Data analysis for mass spectrometry imaging : methods and applications

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It was Monday, $2nd$ of July 2012, when I first arrived to the Netherlands to start my PhD journey at the division of image processing (LKEB), Leiden University Medical Center (LUMC). Looking back over those past few years, I can tell that I learned a lot – gained scientific knowledge and experiences that widened my perspectives. I have had the privilege to not only conduct my research in a vibrant, diverse, and multidisciplinary scientific environment but also be surrounded by great, friendly, and scientifically-enthusiastic people without whom this book would not have been completed in the present form. Therefore, I would like to explicitly express my thanks and deep appreciation to few people who were part of this journey.

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Walid M. Abdelmoula
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CURRICULUM VITÆ

Walid M. Abdelmoula was born on the 2^{nd} of June 1987 in Fayoum, Egypt. In May 2009, Walid obtained his Bachelor's degree with distinction in Systems and Biomedical Engineering from Cairo University. In October 2009, Walid received a fellowship to pursue his Master's studies at the school of Communication and Information Technology at Nile University, Egypt. During that time, Walid joined the Medical Imaging and Image Processing laboratory at Nile University as a research assistant, where he worked on retinal image analysis. In October 2011, Walid received his Master's degree in Communication and Information Technology with a thesis entitled "Segmentation of Choroidal Neovascularization in Fundus Fluorescein Angiograms". Directly after his graduation, Walid joined the Ubiquitous & Visual Computing group at the Nile University as a senior research assistant to work on developing image processing algorithms for unmanned aerial vehicles.

In July 2012, Walid started his PhD research at the Division of Image processing (LKEB), Leiden University Medical Center, the Netherlands. His PhD research was on developing computational methods to intrgrate and analyze multi-modal and multi-scale biomedical imaging data, mainly: mass spectrometry imaging and optical microscopy data. His developements have been used in some pre-clinical applications, for example: i) to identify molecular biomarkers associated with neurological disorders (such as cortical spreading depression and Stork) , and ii) in cancer research to reveal the intra-tumor heterogeneity on the molecular level.

Since July 2016, Walid works as a post-doctoral researcher at the LKEB. Walid currently works on developing methods to reconstruct, visualze and analyze big-data of 3D spatially-mapped omics. Aiming at identifying molecular patterns that are expected to provide deep insights about pathophysiological molecular mechanisms in some disease models.

List of Publications

i. **Walid M. Abdelmoula**, Benjamin Balluff, Sonja Englert, Jouke Dijkstra, Marcel J.T. Reinders, Axel Walch, Liam A. McDonnell, and Boudewijn P.F. Lelieveldt, "Data Driven Identification of Prognostic Tumor Subpopulations Using Spatially Mapped t-SNE of Mass Spectrometry Imaging Data," PNAS, vol. 113, no. 43, pp. 12244-12249, 2016.

ii. **W. M. Abdelmoula**, R. J. Carreira, R. Shyti, B. Balluff, R. J. van Zeijl, E. A. Tolner, B. F.Lelieveldt, A. M. van denMaagdenberg, L. A.McDonnell, and J.Dijkstra, "Automatic registration of mass spectrometry imaging data sets to the Allen brain atlas," Anal Chem, vol. 86, no. 8, pp. 3947–3954, 2014.

iii. **W. M. Abdelmoula**, K. Skraskova, B. Balluff, R. J. Carreira, E. A. Tolner, B. P. Lelieveldt,L. van der Maaten, H. Morreau, A. M. van den Maagdenberg, R. M. Heeren, L. A. McDonnell, and J. Dijkstra, "Automatic generic registration of mass spectrometry imaging data to histology using nonlinear stochastic embedding," Anal Chem, vol. 86, no. 18, pp. 9204–9211, 2014.

iv. **W. M. Abdelmoula**, B. Heijs, S. Lou, I. H. Briaire-de Bruijn, J. Dijkstra, J. V. M. G. Bovée, and L. A. McDonnell, "Histology-Guided High-Resolution Matrix-Assisted Laser Desorption Ionization Mass Spectrometry Imaging," Anal Chem, vol. 87, no. 24, pp. 11978–11983, 2015.

v. **W. M. Abdelmoula**, S. M. Shah, and A. S. Fahmy, "Segmentation of choroidal neovascularization in fundus fluorescein angiograms.," IEEE transactions on biomedical engineering, vol. 60, no. 5, pp. 1439–45, 2013.

vi. K. Skraskova, A. Khmelinskii, **W. M. Abdelmoula**, S. De Munter, M. Baes, L. McDonnell, J. Dijkstra, and R. M. Heeren, "Precise Anatomic Localization of Accumulated Lipids in Mfp2 Deficient Murine Brains Through Automated Registration of SIMS Images to the Allen Brain Atlas," J AmSocMass Spectrom, vol. 26, no. 6, pp. 948-957, 2015.

vii. R. J. Carreira, R. Shyti, B. Balluff, **W. M. Abdelmoula**, S. H. van Heiningen, R. J. van Zeijl, J. Dijkstra, M. D. Ferrari, E. A. Tolner, L. A. McDonnell, and A. M. van den Maagdenberg, "Large-Scale Mass Spectrometry Imaging Investigation of Consequences of Cortical Spreading Depression in a Transgenic Mouse Model of Migraine," J AmSocMass Spectrom, vol. 26, no. 6, pp. 853-861, 2015.

viii. M. Aswendt, Martin Schwarz, **W. M. Abdelmoula**, Jouke Dijkstra, and Stefanie Dedeurwaerdere, "Whole-Brain Microscopy Meets In Vivo Neuroimaging: Techniques, Benefits, and Limitations," Molecular Imaging and Biology, 2016.