayaraman, T. Orlikowsky, M. Sivaprakasam, S. Leonhard, "Fast body part segmentation and tracking of neonatal video data using deep learning", *Medical & Biological Engineering & Computing*, vol. 58, pp. 3049–3061 (2020), doi: <https://doi.org/10.1007/s11517-020-02251-4>.
4. L. Korn, S. Lyra, D. Rüschen, D. Telyshev, S. Leonhardt, M. Walter, „In silico and in vitro conductivity models of the left heart ventricle“, *Journal of Electrical Bioimpedance*, vol. 11, pp. 62 – 71, 2020, <https://doi.org/10.2478/joeb-2020-0010>.
5. C. P. Adans-Dester, S. Bamberg, F. P. Bertacchi, B. Caulfield, K. Chappie, D. Demarchi, M. Kelley Erb, J. Estrada, E. E. Fabara, M. Freni, K. E. Friedl, R. Ghaffari, G. Gill, M. S. Greenberg, R. W. Hoyt, E. Jovanov, C. M. Kanzler, D. Katabi, M. Kernan, C. Kigin, S. I. Lee, S. Leonhardt, N. H. Lovell, J. Mantilla, T. H. McCoy, Jr., N. Meosky Luo, G. A. Miller, J. Moore, D. O’Keeffe, J. Palmer, F. Parisi, S. Patel, J. Po, B. L. Pugliese, T. Quatieri, T. Rahman, N. Ramasarma, J. A. Rogers, G. U. Ruiz-Esparza, S. Sapienza, G. Schiurring, L. Schwamm, H. Shafiee, S. Kelly Silacci, N. M Sims, T. Talkar, W. J. Tharion, J. A. Toombs, C. Uschnig, G. P. Vergara-Diaz, P. Wacnik, M. D. Wang, J. Welch, L. Williamson, R. Zafonte, A. Zai, Y.-T. Zhang, G. J. Tearney, R. Ahmad, D. R. Walt, P. Bonato, „Can mHelath Technology help Mitigate the Effects of the COVID-19 Pandemic?“ , *IEEE Open Journal of Engineering in Medicine and Biology*, vol. 1, 2020. pp 243 – 248, doi: 10.1109/OJEMB.2020.3015141.
6. Y. Li, X. Guan, X. Han, Z. Tang, K. Meng, Z. Shi, B. Penzlin, Y. Yang, J. Ren, Z. Yang, Z. Li, S. Leonhardt, L. Ji, "Design and Preliminary Validation of a Lower Limb Exoskeleton With Compact and Modular Actuation", *IEEE Access*, vol. 8, 2020, pp. 66338 – 66352, doi: 10.1109/ACCESS.2020.2985910.
7. Y. Li, YX. Guan, Z. Li, Z. Tang, B. Penzlin, Z. Yang, S. Leonhardt, L. Ji, "Analysis, Design and Preliminary Evaluation of a Parallel Elastic Actuator for Power-Efficient Walking Assistance", *IEEE Access*, vol. 8, 2020, pp. 88060 – 88075. doi: [10.1109/ACCESS.2020.2993183](https://doi.org/10.1109/ACCESS.2020.2993183).

8. O. Linschmann, S. Leonhardt, C. Hoog Antink, „Model-based sensor fusion of multimodal cardiorespiratory signals using an unscented Kalman filter“, at – *Automatisierungstechnik* 2020, 68(11), pp. 933 – 940, doi: <https://doi.org/10.1515/auto-2020-0075>.
9. L. Liu, Z. Hong, B. Penzlin, B. Misgeld, C. Ngo, L. Bergmann, S. Leonhardt, „Low Impedance-Guaranteed Gain-Scheduled GESO for Torque-Controlled VSA, with Application of Exoskeleton-Assisted Sit-to-Stand“, *IEEE/ASME Transactions on Mechatronics*, pp. 1 -12, doi: [10.1109/TMECH.2020.3032372](https://doi.org/10.1109/TMECH.2020.3032372).
10. M. Lueken, L. Mueller, M.G. Decker, C. Bollheimer, S. Leonhardt, C. Ngo, „Evaluation and Application of a Customizable Wireless Platform: A Body Sensor Network for Unobtrusive Gait Analysis in Everyday Life“, *Sensors* 2020, 20(24), 7325; pp. 1-23, doi: <https://doi.org/10.3390/s20247325>.
11. M. Lueken, W. ten Kate, G. Valenti, J.P. Batista, C. Bollheimer, S. Leonhardt, C. Ngo, „Estimation of Stride Time Variability in Unobtrusive Long-Term Monitoring Using Inertial Measurement Sensors“, *IEEE Journal of Biomedical and Health Informatics*, Vol. 24, No. 7, July 2020, pp. 1879 – 1886, doi: [10.1109/JBHI.2020.2992448](https://doi.org/10.1109/JBHI.2020.2992448).
12. T. Muders, H. Luepschen, T. Meier, A. W. Reske, J. Zinserling, S. Kreyer, R. Pikkemaat, E. Maripu, S. Leonhardt, G. Hedenstierna, C. Putensen, H. Wrigge, “ Individualized Positive End-expiratory Pressure and Regional Gas Exchange in Porcine Lung Injury”, *Anesthesiology* 2020 Apr; 132(4) pp. 808-824, doi: [10.1097/ALN.000000-0000003151](https://doi.org/10.1097/ALN.000000-0000003151).
13. J. Orschulik, N. Hochhausen, M. Czaplik, S. Aguiar Santos, S. Leonhardt, M. Walter, „Impact of Lung Pathologies on Bioimpedance Spectroscopy Measurements – An Experimental Study“, *International Journal of Bioelectromagnetism*, Vol 22, No. 1, 2020, pp. 1 – 19, doi: [10.18154/RWTH-2020-10044](https://doi.org/10.18154/RWTH-2020-10044).
14. B. Penzlin, A. Leipnitz, L. Bergmann, Y. Li, L. Ji, S. Leonhardt, C. Ngo, “Conceptual design, modeling and control of a rigid parallel serial-elastic actuator”, at - *Automatisierungstechnik* 68(6), 2020 pp. 410 - 422, DOI: <https://doi.org/10.1515/auto-2020-0008>.
15. P. v. Platen, A. Pomprapa, B. Lachmann, S. Leonhardt, „ The dawn of physiological closed-loop ventilation - a review“, *Critical Care*, (2020) 24:121, doi: <https://doi.org/10.1186/s13054-020-2810-1>.
16. D. Silva, S. Leonhardt, C. Hoog Antink, “Copula-based Data Augmentation on a Deep Learning Architecture for Cardiac Sensor Fusion“, *IEEE Journal of Biomedical and Health Informatics*, 2020, pp. 1- 12, doi: [10.1109/JBHI.2020.3040551](https://doi.org/10.1109/JBHI.2020.3040551).
17. D. U. Uguz, T. B. Tufan, A. Uzun, S. Leonhardt, C. Hoog Antink, “Physiological Motion Artifacts in Capacitive ECG: Ballistocardiographic Impedance Distortions“, *IEEE Transactions on Instrumentation and Measurement*, vol. 69, no. 6, June 2020, pp. 3297 – 3307, doi: [10.1109/TIM.2020.2971336](https://doi.org/10.1109/TIM.2020.2971336).
18. D. U. Uguz, R. Dettori, A. Napp, M. Walter, N. Marx, S. Leonhardt, C. Hoog Antink, „Car Seats with Capacitive ECG Electrodes can detect Cardiac Pacemaker Spikes“, *Sensors* 2020, 20, 6288; pp. 1 – 20, doi:[10.3390/s20216288](https://doi.org/10.3390/s20216288).

19. X. Yu, T. Laurentius, C. Bollheimer, S. Leonhardt, C. Hoog Antink, „Noncontact Monitoring of Heart Rate and Heart Rate Variability in Geriatric Patients using Photoplethysmography imaging”, *IEEE Journal of Biomedical and Health Informatics*, pp, 1 – 12, 2020. doi: 10.1109/JBHI.2020.3018394.
20. M. D. Zink, F. König, S. Weyer, K. Willmes, S. Leonhardt, N. Marx, A. Napp, „Segmental Bioelectrical Impedance Spectroscopy to Monitor Fluid Status in Heart Failure”, *Scientific Reports*, 10:3577, pp. 1 – 9, 2020. doi: <https://doi.org/10.1038/s41598-020-60358-y>
21. C. Hoog Antink, Y. Mai, R. Aalto, C. Brüser, S. Leonhardt, N. Oksala, and A. Vehkaoja, “Ballistocardiography Can Estimate Beat-to-Beat Heart Rate Accurately at Night in Patients After Vascular Intervention,” *IEEE J. Biomed. Heal. Informatics*, vol. 24, no. 8, pp. 2230–2237, 2020. doi: 10.1109/JBHI.2020.2970298.

Submitted:

22. L. Bergmann, S. Leonhardt, D. Greven, B.J.E. Misgeld, „Optimal Assistive Control of a Pedal-Electric Drive Unit”, *Control Engineering Practice*, 2020.
23. Y. Li, W. Li, B. Penzlin Z. Yang, B. Liu, S. Leonhardt, L. Ji, “A force/torque sensorless method to comprehensively model and identify the dynamics of a human-exoskeleton system, *Mechanism and Machine Theory*, 2020.
24. M. Paul, S. Caprice Behr, C. Weiss, K. Heimann, T. Orlikowsky, S. Leonhardt, “Spatio-temporal and spectral feature maps in photoplethysmography imaging and infrared thermography”, *BioMedical Engineering*, 2020.

## **Konferenzbeiträge mit Beteiligung des Lehrstuhls 2020 / Conference Proceedings 2020**

### **14. Interdisziplinäres Symposium - AUTOMED - Automatisierung in der Medizintechnik, March 2 – 3, 2020, Lübeck Germany**

1. L. Bergmann, L. Liu, B. Penzlin S. Leonhardt, N. Ngo, „Preliminary test of a zero-torque controlled exoskeleton on a treadmill“, Proceedings on Automation in Medical Engineering (AUTOMED), vol. 1, no. 1, March 2-3, 2020, Lübeck, Germany. doi: <https://doi.org/10.18416/AUTOMED.2020>,
2. O. Linschmann, S. Leonhardt, C. Hoog Antink, „Model-based sensor fusion of multimodal cardiorespiratory signals using an unscented Kalman filter“, Proceedings on Automation in Medical Engineering (AUTOMED), vol. 1, no. 1, March 2-3, 2020, Lübeck, Germany. doi: <https://doi.org/10.18416/AUTOMED.2020>,
3. P. von Platen, A. Pomprapa, L. Leonhardt, P.A. Pickerodt, M. Ruß, M. Taher, W. Braun, L. Hinken, R. Köbrich, R.C.E. Francis, B. Lachmann, M. Walter, “A rapid control prototyping system for the automated control of mechanical ventilation”, Proceedings on Automation in Medical Engineering (AUTOMED), vol. 1, no. 1, March 2-3, 2020, Lübeck, Germany. doi: <https://doi.org/10.18416/AUTOMED.2020>,
4. M. Walter, S. Eisenbrand, C. Luebke, R. Kopp, S. Leonhardt, „Ein Hardware-in-the-loop Prüfstand für die Entwicklung einer künstlichen Lunge“, Proceedings on Automation in Medical Engineering (AUTOMED), vol. 1, no. 1, March 2-3, 2020, Lübeck, Germany. doi: <https://doi.org/10.18416/AUTOMED.2020>,

### **2020 Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology (USBEREIT), May 14 – 15, 2020, Yekaterinburg, Russia**

5. A.Z.Galiyev, A.A. Zakirova, I.A. Kudashov, J.V. Reshetov, A.V. Shcherbachev, S. Leonhardt, T. Gries, V. Reimer, “ Bioimpedance Spectroscopy for the Postmastectomy Lymphedem Diagnostics”, 2020 Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology (USBEREIT), May 14 – 15, 2020, Yekaterinburg, Russia. doi: [10.1109/USBEREIT48449.2020.9117780](https://doi.org/10.1109/USBEREIT48449.2020.9117780).
6. A. Mugeb, E.S. Chernikov, S.I. Shchukin, T. Gries, S. Leonhardt, “Renal Blood Monitoring System Using Bioimpedance Measurement: Pilot Study”, 2020 Ural Symposium on Biomedical Engineering, Radioelectronics and Information Technology (USBEREIT), May 14 – 15, 2020, Yekaterinburg, Russia. doi: [10.1109/USBEREIT48449.2020.9117780](https://doi.org/10.1109/USBEREIT48449.2020.9117780).

**2020 American Control Conference (ACC), July 1 – 3, 2020, Denver, CO, USA**

7. B.J.E. Misgeld, M. Illian, S. Leonhardt, „Robust strict positive real control of variable stiffness actuators”, American Control Conference (ACC2020), July 1 – 3, 2020, Denver, CO, USA. doi: 10.23919/ACC45564.2020.9147209.

**1<sup>st</sup> Virtual IFAC World Congress 2020 (IFAC-V-2020), July, 11 – 17, 2020, Germany**

8. L. Bergmann, L. Liu, N. Pham, B. Misgeld, S. Leonhardt, C. Ngo, „Implementation of LPV H-inf Loop-Shaping Control for a Variable Stiffness Actuator”, 1<sup>st</sup> Virtual IFAC World Congress 2020 (IFAC-V-2020), July, 11 – 17, 2020, Germany.
9. B.J.E. Misgeld, L. Bergmann, B. Szilasi, S. Leonhardt, D. Greven, „Virtual torque sensor for electrical bicycles”, 1<sup>st</sup> Virtual IFAC World Congress 2020 (IFAC-V-2020), July, 11 – 17, 2020, Germany.

**European Respiratory Society International Congress 2020, September 5 - 9, 2020, Virtual**

10. C. Ngo, S. Lehmann, E. Verjans, K. Tenbrock, S. Leonhardt, „Assessing global and regional pulmonary function with electrical impedance tomography in pediatric patients: the EIT-derived flow-volume loops”, European Respiratory Society International Congress 2020, September 5 – 9, 2020, in: *European Respiratory Journal* 2020 56:1239, doi: 10.1183/13993003.congress-2020.1239
11. C. Ngo, F. Dippel, S. Leonhardt, „The nonlinear volume-dependent extended RIC model for Forced Oscillation Technique measurement”, European Respiratory Society International Congress 2020, September 5 – 9, 2020, in: *European Respiratory Journal* 2020 56:3087, doi: 10.1183/13993003.congress-2020.3087.

**International Conference in Computing in Cardiology 2020, Rimini, Italy, 13-16 September 2020**

12. D. U. Uguz, F. Berief, S. Leonhardt, C. Hoog Antink, “Classification of 12-lead ECGs using Gradient Boosting on Features Acquired with Domain-Specific and Domain-Agnostic Methods”, International Conference in Computing in Cardiology (CinC) 2020, Rimini, Italy, Sep. 13-16, 2020.

# **Eingeladene Vorträge 2020 /**

## ***Invited Talks and Lectures 2020***

### Physical Talks

1. Steffen Leonhardt, „*Thou shalt not touch* – How to design Smart Beds ...“, Institute Seminar, Biomedical Engineering Laboratory, Department of Applied Mechanics, Indian Institute of Technology Madras, Friday, Feb. 21<sup>st</sup>, 2020.

### Remote/Digital Talks

Vorstellung des PV1000 Projektes bei verschiedenen Rotary Clubs der Städteregion Aachen:

2. Steffen Leonhardt, „Das PV1000 Projekt“, Rotary Club Charlemagne, 27. Mai 2020.
3. Steffen Leonhardt, „Das PV1000 Projekt“, Rotary Club Charlemagne, 3. Juni 2020.
4. Steffen Leonhardt, „Das PV1000 Projekt“, Rotary Club Aachen Nordkreis, 16. Juni 2020.
5. Steffen Leonhardt, „Update zum PV1000 Projekt“, Rotary Club Charlemagne, 9. Dez. 2020.
6. Steffen Leonhardt, „The PV1000 Pandemic Ventilator: A Quadruple Helix and Multidisciplinary Approach“, UTM Distinguished Lecture Series, Universiti Teknologi Malaysia, Johor Bahru, Malaysia, July 2<sup>nd</sup>, 2020.
7. Steffen Leonhardt, „Control aspects in artificial ventilation“, TELI seminar series, Beijing Institute of Technology, China, Sep. 28<sup>th</sup>, 2020.
8. Steffen Leonhardt, „Control and Design Aspects for a Rapid Response Artificial Ventilator“, Amrita University, Coimbatore, India, Oct 24<sup>th</sup>, 2020.
9. Steffen Leonhardt, „Biomechanics, actuation, and multi-level control strategies of power-augmentation lower extremity exoskeletons“, 4<sup>th</sup> Sechenov International Biomedical Summit (SIBS 2020), Sechenov University, Moscow, Russia, Nov 17-18, 2020.
10. Steffen Leonhardt, „Brunch with Leaders“, IEEE EMBS Workshop on Wearable Sensors and devices, Artificial Intelligence, and wearables Markets (WSAIM), Nov. 19<sup>th</sup>, 2020.