International Journal on Magnetic Particle Imaging
Vol 2, No 2, Article ID 1703000, 2 Pages

Infinite Science Publishing

Guest Editorial

Novel Reconstruction Techniques and Applications for Magnetic Particle Imaging

Volker C. Behr*

Experimental Physics 5 (Biophysics), University of Würzburg, Würzburg, Germany
*Corresponding author, email: behr@physik.uni-wuerzburg.de

Received 3 March 2016; Accepted 5 March 2017; Published online 8 March 2017

Abstract

The first two manuscripts in this second issue of the second volume of the International Journal on Magnetic Particle Imaging are covering novel reconstruction techniques. While there are already established methods available the very young field of magnetic particle imaging (MPI) still offers much room for new concepts and algorithms to improve image quality, quantification, or processing speed. The remaining manuscripts are dealing with measurements obtaining additional information on top of tracer localization and the study of magnetic nanoparticle processing in organisms to help establish MPI as a clinical diagnostic tool.

Following a rich first issue of the second volume of the International Journal on Magnetic Particle Imaging (IJMPI) with articles covering a broad spectrum of topics in magnetic particle imaging (MPI) [1] this second issue gives insights in reconstruction, methodology, and nanoparticle characteristics for applications.

The manuscript by Vogel et al. [2] presents a "Flexible and Dynamic Patch Reconstruction for Traveling Wave Magnetic Particle Imaging". This technique aims at combining the advantages of established reconstruction methods allowing for operation independent of employed scanner hardware. Furthermore, different ways of creating a system matrix are shown and compared. They find the new approach to be a versatile and fast way for reconstructing very large datasets with the option to select specific regions of interest for reconstruction at a higher resolution than the full image. The advances in reconstruction are demonstrated in simulated and real datasets.

The reduction of image blurring and artifacts is the focus of a "Basic Study of Image Reconstruction Method Using Neural Networks with Additional Learning for Magnetic Particle Imaging" by Hatsuda et al. [3]. In contrast to the established reconstruction using the information gained from scanning the entire sample volume with a single point sample the authors suggest using information created by two or more point samples at a time. To handle the large number of possible combinations they introduce neural networks that learn the possible combinations to help choosing the required ones. The performance is evaluated in numerical experiments.

MPI signal conveys more than just the information of magnetic particle distribution. Stehning et al. show in their paper "Simultaneous magnetic particle imaging (MPI) and temperature mapping using multi-color MPI" [4] the successful combination of imaging and temperature mapping. Using a colored MPI image reconstruction, the authors demonstrate the feasibility of obtaining a three-dimensional image of tracer concentration with additional temperature information for each voxel containing superparamagnetic material.

Rounding off this issue of the IJMPI, Finas et al. present in the manuscript "Processing of SPIO in macrophages and tumor tissue for MPI lymph node imaging in breast cancer" [5] a study of the processing of magnetic nanoparticles in macrophages and tumor tissue.

In order to establish the foundation for a new sentinel lymph node biopsy technique using MPI that will be a great benefit for cancer patients and clinical staff, the authors examine the behavior of magnetic nanoparticles inside organisms by use of multiphoton microscopy and fluorescence lifetime imaging.

References

[1] T. M. Buzug. From Magnetic Nanoparticle Spectroscopy to Imaging Methodology. *Intern. J. Magnetic Particle Imaging*, 2(1):1610000, 2016. doi:10.18416/ijmpi.2016.1610000.

[2] P. Vogel, T. Kampf, M. A. Rückert, and V. C. Behr. Flexible and Dynamic Patch Reconstruction for Travelling Wave Magnetic Particle Imaging. *Intern. J. Magnetic Particle Imaging*, 2(2):1611001, 2016. doi:10.18416/ijmpi.2016.1611001.

[3] T. Hatsuda, T. Takagi, A. Matsuhisa, M. Arayama, H. Tsuchiya, S. Takahashi, and Y. Ishihara. Basic Study of Imaging Reconstruction Methods Using Neural Networks with Additional Learning for Magnetic Particle Imaging. *Intern. J. Magnetic Particle Imaging*, 2 (2):1611002, 2016. doi:10.18416/ijmpi.2016.1611002.

[4] C. Stehning, B. Gleich, and J. Rahmer. Simultaneous magnetic particle imaging (MPI) and temperature mapping using multi-color MPI. *Intern. J. Magnetic Particle Imaging*, 2(2):1612001, 2016. doi:10.18416/ijmpi.2016.1612001.

[5] D. Finas, J. Stegmann-Frehse, B. Sauer, G. Hüttmann, A. Rody, T. M. Buzug, and K. Lüdtke-Buzug. Processing of SPIO in macrophages and tumor tissue for MPI lymph node imaging in breast cancer. *Intern. J. Magnetic Particle Imaging*, 2(2):1702001, 2017. doi:10.18416/ijmpi.2017.1702001.

10.18416/ijmpi.2017.1703000