

Axel Loewe's Publications

1 Peer-reviewed Journal Articles¹

- Forthcoming**
- [j57] Brenneisen, J., Daub, A., Gerach, T., Kovacheva, E., Huetter, L., Frohnapfel, B., Doessel, O., and **Loewe, A.** "A sequential coupling approach for fluid-structure interaction in a patient-specific whole-heart geometry". In: under review.
 - [j56] Vila, M., Rivolta, M. W., Luongo, G., Unger, L. a., Luik, A., Gigli, L., Lombardi, F., **Loewe, A.**, and Sassi, R. "Atrial Flutter Mechanism Detection Using Directed Network Mapping". In: under review.
 - [j55] Sánchez, J., Trenor, B., Saiz, J., Dössel, O., and **Loewe, A.** "Fibrotic Remodeling during Persistent Atrial Fibrillation: In Silico Investigation of the Role of Calcium for Human Atrial Myofibroblast Electrophysiology". In: under review.
 - [j54] Luongo, G., Vacanti, G., Nitzke, V., Nairn, D., Nagel, C., Kabiri, D., Almeida, T. P., Soriano, D. C., Rivolta, M. W., Ng, G. A., Dössel, O., Luik, A., Sassi, R., Schmitt, C., and **Loewe, A.** "Hybrid Machine Learning to Localize Atrial Flutter Substrates Using the Surface 12-lead ECG". In: under review.
 - [j53] Moss, R., Wülfers, E. M., Schuler, S., **Loewe, A.**, and Seemann, G. "Impact of cardiac contraction on the ECG – an electro-mechanical whole-heart in silico study". In: under review.
 - [j52] Schuler, S., Schaufelberger, M., Bear, L. R., Bergquist, J. A., Cluitmans, M. J. M., Coll-Font, J., Onak, Ö. N., Zenger, B., **Loewe, A.**, MacLeod, R. S., Brooks, D. H., and Dössel, O. "Reducing Line-of-block Artifacts in Cardiac Activation Maps Estimated Using ECG Imaging: A Comparison of Source Models and Estimation Methods". In: under review, arXiv preprint available. URL: <https://arxiv.org/pdf/2108.06602.pdf>.
 - [j51] Tóth, N., **Loewe, A.**, Szlovák, J., Kohajda, Z., Bitay, G., Levijokic, J., Varró, A., and Nagy, N. "The reverse mode of the Na⁺/Ca²⁺ exchanger contributes to the pacemaker mechanism in rabbit sinus node cells". In: under review.
- 2021**
- [j50] Nagel, C., Schuler, S., Dössel, O., and **Loewe, A.** "A bi-atrial statistical shape model for large-scale in silico studies of human atria: model development and application to ECG simulations". In: *Medical Image Analysis* 2021, epub ahead. DOI: 10.1016/j.media.2021.102210.
 - [j49] Azzolin, L., Schuler, S., Dössel, O., and **Loewe, A.** "A Reproducible Protocol to Assess Arrhythmia Vulnerability in Silico: Pacing at the End of the Effective Refractory Period". In: *Frontiers in Physiology* 2021;12:656411. DOI: 10.3389/fphys.2021.656411.
 - [j48] Anzt*, H., Bach*, F., Druskat*, S., Löffler*, F., **Loewe*, A.**, Renard*, B. Y., Seemann*, G., Struck*, A., Achhammer, E., Aggarwal, P., Appel, F., Bader, M., Bruschi, L., Busse, C., Chourdakis, G., Dabrowski, P. W., Ebert, P., Flemisch, B., Friedl, S., Fritzsche, B., Funk, M. D., Gast, V., Goth, F., Grad, J.-N., Hermann, S., Hohmann, F., Janosch, S., Kutra, D., Linxweiler, J., Muth, T., Peters-Kottig, W., Rack, F., Raters, F. H., Rave, S., Reina, G., Reißig, M., Ropinski, T., Schaarschmidt, J., Seibold, H., Thiele, J. P., Uekerman, B., Unger, S., and Weeber, R. "An environment for sustainable research software in Germany and beyond: current state, open challenges, and call for action". In: *F1000Research* 2021;9:295. DOI: 10.12688/f1000research.23224.2.
 - [j47] Kovacheva, E., Gerach, T., Schuler, S., Ochs, M., Dössel, O., and **Loewe, A.** "Causes of Altered Ventricular Mechanics in Hypertrophic Cardiomyopathy — an In-Silico Study". In: *BioMedical Engineering OnLine* 2021;20:69. DOI: 10.1186/s12938-021-00900-9.
 - [j46] Dössel, O., Lunogo, G., Nagel, C., and **Loewe, A.** "Computer Modeling of the Heart for ECG Interpretation". In: *Hearts* 2021;2(3):350–368. DOI: 10.3390/hearts2030028.
 - [j45] Schuler, S., Pilia, N., Potyagaylo, D., and **Loewe, A.** "Consistent biventricular coordinates for precise and intuitive description of position in the heart – with MATLAB implementation". In: *Medical Image Analysis* 2021, accepted, preprint available. URL: <https://arxiv.org/abs/2102.02898>.

¹Equal contributions by several authors are denoted by *.

- [j44] Nothstein, M., Luik, A., Jadidi, A., Sánchez, J., Unger, L. A., Wülfers, E. M., Dössel, O., Seemann, G., Schmitt, C., and **Loewe, A.** "CVAR-Seg: An Automated Conduction Velocity and Amplitude Restitution Signal Segmentation Pipeline". In: *Frontiers in Physiology* 2021;12:673047. DOI: 10.3389/fphys.2021.673047.
- [j43] Unger, L. A., Luik, A., Azzolin, L., Nothstein, M., Sánchez, J., Seemann, G., Yeshwant, S., Oesterlein, T., Dössel, O., Schmitt, C., Spector, P., and **Loewe, A.** "Cycle Length Statistics During Human Atrial Fibrillation Reveal Refractory Properties of the Underlying Substrate – A Combined in Silico and Clinical Test of Concept Study". In: *Europace* 2021;23:i133–i142. DOI: 10.1093/europace/eaab404.
- [j42] Pilia, N., Nagel, C., Lenis, G., Becker, S., Dössel, O., and **Loewe, A.** "ECGdeli - An Open Source ECG Delineation Toolbox for MATLAB". In: *SoftwareX* 2021;13:100639. DOI: 10.1016/j.softx.2020.100639.
- [j41] Gerach, T., Schuler, S., Fröhlich, J., Lindner, L., Kovacheva, E., Moss, R., Wülfers, E. M., Seemann, G., Wieners, C., and **Loewe, A.** "Electro-mechanical Whole-Heart Digital Twins: a Fully Coupled Multi-Physics Approach". In: *Mathematics* 2021;9(11):1247. DOI: 10.3390/math9111247.
- [j40] Kovacheva, E., Thämer, L., Fritz, T., Seemann, G., Ochs, M., Dössel, O., and **Loewe, A.** "Estimating Cardiac Active Tension from Wall Motion - The Inverse Problem of Cardiac Biomechanics". In: *International Journal for Numerical Methods in Biomedical Engineering* 2021, e3448. DOI: 10.1002/cnm.3448.
- [j39] Luongo, G., Azzolin, L., Schuler, S., Rivolta, M. W., Almeida, T. P., Martínez, J. P., Soriano, D. C., Luik, A., Müller-Edenborn, B., Jadidi, A., Dössel, O., Sassi, R., Laguna, P., and **Loewe, A.** "Machine learning enables non-invasive prediction of atrial fibrillation driver location and acute pulmonary vein ablation success using the 12-lead ECG". In: *Cardiovascular Digital Health Journal* 2021;2(2):126–136. DOI: 10.1016/j.cvdhj.2021.03.002.
- [j38] Nagel, C., Luongo, G., Azzolin, L., Schuler, S., Dössel, O., and **Loewe, A.** "Non-invasive and Quantitative Estimation of Left Atrial Fibrosis based on P waves of the 12-lead ECG - A Large-scale Computational Study Covering Anatomical Variability". In: *Journal of Clinical Medicine* 2021;10(8):1797. DOI: 10.3390/jcm10081797.
- [j37] Eichenlaub, M., Lehrmann, H., Mueller-Edenborn, B., Minners, J., Nairn, D., **Loewe, A.**, Allgeier, J., Jander, N., Allgeier, M., Ruile, P., Hein, M., Rees, F., Trenk, D., Weber, R., Neumann, F.-J., Arentz, T., and Amir, J. "Non-invasive Body Surface Electrocardiographic Imaging for Diagnosis of Fibrotic Atrial Cardiomyopathy". In: *EP Europace* 2021, epub ahead. DOI: 10.1093/europace/eaab140.
- [j36] Luongo, G., Schuler, S., Luik, A., Almeida, T. P., Soriano, D. C., Doessel, O., and **Loewe, A.** "Non-Invasive Characterization of Atrial Flutter Mechanisms Using Recurrence Quantification Analysis on the ECG: a Computational Study." In: *IEEE Transactions on Biomedical Engineering* 2021;68(3):914–925. DOI: 10.1109/TBME.2020.2990655.
- [j35] Viceconti, M., Afshari, P., Courcelles, E., Curreli, C., Emili, L., Famaey, N. M., Geris, L., Horner, M., Jori, M. C., Kulesza, A., **Loewe, A.**, Neidlin, M., Reiterer, M., Rousseau, C. F., Russo, G., Sonntag, S. J., Voisin, E. M., and Pappalardo, F. "Possible Contexts of Use for In Silico trials methodologies: a consensus-based review". In: *IEEE Journal of Biomedical and Health Informatics* 2021, epub ahead. DOI: 10.1109/JBHI.2021.3090469.
- [j34] Lutz, Y., Meißner, T., Krames, L., Cattaneo, G., Meckel, S., Doessel, O., and **Loewe, A.** "Selective Brain Hypothermia for Ischemic MCA-M1 Stroke: Influence of Cerebral Arterial Circulation in a 3D Brain Temperature Model." In: *IEEE Transactions on Biomedical Engineering* 2021;68(2):404–415. DOI: 10.1109/TBME.2020.3000521.
- [j33] Plank, G., **Loewe, A.**, Neic, A., Augustin, C., Huang, Y.-L., Gsell, M. A., Elias Karabelas, J. S., Prassl, A. J., Seemann, G., and Vigmond, E. J. "The openCARP Simulation Environment for Cardiac Electrophysiology". In: *Computer Methods and Programs in Biomedicine* 2021;208:106223. DOI: 10.1016/j.cmpb.2021.106223.
- [j32] Sánchez, J., Luongo, G., Nothstein, M., Unger, L., Saiz, J., Trenor, B., Luik, A., Dössel, O., and **Loewe, A.** "Using Machine Learning to Characterize Atrial Fibrotic Substrate from Intracardiac Signals using a Hybrid in silico and in vivo Dataset". In: *Frontiers in Physiology* 2021;12:699291. DOI: 10.3389/fphys.2021.699291.

- 2020 [j31] Nairn, D., Lehrmann, H., Müller-Edenborn, B., Schuler, S., Arentz, O., Jadidi, A., and **Loewe, A.** "Comparison of Unipolar and Bipolar Voltage Mapping for Localization of Left Atrial Arrhythmogenic Substrate in Patients with Atrial Fibrillation". In: *Frontiers in Physiology* 2020;11:1461. DOI: 10.3389/fphys.2020.575846.
- [j30] Frisch, D., Oesterlein, T. G., Unger, L. A., Lenis, G., Wakili, R., Schmitt, C., Luik, A., Doessel, O., and **Loewe, A.** "Mapping and Removing the Ventricular Far Field Component in Unipolar Atrial Electrograms." In: *IEEE Transactions on Biomedical Engineering* 2020;67(10):2905–2915. DOI: 10.1109/TBME.2020.2973471.
- [j29] Pollnow, S., Schwaderlapp, G., **Loewe, A.**, and Dössel, O. "Monitoring the dynamics of acute radiofrequency ablation lesion formation in thin-walled atria – a simultaneous optical and electrical mapping study". In: *Biomedical Engineering / Biomedizinische Technik* 2020;65(3):327–341. DOI: 10.1515/bmt-2019-0013.
- [j28] Kohajda, Z., Tóth, N., Szlovák, J., **Loewe, A.**, Bitay, G., Gazdag, P., Prorok, J., Jost, N., Levijoki, J., Pollesello, P., Papp, J. G., Varró, A., and Nagy, N. "Novel Na/Ca Exchanger Inhibitor ORM-10962 Supports Coupled Function of Funny-Current and Na/Ca Exchanger in Pacemaking of Rabbit Sinus Node Tissue". In: *Frontiers in Pharmacology* 2020;10:1632. DOI: 10.3389/fphar.2019.01632.
- [j27] Wiedmann, F., Beyersdorf, C., Zhou, X., Büscher, A., Kraft, M., Nietfeld, J., Walz, T. P., Unger, L. A., **Loewe, A.**, Schmack, B., Ruhparwar, A., Karck, M., Thomas, D., Borggreffe, M., Seemann, G., Katus, H. A., and Schmidt, C. "Pharmacologic TWIK-Related Acid-Sensitive K⁺ Channel (TASK-1) Potassium Channel Inhibitor A293 Facilitates Acute Cardioversion of Paroxysmal Atrial Fibrillation in a Porcine Large Animal Model". In: *Journal of the American Heart Association* 2020. DOI: 10.1161/JAHA.119.015751.
- [j26] Pilia, N., Severi, S., Raimann, J. G., Genovesi, S., Dössel, O., Kotanko, P., Corsi, C., and **Loewe, A.** "Quantification and Classification of Potassium and Calcium Disorders with the Electrocardiogram – What Do Clinical Studies, Modeling and Reconstruction Tell Us?" In: *APL Bioengineering* 2020;4(4):041501. DOI: 10.1063/5.0018504.
- [j25] Jadidi, A., Nothstein, M., Chen, J., Lehrmann, H., Dössel, O., Allgeier, J., Trenk, F.-J., **Loewe, A.**, Müller-Edenborn, B., and Arentz, T. "Specific Electrogram Characteristics Identify the Extra-Pulmonary Vein Arrhythmogenic Sources of Persistent Atrial Fibrillation - Characterization of the Arrhythmogenic Electrogram Patterns During Atrial Fibrillation and Sinus Rhythm." In: *Scientific Reports* 2020;10(1):9147. DOI: 10.1038/s41598-020-65564-2.
- [j24] Kohajda*, Z., **Loewe***, A., Tóth, N., Varró, A., and Nagy, N. "The Cardiac Pacemaker Story-Fundamental Role of the Na/Ca Exchanger in Spontaneous Automaticity." In: *Frontiers in Pharmacology* 2020;11:516. DOI: 10.3389/fphar.2020.00516.
- 2019 [j23] Wang, Y., Xiong, Z., Nalar, A., Hansen, B. J., Kharche, S., Seemann, G., **Loewe, A.**, Fedorov, V. V., and Zhao, J. "A robust computational framework for estimating 3D Bi-Atrial chamber wall thickness". In: *Computers in Biology and Medicine* 2019;114:103444. DOI: 10.1016/j.compbiomed.2019.103444.
- [j22] Lutz, Y., **Loewe, A.**, Meckel, S., Dössel, O., and Cattaneo, G. "Combined local hypothermia and recanalization therapy for acute ischemic stroke: Estimation of brain and systemic temperature using an energetic numerical model." In: *Journal of Thermal Biology* 2019;84:316–322. DOI: 10.1016/j.jtherbio.2019.06.011.
- [j21] **Loewe, A.**, Lutz, Y., Nairn, D., Fabbri, A., Nagy, N., Tóth, N., Ye, X., Fuertinger, D. H., Genovesi, S., Kotanko, P., Raimann, J. G., and Severi, S. "Hypocalcemia-Induced Slowing of Human Sinus Node Pacemaking". In: *Biophysical Journal* 2019;117(12):2244–2254. DOI: 10.1016/j.bpj.2019.07.037.
- [j20] Lutz, Y., Daschner, R., Krames, L., **Loewe, A.**, Cattaneo, G., Meckel, S., and Dössel, O. "Modeling selective therapeutic hypothermia in case of acute ischemic stroke using a 1D hemodynamics model and a simplified brain geometry." In: *Mathematical Biosciences and Engineering: MBE* 2019;17(2):1147–1167. DOI: 10.3934/mbe.2020060.
- [j19] **Loewe, A.**, Poremba, E., Oesterlein, T., Luik, A., Schmitt, C., Seemann, G., and Dössel, O. "Patient-Specific Identification of Atrial Flutter Vulnerability—A Computational Approach to Reveal

- Latent Reentry Pathways". In: *Frontiers in Physiology* 2019;9:1910. DOI: 10.3389/fphys.2018.01910.
- 2018 [j18] Alessandrini, M., Valinoti, M., Unger, L., Oesterlein, T., Dössel, O., Corsi, C., **Loewe, A.**, and Severi, S. "A Computational Framework to Benchmark Basket Catheter Guided Ablation in Atrial Fibrillation". In: *Frontiers in Physiology* 2018;9:1251. DOI: 10.3389/fphys.2018.01251.
- [j17] Pollnow, S., Pilia, N., Schwaderlapp, G., **Loewe, A.**, Dössel, O., and Lenis, G. "An adaptive spatio-temporal Gaussian filter for processing cardiac optical mapping data". In: *Computers in Biology and Medicine* 2018;102:267–277. DOI: 10.1016/j.compbiomed.2018.05.029.
- [j16] Oesterlein, T. G., **Loewe, A.**, Lenis, G., Luik, A., Schmitt, C., and Doessel, O. "Automatic Identification of Reentry Mechanisms and Critical Sites during Atrial Tachycardia by Analyzing Areas of Activity." In: *IEEE Transactions on Biomedical Engineering* 2018;65(10):2334–2344. DOI: 10.1109/TBME.2018.2794321.
- [j15] **Loewe, A.**, Wülfers, E. M., and Seemann, G. "Cardiac ischemia-insights from computational models." In: *Herzschrittmachertherapie & Elektrophysiologie* 2018;29(1):48–56. DOI: 10.1007/s00399-017-0539-6.
- [j14] Andlauer, R., Seemann, G., Baron, L., Dössel, O., Kohl, P., Platonov, P., and **Loewe, A.** "Influence of left atrial size on P-wave morphology: differential effects of dilation and hypertrophy". In: *Europace* 2018;20(S3):iii36–iii44. DOI: 10.1093/europace/euy231.
- [j13] Lehrmann, H., Jadidi, A. S., Minners, J., Chen, J., Müller-Edenborn, B., Weber, R., Dössel, O., Arentz, T., and **Loewe, A.** "Novel Electrocardiographic Criteria for Real-Time Assessment of Anterior Mitral Line Block". In: *JACC: Clinical Electrophysiology* 2018;4(7):920–932. DOI: 10.1016/j.jacep.2018.03.007.
- [j12] Verma, B., Oesterlein, T., **Loewe, A.**, Luik, A., Schmitt, C., and Dössel, O. "Regional conduction velocity calculation from clinical multichannel electrograms in human atria". In: *Computers in Biology and Medicine* 2018;92:188–196. DOI: 10.1016/j.compbiomed.2017.11.017.
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- [j10] Lenis, G., Pilia, N., **Loewe, A.**, Schulze, W. H. W., and Dössel, O. "Comparison of Baseline Wander Removal Techniques considering the Preservation of ST Changes in the Ischemic ECG: A Simulation Study". In: *Computational and Mathematical Methods in Medicine* 2017;2017(Article ID 9295029):13. DOI: 10.1155/2017/9295029.
- [j9] Dössel, O. and **Loewe, A.** "Computerized modeling of the human heart". In: *Zeitschrift für Medizinische Physik* 2017;27(3):167–169. DOI: 10.1016/j.zemedi.2017.06.002.
- [j8] Pollnow, S., Greiner, J., Oesterlein, T., Wülfers, E. M., **Loewe, A.**, and Dössel, O. "Mini Electrodes on Ablation Catheters: Valuable Addition or Redundant Information? Insights from a Computational Study". In: *Computational and Mathematical Methods in Medicine* 2017;2017:168629. DOI: 10.1155/2017/1686290.
- 2016 [j7] Oesterlein, T., Frisch, D., **Loewe, A.**, Seemann, G., Schmitt, C., Dössel, O., and Luik, A. "Basket-Type Catheters: Diagnostic Pitfalls caused by Deformation and Limited Coverage". In: *BioMed Research International* 2016;2016:5340574. DOI: 10.1155/2016/5340574.
- [j6] **Loewe, A.**, Krueger, M. W., Holmqvist, F., Dossel, O., Seemann, G., and Platonov, P. G. "Influence of the earliest right atrial activation site and its proximity to interatrial connections on P-wave morphology". In: *Europace* 2016;18(S4):iv35–iv43. DOI: 10.1093/europace/euw349.
- [j5] Dössel, O., Lenis, G., **Loewe, A.**, Rottmann, M., Seemann, G., and Oesterlein, T. "Model Assisted Biosignal Analysis of Atrial Electrograms". In: *Technisches Messen* 2016;83(2):102–111. DOI: 10.1515/teme-2015-0122.
- [j4] **Loewe, A.**, Wilhelms, M., Schmid, J., Krause, M. J., Fischer, F., Thomas, D., Scholz, E. P., Dössel, O., and Seemann, G. "Parameter estimation of ion current formulations requires hybrid optimization approach to be both accurate and reliable". In: *Frontiers in Bioengineering and Biotechnology* 2016;3:209. DOI: 10.3389/fbioe.2015.00209.
- 2014 [j3] **Loewe, A.**, Wilhelms, M., Fischer, F., Scholz, E. P., Dössel, O., and Seemann, G. "Arrhythmic potency of human ether-a-go-go-related gene mutations L532P and N588K in a computational

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- [j2] **Loewe, A.**, Schulze, W. H. W., Jiang, Y., Wilhelms, M., Luik, A., Dössel, O., and Seemann, G. "ECG-Based Detection of Early Myocardial Ischemia in a Computational Model: Impact of Additional Electrodes, Optimal Placement, and a New Feature for ST Deviation". In: *BioMed Research International* 2014;2015:530352. DOI: 10.1155/2015/530352.
- [j1] **Loewe, A.**, Lutz, Y., Wilhelms, M., Sinnecker, D., Barthel, P., Scholz, E. P., Dössel, O., Schmidt, G., and Seemann, G. "In-silico assessment of the dynamic effects of amiodarone and dronedarone on human atrial patho-electrophysiology." In: *Europace* 2014;16(S4):iv30–iv38. DOI: 10.1093/europace/euu230.

2 Data & Software

- [d7] Wachter, A., Azzolin, L., **Loewe, A.** 2021. "RESILIENT – Rule based atrial fiber generator", DOI: 10.5281/ZENODO.4738369
- [d6] Nothstein, M., **Loewe, A.** 2021. "CVAR-Seg – Segmentation of S1S2 stimulation protocol measurements", <https://github.com/KIT-IBT/CVAR-Seg>
- [d5] Schuler, S., **Loewe, A.** 2021. "Biventricular statistical shape model of the human heart adapted for computer simulations", DOI: 10.5281/ZENODO.4419783
- [d4] **Loewe, A.**, Neic, A., Plank, G., Seemann, G., Vigmond, E. et al. 2020. "openCARP - an open cardiac electrophysiology simulator", www.openCARP.org, >130 registered users, 90 attendees at 2020 user meeting
- [d3] Nagel, C., Schuler, S., Dössel, O., **Loewe, A.** 2020. "A Bi-atrial Statistical Shape Model and 100 Volumetric Anatomical Models of the Atria", DOI: 10.5281/ZENODO.4309957
- [d2] Pilia, N., Nagel, C., Lenis, G., Becker, S., Dössel, O., **Loewe, A.** 2020. "ECGdeli - An Open Source ECG Delineation Toolbox for MATLAB", DOI: 10.5281/ZENODO.3944621
- [d1] Pollnow, S., Pilia, N., Schwaderlapp, G., **Loewe, A.**, Dössel, O., Lenis, G. 2018. "FilterAd3DGaFilt – Adaptive 3D Gaussian Filter", DOI: 10.5281/ZENODO.4316477

3 Proceedings

- 2021 [p70] Nagel, C., Schaufelberger, M., Dössel, O., and **Loewe, A.** "A bi-atrial statistical shape model as a basis to classify left atrial enlargement from simulated and clinical 12-lead ECGs". In: 12th Workshop on Statistical Atlases and Computational Modelling of the Heart 2021. under review.
- [p69] Appel, S., Gerach, T., Dössel, O., and **Loewe, A.** "Adaptation of the Calcium-dependent Tension Development in Ventricular Cardiomyocytes". In: *Current Directions in Biomedical Engineering*. BMT 2021 - 55th Annual Conference of the German Society for Biomedical Engineering (VDE|DGBMT) 2021. accepted.
- [p68] Zheng, T., Azzolin, L., Sánchez, J., Dössel, O., and **Loewe, A.** "An automated pipeline for generating fiber orientation and region annotation of patient-specific atrial model". In: *Current Directions in Biomedical Engineering*. BMT 2021 - 55th Annual Conference of the German Society for Biomedical Engineering (VDE|DGBMT) 2021. accepted.
- [p67] Azzolin, L., Zheng, T., Nagel, C., Dössel, O., and **Loewe, A.** "Automated framework for the augmentation of missing anatomical structures and generation of personalized atrial models from clinical data". In: *Computing in Cardiology Conference (CinC)*. Vol. 48. 2021. accepted.
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5 Invited Talks

- 2021 [t9] **Loewe, A.** "Computational Cardiac Modeling - Synergies with Machine Learning". In: Cardiac Electromechanics Research Group (Prof. Niederer / Bishop), King's College London 2021. London, UK.
- 2019 [t8] **Loewe, A.** "The inverse problem of cardiac mechanics - estimation of cardiac active stress distribution through imaging-driven computational modeling". In: 9th International Congress on Industrial and Applied Mathematics 2019. Valencia, Spain.
- [t7] **Loewe, A.** "The inverse problem of cardiac mechanics - estimation of cardiac active stress from endocardial motion tracking". In: 6th International Conference on Computational and Mathematical Biomedical Engineering 2019. Sendai City, Japan.
- 2017 [t6] **Loewe, A.** "Multiscale modeling of cardiac electrophysiology". In: School of Science and Engineering, Reykjavik University / Háskólinn í Reykjavík 2017. Reykjavik, Iceland.
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- 2015 [t3] **Loewe, A.** "In-silico Assessment of the Dynamic Effects of Amiodarone and Dronedarone on Human Atrial Patho-Electrophysiology". In: Emerging Mathematical Topics in Biology and Life Sciences 2015. Graz, Austria.
- 2014 [t2] **Loewe, A.** "Modeling human atrial patho-electrophysiology: genetic defects and pharmacological agents". In: Simula Cardiac Modeling Workshop 2014. Oslo, Norway.
- [t1] **Loewe, A.** "Multiscale in silico modeling of human atrial electrophysiology". In: Computational Cardiology Lab (Prof. Natalia Trayanova), Johns Hopkins University 2014. Baltimore, USA.

6 Patents

- 2019 [pa3] Oesterlein, T., Dössel, O., Frisch, D., **Loewe, A.**, Lenis, G., and Pilia, N. *Method and system for determining ventricular far field contribution in atrial electrograms*. United States Patent Application 20190059765, 16/111092.
- 2015 [pa2] Liu, J., Yang, Z., Nadar, M. S., Janardhanan, N., Wang, Q., and **Loewe, A.** *Multi-stage Magnetic Resonance Reconstruction for Parallel Imaging Applications*. United States Patent 9097780.
- 2014 [pa1] Lefebvre, A., **Loewe, A.**, Nadar, M. S., and Liu, J. *Zero communication block partitioning*. United States Patent Application 20140037228, 13/950535.

7 Public Outreach / Popular Science

- 2021 [o9] Anzt, H. and **Loewe, A.** "Forschungssoftware – Nachhaltige Entwicklung und Bereitstellung". In: *Forschung & Lehre* 2021;28(5):380–381. URL: <https://www.wissenschaftsmanagement-online.de/beitrag/forschungssoftware-nachhaltige-entwicklung-und-bereitstellung-12233>.

- [o8] Appel, F. and **Loewe, A.** "Forschungssoftware – Nachhaltige Entwicklung und Unterstützung". In: *IAMO Policy Briefs* 2021;42. URL: https://www.iamo.de/fileadmin/documents/IAMOPolicyBrief42_de.pdf.
- [o7] **Loewe, A.** "KIT Forscher simulieren Herzen". In: *Badische Neueste Nachrichten* 2021.
- [o6] Appel, F. and **Loewe, A.** "Research Software–Sustainable Development and Support". In: *IAMO Policy Briefs* 2021;42. URL: https://www.iamo.de/fileadmin/documents/IAMOPolicyBrief42_en.pdf.
- 2020 [o5] **Loewe, A.** "Ein digitales Herz". In: *Spektrum der Wissenschaft* 2020;20(10):44–48.
- [o4] Lohrer, M. and **Loewe, A.** "Herzsimulator 1.0". In: *dotnetpro* 2020;2020(1):13–19.
- [o3] **Loewe, A.** "Mit Computerherz zum Therapieerfolg". In: *KIT NEULAND* 2020, 36–43.
- 2019 [o2] Hallensleben, S. and **Loewe, A.** "Wie wirken Arzt und digitale Technik im Jahr 2035 zusammen?" In: *VDE DGBMT* 2019.
- 2018 [o1] **Loewe, A.** "Mit Vortests zur besten Therapie - KIT-Forscher simuliert am PC Behandlungsmethoden bei Vorhofflimmern". In: *Badische Neueste Nachrichten* 2018.

See CV for further dissemination and outreach activities.

8 Book Chapters and Monographs

- Forthcoming [b4] **Loewe, A.** "Cardiac Digital Twins". In: *Innovative treatment strategies for clinical electrophysiology*. Ed. by T. Jadczyk and G. Caluori. Invited for 2021. Springer.
- 2016 [b3] **Loewe, A.** "Modeling human atrial patho-electrophysiology from ion channels to ECG : substrates, pharmacology, vulnerability, and P-waves". PhD thesis. Karlsruhe Institute of Technology (KIT). DOI: 10.5445/KSP/1000054615.
- 2013 [b2] **Loewe, A.** "Arrhythmic potency of human electrophysiological models adapted to chronic and familial atrial fibrillation". MA thesis. Karlsruhe Institute of Technology (KIT).
- 2010 [b1] **Loewe, A.** "Comparison of cardiac simulation tools regarding the modeling of acute ischemia". BA thesis. Karlsruhe Institute of Technology (KIT).

9 Reviewer Activity

9.1 Funding Agencies

- *British Heart Foundation* (2020)
- *Czech Academy of Sciences, member of evaluation panel "Engineering and Technology"* (2021)
- *Deutsche Forschungsgemeinschaft* (2021)
- *Fondazione Leonardo* (2021)
- *Medical Research Council, United Kingdom* (2018)
- *Swiss National Science Foundation* (2021)
- *Wellcome Trust* (2021)

9.2 Scientific Journals

- *Annals of Biomedical Engineering* (2019-20)
- *Biomechanics and Modeling in Mechanobiology* (2020)
- *Biophysical Journal* (2019)
- *BMC Nephrology* (2021)
- *Cardiology Research and Practice* (2021)
- *Cardiovascular Engineering and Technology* (2021)

- *Cardiovascular Research* (2018)
- *Circulation: Arrhythmia and Electrophysiology* (2021)
- *Clinical Medicine Insights Cardiology* (2019)
- *Computers in Biology and Medicine* (2018-21)
- *Computing in Cardiology Conference* (2017-21)
- *eLIFE* (2021)
- *Europace* (2016-21)
- *Frontiers in Cardiovascular Medicine* (2020)
- *Frontiers in Physiology* (2017, 2019-21)
- *Heart Rhythm* (2017-19)
- *IEEE Transactions on Biomedical Engineering* (2016, 2019-21)
- *International Journal of Clinical Cardiology* (2017)
- *JACC Clinical Electrophysiology* (2021)
- *Journal of Cardiovascular Electrophysiology* (2021)
- *Medical and Biological Engineering and Computing* (2016-17, 2019)
- *Medical Image Analysis* (2020-21)
- *Platform for Advanced Scientific Computing (PASC) Conference* (2021)
- *Philosophical Transactions of the Royal Society A* (2019-20)
- *PLOS Computational Biology* (2017, 2019)
- *PLOS ONE* (2019)
- *Simulation: Transactions of the Society for Modeling and Simulation* (2018)

Axel Loewe's Supervisions

10 Supervised PhD Students

- [3] Kovacheva, E. 2021. *"Model Based Estimation of the Elastomechanical Properties of the Human Heart"*. PhD Thesis. Karlsruhe Institute of Technology (KIT). DOI:
 - [2] Sánchez Arciniegas, J P. 2021. *"A Multiscale In Silico Study to Characterize the Atrial Electrical Activity of Patients With Atrial Fibrillation : A Translational Study to Guide Ablation Therapy"*. PhD Thesis. Karlsruhe Institute of Technology (KIT). DOI: 10.5445/IR/1000134665
 - [1] Lutz, Y. 2020. *"Modeling of the Human Brain to Predict Spatial and Temporal Temperature Profiles for the Selective Hypothermia Treatment of an Ischemic Stroke"*. PhD Thesis. Karlsruhe Institute of Technology (KIT). DOI: 10.5445/IR/1000122124
- Schuler, S., expected 2021
 - Nothstein, M., expected 2021
 - Gerach, T., expected 2022
 - Luongo, G., expected 2022
 - Azzolin, L., expected 2022
 - Nairn, D., expected 2022
 - Brenneisen, J., expected 2022
 - Nagel, C., expected 2023
 - Barrios Espinosa, C.A., expected 2024
 - Martinez Diaz, L.P., expected 2024

11 Supervised and Refereed Student Theses

- [53] Zheng, T. 2021. *"Automatic patient-specific atrial model generation to study arrhythmia vulnerability"*. Master Thesis.
- [52] Krames, L. 2021. *"Implementation and Evaluation of a (Semi-)Automatic Registration Framework for the Alignment of Pre- and Intra-operative Imaging Data in Laparoscopic Liver Surgery"*. Master Thesis.
- [51] Weiß, M. 2021. *"Bewertung und Anpassung der Mitralklappenimplementierung in einem parametrischen Kreislaufmodell basierend auf fluiddynamischen Simulationen"*. Master Thesis.
- [50] Tischer, J. 2021. *"Implementation and assessment of a statistical fitting approach for detection of conduction velocity, anisotropy ratio and fiber orientation of cardiac tissue"*. Bachelor Thesis.
- [49] Dzindo, H. 2020. *"Behavior and Transformation of Restitution Curves of Different Stimulation Protocols under Atrial Fibrillation Conditions"*. Bachelor Thesis.
- [48] Esnaola Capa, J M. 2020. *"Co-Registration of Multimodal Datasets in Patient-Specific Computational Models to Correlate Fibrotic Area and Electograms' Signals"*. Master Thesis.
- [47] Becker, S. 2020. *"Separating ECG changes caused by potassium channel blocks from changes by anormal potassium concentrations"*. Bachelor Thesis.
- [46] Meinzer, M. 2020. *"Patientenabhängigkeit von Algorithmen zur Ionenkonzentrationsrekonstruktion und deren Überwindung"*. Master Thesis.
- [45] Koch, J. 2020. *"Enhancing Conduction Velocity Estimation by Atrial Electrogram Analysis"*. Bachelor Thesis.
- [44] Schweda, C. 2020. *"Online Gastransferratenmessung und Performance-Indikation von Hohlfasermembranoxygenatoren"*. Master Thesis.
- [43] Schicketanz, L. 2020. *"Erkennung von atrialen Nahfeld und Fernfeld Komponenten in Elektrogrammen bei atrialen Tachykardie"*. Bachelor Thesis.
- [42] Sandrock, J. 2020. *"Ermittlung und Analyse einer Optimierungskurve über die Anzahl von Elektroden zur Erfassung von Myosignalen zur Steuerung einer Handprotheseattern Recognition"*. Master Thesis.

- [41] Hunyar, D. 2020. "Identification of how voltage is affected due to changes in electrode size and the use of a Lasso catheter using a computational model". Bachelor Thesis.
- [40] Bettaieb, F. 2020. "The Effect of Fibrosis Transmurality on Electrogram Morphology and Atrial Fibrillation Dynamics". Bachelor Thesis.
- [39] Appel, S. 2020. "Parameteroptimierung zur Regulierung der calciumabhängigen Kraftentwicklung in Herzmuskelzellen". Bachelor Thesis.
- [38] Hii, K. 2020. "Reorientation of an Atrial Model: to Simulate 12-lead ECG Signals: An Overfitting and Data Augmentation Problem". Bachelor Thesis.
- [37] Andlauer, R. 2020. "Bidirectional Translation Between Facial Image and 3D Reconstruction for Post-operative Face Prediction". Master Thesis.
- [36] Reiß, M. 2020. "Verbesserung der Genauigkeit bei der Bestimmung der Zeitdifferenz zwischen zwei Indikator dilutionskurven in Quantitativer Fluoreszenzangiographiewendung mathematischer Modelle". Bachelor Thesis.
- [35] Schaufelberger, M. 2019. "Activation Times Estimation in ECG Imaging: Comparison of Source Models and Estimation Methods". Master Thesis.
- [34] Stritt, M. 2019. "High-Density Mapping of Ablation Lesions for the Assessment of Myocardial Scar". Master Thesis.
- [33] Troschke, A. 2019. "Entwicklung eines Konzeptes zum Speichern gleichzeitiger Aufnahmen eines Multikameraaufbaus". Bachelor Thesis.
- [32] Moik, G. 2019. "Reconstruction of the Excitation Origin in the Ventricles using Body Surface Potential Maps". Master Thesis.
- [31] Thämer, L. 2019. "The Inverse Problem of the Heart Mechanics - Reconstruction of the Active Tension". Master Thesis.
- [30] Brenneisen, J. 2019. "Evaluation and comparison of multiple EIT reconstruction approaches on simulated and measured data with respect to cardiosynchronousty". Master Thesis.
- [29] Hammami, F. 2019. "Berechnung von spezifischen absorbierten Anteilen und ihren Unsicherheiten mit verschiedenen Voxelmodellen". Master Thesis.
- [28] Meyer-Hilberg L. 2019. "Investigation and Analysis of Spatio-Temporal ICG Fluorescence Signal of Intraoperative Angiography". Master Thesis.
- [27] Greiner, J. 2019. "Confocal Microscopy-Based Estimation of Passive Conductivity Tensors in the Normal and Infarcted Heart". Master Thesis.
- [26] Smardanski, B. 2019. "Diagnosing hypo- and hyperkalaemia and hypo- and hypercalcaemia with the 12-lead ECG". Master Thesis.
- [25] Baumann, D. 2018. "Robust Bi-Domain Registration of Vessels". Bachelor Thesis.
- [24] Tabet I. 2019. "Development and Quantitative Analysis of Automatic Electrical Impedance Tomography Signal Component Detection and Separation Algorithms". Bachelor Thesis.
- [23] Nagel, C. 2019. "Robust conduction velocity estimation in a clinical setting". Master Thesis.
- [22] Luz, C. 2019. "Determination and Transformation of conduction velocities during a catheter study using a computational model". Bachelor Thesis.c
- [21] Meissner, T. 2019. "Adaption and Partitioning of a Brain Geometry for Spatially Detailed Calculation of Local Cerebral Temperatures". Master Thesis.
- [20] Fries, J. 2019. "Konzeptionierung und Erweiterung des Virtual-Reality Operationssaals zu einem Mixed-Reality Operationssaal". Master Thesis.
- [19] Molchanova, O. 2018. "Devolpment and Characterisation of a SD-OCT system for imaging scattering samples". Master Thesis.
- [18] Álvarez Guirado, P. 2018. "Classification of atrial ectopic origins into spatial segments based on the 12-lead ECG". Master Thesis.
- [17] Huck, S. 2018. "Kontaktlose Messung des Atmungssignals und der Atemrate unter Nutzung von 3D Daten". Master Thesis.
- [16] Stein, G. 2018. "Farbraumanpassung zur Optimierung des SNR von physiologisch relevanten Signalen in intraoperativen Systemen". Master Thesis.
- [15] Wirth, T. 2018. "Optical Detection of Regions of No Interest in Medical Sceneries". Master Thesis.
- [14] Debatin, S. 2017. "Quantifying and Optimizing the Diagnostic Potential of the ECG Regarding the Atria: Contribution of the Left Atrium, Zones of Low Voltage, andnrization". Bachelor Thesis.
- [13] Kahlmann, W. 2017. "Development of a Fast Method to Tailor Purkinje Activation Based on QRS Information". Master Thesis.

- [12] Unger, L. A. 2017. "*Substrate Mapping During Atrial Fibrillation – A Combined in Silico and Clinical Proof of Concept Study*". Master Thesis.
- [11] Hernández Mesa, M. 2017. "*Analysis of the Effects of Serum Calcium Changes on the ECG in a Computational Model*". Bachelor Thesis.
- [10] Lutz, Y. 2016. "*Influence of Electrolyte Concentration Changes on Sinus Node Function - A new player regarding sudden cardiac death in patients with chronic kidney*". Master Thesis.
- [9] Pilia, N. 2016. "*Characterization and reconstruction of ionic concentrations in the human ventricles analyzing the action potential and the surface ECG*". Master Thesis.
- [8] Ly, M. 2016. "*Untersuchung der elektrophysiologischen Auswirkung von Lücken in kardialen Ablationsnarben in einem numerischen Modell*". Bachelor Thesis.
- [7] Nguyen, H. 2016. "*Estimation of Local Cardiac Conduction Velocity Based on Intra-cardiac Recordings*". Bachelor Thesis.
- [6] Wachter, A. 2015. "*In-silico Assessment of Arrhythmogenic Potential of Atrial Ablation Patterns: A Sensitivity Analysis*". Diploma Thesis.
- [5] Khalef, A. 2015. "*Comparison of Statistic and Optimization-based Approaches for Parameter Estimation of Ion Current Formulations*". Bachelor Thesis.
- [4] Andlauer, R. 2015. "*Investigation of the Effect of Left Atrial Anatomy Alterations on P-Wave Morphology in a Computational Model*". Bachelor Thesis.
- [3] Xu, Y. 2014. "*In-silico Characterization of the Atrial Mode of Action of Ajmaline and Vernakalant and their Effect on Spiral Waves*". Bachelor Thesis.
- [2] Poremba, E. 2013. "*Implementation of a Fast Simulation C++ Framework for the Computation of Vulnerability to Atrial Arrhythmias Using the Fast Marching Algorithm*". Bachelor Thesis.
- [1] Lutz, Y. 2013. "*Specific Antiarrhythmic Therapy for Familial Atrial Fibrillation in a Numerical Model of Human Atrial Electrophysiology*". Bachelor Thesis.