Michael Loecher

Curriculum Vitae
(716) 440-6549
michael.w.loecher@gmail.com

Education

2009-2015 **PhD in Medical Physics**
University of Wisconsin Madison
(Supervised by Dr. Oliver Wieben)

2005-2009 **BSc in Physics**
Johns Hopkins University

Experience

2018 - present **Research Scientist** - Stanford University
Projects include:
- Creating a deep learning framework for tracking cardiac motion from a comprehensive synthetic training data generator
- Designing open-source software for design and optimization of MR gradient waveforms.
- Developing novel MR-Tagging techniques to better resolve cardiac motion over the whole cardiac cycle
- Reducing errors and improving acquisition efficiency in phase-contrast imaging with arbitrary optimized gradients

2015-2018 **Postdoctoral Researcher** - University of California Los Angeles
Projects include:
- Designing a weighted and regularized non-convex optimization method for better recovering velocities from low-Venc data.
- Using advanced convex optimization techniques to generate time optimal gradient waveforms to reduce the scan time of 4D-Flow acquisitions.
- Using bootstrapping based methods to estimate velocity error in PC-MRI data.
- Assessing hemodynamic changes in intracranial aneurysms that may lead to rupture.

2013 **Visiting Researcher** - ETH Zurich
Three month collaborative exchange working on TKE VIPR implementations and divergence constrained compressed sensing reconstructions.

2009 - 2015 **Research Assistant** - University of Wisconsin Madison
PhD Research:
- Creating an easy to use and effective automatic phase unwrapping algorithm for 4D datasets based on minimizing 4D Laplacian convolutions of the entire dataset.
- Improving velocity to noise ratios and streamline quality by enforcing divergence-free constraints with post-processing methods and as a constraint in compressed sensing reconstructions.
- Improving streamline quality by correcting for displacement based offsets accrued during measurement.
- Extending probabilistic streamlines and the previously described algorithms to create 'virtual injections' from 4D MR Flow data to better track the expected path of blood through the vasculature.

2007 - 2009 **Summer Undergraduate Researcher** - Roswell Park Cancer Institute, Buffalo, NY
Preclinical MR cancer research on small animals, mainly DCE-MRI analysis to measure tumor response to chemotherapeutic agents.

Grants and Awards

2021 **FIMH Conference: Best Oral Presentation**

2019–2020 **Trainee Representative**
ISMRM Flow and Motion Study Group

2018–2019 **MRM Distinguished Reviewer**

2016–2019 **JMRI Distinguished Reviewer**

2016,'17 **SMRA Travel Award**

2014,'20 **ISMRM Trainee Abstract: Summa Cum Laude**

2013,'16,'17,'20 **ISMRM Trainee Abstract: Magna Cum Laude**

2012 - 2014 **AHA Predoctoral Fellowship**
"Novel hemodynamic parameters and correction methods for PC-MRI for aid in diagnosis of brain AVMs and aneurysms"
American Heart Association, 12PRE12080073

2011,'12,'13 **ISMRM Student Stipend**

Skills

- **Programming Languages:**
  Most experienced with Python, C/C++, Matlab
  Some experience with HTML/css/javascript, CUDA, Qt, R, bash, Java
- Siemens (IDEA) and GE (EPIC) MR pulse programming
- Some small animal handling

Teaching

2016 - 2018 **Guest Lecturer**
Taught classes on gradient echo imaging and phase contrast MRI in 'M219 Principles and Applications of Magnetic Resonance Imaging'

2014   **Guest Lecturer**
Taught classes on compressed sensing and constrained reconstructions in 'Med Phys / Biomedical Engineering 710 - Advances in MRI'

Memberships

2012-present   **American Heart Association**

2010-present   **International Society for Magnetic Resonance in Medicine**

Patents

2021   **Loecher, M.**, & Ennis, D. B. (2021). *Synthetically Trained Neural Network for MRI Tag Tracking* (p. US20210219862A1).

Publications

2021   **Loecher, M.**, Perotti, L. E., & Ennis, D. B. (2021). Using Synthetic Data Generation to Train a Cardiac Motion Tag Tracking Neural Network. *Medical Image Analysis*, Accepted Sep 2021.

2021   Zimmermann, J., **Loecher, M.**, Kolawole, F. O., Bäumler, K., Gifford, K., Dual, S. A., Levenston, M., Marsden, A. L., & Ennis, D. B. (2021). On the impact of vessel wall stiffness on quantitative flow dynamics in a synthetic model of the thoracic aorta. *Scientific Reports*, *11*(1), 6703. https://doi.org/10.1038/s41598-021-86174-6

2021   Maier, O., Baete, S. H., Fyrdahl, A., Hammernik, K., Harrevelt, S., Kasper, L., Karakuzu, A., **Loecher, M.**, Patzig, F., Tian, Y., Wang, K., Gallichan, D., Uecker, M., & Knoll, F. (2021). CG-SENSE revisited: Results from the first ISMRM reproducibility challenge. *Magnetic Resonance in Medicine*, *85*(4), 1821–1839. https://doi.org/10.1002/mrm.28569

2021   Perotti, L. E., Verzhbinsky, I. A., Moulin, K., Cork, T. E., **Loecher, M.**, Balzani, D., & Ennis, D. B. (2021). Estimating cardiomyofiber strain in vivo by solving a computational model. *Medical Image Analysis*, *68*, 101932. https://doi.org/10.1016/j.media.2020.101932

2021   Zimmermann, J., Bäumler, K., **Loecher, M.**, Cork, T. E., Kolawole, F. O., Gifford, K., Marsden, A. L., Fleischmann, D., & Ennis, D. B. (2021). Quantitative Hemodynamics in Aortic Dissection: Comparing in Vitro MRI with FSI Simulation in a Compliant Model. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *12738 LNCS*, 575–586. https://doi.org/10.1007/978-3-030-78710-3_55

2021   **Loecher, M.**, Hannum, A. J., Perotti, L. E., & Ennis, D. B. (2021). Arbitrary Point Tracking with Machine Learning to Measure Cardiac Strains in Tagged MRI. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *12738 LNCS*, 213–222. https://doi.org/10.1007/978-3-030-78710-3_21

2020   Middione, M. J., **Loecher, M.**, Moulin, K., & Ennis, D. B. (2020). Optimization methods for magnetic resonance imaging gradient waveform design. *NMR in Biomedicine*, *33*(12). https://doi.org/10.1002/nbm.4308

2020   **Loecher, M.**, Middione, M. J., & Ennis, D. B. (2020). A gradient optimization toolbox for general purpose time-optimal MRI gradient waveform design. *Magnetic Resonance in Medicine*, *84*(6), 3234–3245. https://doi.org/10.1002/mrm.28384

2020   Chiang, J., **Loecher, M.**, Moulin, K., Meloni, M. F., Raman, S. S., McWilliams, J. P., Ennis, D. B., & Lee, E. W. (2020). 4D Flow MR Imaging to Improve Microwave Ablation Prediction Models: A Feasibility Study in an In Vivo Porcine Liver. *Journal of Vascular and Interventional Radiology*, *31*(10), 1691–1696.e1. https://doi.org/10.1016/j.jvir.2019.11.034

2019   Verzhbinsky, I. A., Perotti, L. E., Moulin, K., Cork, T. E., **Loecher, M.**, & Ennis, D. B. (2019). Estimating Aggregate Cardiomyocyte Strain Using In Vivo Diffusion and Displacement Encoded MRI. *IEEE Transactions on Medical Imaging*. https://doi.org/10.1109/TMI.2019.2933813

2019   **Loecher, M.**, Magrath, P., Aliotta, E., & Ennis, D. B. (2019). Time-optimized 4D phase contrast MRI with real-time convex optimization of gradient waveforms and fast excitation methods. *Magnetic Resonance in Medicine*, *82*(1), 213–224. https://doi.org/10.1002/mrm.27716

2019   Cork, T. E., Perotti, L. E., Verzhbinsky, I. A., **Loecher, M.**, & Ennis, D. B. (2019). High-Resolution Ex Vivo Microstructural MRI After Restoring Ventricular Geometry via 3D Printing. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *11504 LNCS*, 177–186. https://doi.org/10.1007/978-3-030-21949-9_20

2018   **Loecher, M.**, & Ennis, D. B. (2018). Velocity reconstruction with nonconvex optimization for low-velocity-encoding phase-contrast MRI. *Magnetic Resonance in Medicine*, *80*(1), 42–52. https://doi.org/10.1002/mrm.26997

2016   **Loecher, M.**, Schrauben, E., Johnson, K. M., & Wieben, O. (2016). Phase unwrapping in 4D MR flow with a 4D single-step laplacian algorithm. *Journal of Magnetic Resonance Imaging*, *43*(4), 833–842. https://doi.org/10.1002/jmri.25045

2015   Santelli, C., **Loecher, M.**, Busch, J., Wieben, O., Schaeffter, T., & Kozerke, S. (2015). Accelerating 4D flow MRI by exploiting vector field divergence regularization. *Magnetic Resonance in Medicine*. https://doi.org/10.1002/mrm.25563

2015   Chang, W., Wu, Y., Johnson, K., **Loecher, M.**, Wieben, O., Edjlali, M., Oppenheim, C., Roca, P., Hald, J., Aagaard-Kienitz, B., Niemann, D., Mistretta, C., & Turski, P. (2015). Fast contrast-enhanced 4D MRA and 4D flow MRI using constrained reconstruction (HYPRFlow): Potential applications for brain arteriovenous malformations. *American Journal of Neuroradiology*, *36*(6), 1049–1055. https://doi.org/10.3174/ajnr.A4245

2012   Chang, W., **Loecher, M.**, Wu, Y., Niemann, D. B., Ciske, B., Aagaard-Kienitz, B., Kecskemeti, S., Johnson, K. M., Wieben, O., Mistretta, C., & Turski, P. (2012). Hemodynamic changes in patients with arteriovenous malformations assessed using high-resolution 3D radial phase-contrast MR angiography. *AJNR. American Journal of Neuroradiology*, *33*(8), 1565–1572. https://doi.org/10.3174/ajnr.A3010

2008   Turowski, S. G., Seshadri, M., **Loecher, M.**, Podniesinski, E., Spernyak, J. A., & Mazurchuk, R. V. (2008). Performance of a novel piezoelectric motor at 4.7 T: applications and initial tests. *Magnetic Resonance Imaging*, *26*(3), 426–432. https://doi.org/10.1016/j.mri.2007.07.005

Book Chapters

2015   **Loecher, M.**, & Wieben, O. (2015). k-Space. In *Basic principles of cardiovascular MRI* (pp. 13–23). Springer International Publishing. https://doi.org/10.1007/978-3-319-22141-0_2

Proceedings (first author only)

Oral Presentations

2021　　**Loecher, M.**, Zimmermann, J., Middione, M. J., & Ennis, D. B. (2021). Using GrOpt with Pulseq for Easy Prototyping of Pulse Sequences with Optimized Waveforms. *ISMRM Annual Meeting, Remote*.

2021　　**Loecher, M.**, Perotti, L. E., & Ennis, D. B. (2021). Voxel-wise Tracking of Grid Tagged Cardiac Images using a Neural Network Trained with Synthetic Data. *ISMRM Annual Meeting, Remote*.

2020　　**Loecher, M.**, Perotti, L. E., & Ennis, D. B. (2020). Cardiac Tag Tracking with Deep Learning Trained with Comprehensive Synthetic Data Generation. *ISMRM Annual Meeting, Remote*.

2020　　**Loecher, M.**, Perotti, L. E., Magrath, P., & Ennis, D. B. (2020). Measuring Cardiac Strain in Duchenne Muscular Dystrophy with a Convolutional Neural Net Tag Tracking Method. *ISMRM Annual Meeting, Remote*.

2020　　**Loecher, M.**, Middione, M. J., & Ennis, D. B. (2020). Gradient Optimization (GrOpt) Toolbox: A Software Package for Fast Gradient WaveformDesign. *ISMRM Annual Meeting, Remote*.

2018　　**Loecher, M.**, & Ennis, D. B. (2018). New Techniques for Imaging Cardiac Motion with MRI. *Cardiac Imaging, Mechanics, and Modeling Symposium, Stanford, USA*.

2018　　**Loecher, M.**, Magrath, P., Aliotta, E., & Ennis, D. B. (2018). Accelerating 4D-Flow Acquisitions by Reducing TE and TR with Optimized RF and Gradient Waveforms. *ISMRM Annual Meeting, Paris, France*.

2017　　**Loecher, M.**, Magrath, P., Aliotta, E., & Ennis, D. B. (2017). Optimizing TE and TR of 4D-Flow Acquisitions for Reduced Scan Times. *SMRA Annual Meeting, Stellenbosch, South Africa*.

2017　　**Loecher, M.**, & Ennis, D. B. (2017). Pushing the Boundaries of Low-Venc PC-MRI Acquisition Strategies with a Weighted, Regularized Optimization Reconstruction. *ISMRM Annual Meeting, Honolulu, USA*.

2016　　**Loecher, M.**, & Ennis, D. B. (2016). Improving Velocity Accuracy for Low-Venc Phase Contrast Acquisitions with a Constrained Optimization Reconstruction. *ISMRM Flow and Motion Workshop, San Francisco, USA*.

2016　　**Loecher, M.**, & Ennis, D. B. (2016). More accurate velocimetry for high-moment phase contrast using weighted non-convex optimization. *SMRA Annual Meeting, Chicago, USA*.

2014　　**Loecher, M.**, Johnson, K. M., Turski, P., & Wieben, O. (2014). Improved "virtual injections" with 4D MR flow. *MR Angiography Club, Rome, Italy*.

2014　　**Loecher, M.**, Johnson, K. M., Turski, P., & Wieben, O. (2014). Robust Whole-Brain Blood Tracking from 4D Flow Using Displacement Corrected Probabilistic Streamlines. *ISMRM Annual Meeting, Milan, Italy*.

2013　　**Loecher, M.**, Wieben, O., & Johnson, K. M. (2013). 4 Dimensional, Single Step Laplacian Algorithm for Phase Unwrapping in 4D MR Flow. *ISMRM Annual Meeting, Salt Lake City, USA*.

Poster Presentations

2019   **Loecher, M.**, Middione, M. J., Moulin, K., & Ennis, D. B. (2019). A Real-time Solver for Convex Optimization of Diffusion Encoding Gradient Waveforms. *ISMRM Annual Meeting, Montreal, Canada*.

2017   **Loecher, M.**, & Ennis, D. B. (2017). Bootstrapped Estimates of Velocity Uncertainty for 4D Flow PC-MRI. *ISMRM Annual Meeting, Honolulu, USA*.

2016   **Loecher, M.**, Hu, P., & Ennis, D. B. (2016). Temporal Dynamics and Sampling Rate Effects for Background Phase Estimates in 4D Flow MRI. *ISMRM Annual Meeting, Singapore*.

2015   **Loecher, M.**, Johnson, K. M., Turski, P., & Wieben, O. (2015). Radial displacement errors and correction efficiency for streamline visualization in 4D-Flow MRI. *ISMRM Annual Meeting, Toronto, Canada*.

2013   **Loecher, M.**, Santelli, C., Wieben, O., & Kozerke, S. (2013). L1-SPIRiTPhase for Separate Magnitude and Phase Reconstruction with a Divergence Penalty for 3D Phase-Contrast Flow Measurements. *ISMRM Data Sampling and Image Reconstruction Workshop, Sedona, USA*.

2013   **Loecher, M.**, Santelli, C., Wieben, O., & Kozerke, S. (2013). Improved L1-SPIRiT Reconstruction with a Phase Divergence Penalty for 3D Phase-Contrast Flow Measurements. *ISMRM Annual Meeting, Salt Lake City, USA*.

2012   **Loecher, M.**, Kecskemeti, S., Turski, P., & Wieben, O. (2012). Comparison of divergence-free algorithms for 3D MRI with three-directional velocity encoding. *ISMRM Flow and Motion Workshop, Orlando, USA*.

2012   **Loecher, M.**, Kecskemeti, S., Johnson, K. M., Turski, P., & Wieben, O. (2012). Evaluation of divergence-free correction algorithms in high resolution 4-D flow images of cranial vasculature. *ISMRM Annual Meeting, Melbourne, Australia*.

2011   **Loecher, M.**, Johnson, K. M., Francois, C. J., & Wieben, O. (2011). 4D Gradient Based Phase Unwrapping for PC-MR Flow Data. *ISMRM Annual Meeting, Montreal, Canada*.

2010   **Loecher, M.**, Johnson, K. M., Francois, C. J., & Wieben, O. (2010). Peak Angiogram Calculations from 4D Flow Imaging. *ISMRM Annual Meeting, Stockholm, Sweden*.

2010   **Loecher, M.**, Francois, C. J., Johnson, K. M., Lum, D., & Wieben, O. (2010). Benefits and Pitfalls in the Use of Contrast Agents in 4D Flow Imaging. *ISMRM Annual Meeting, Stockholm, Sweden*.