



# Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization

ISSN: 2168-1163 (Print) 2168-1171 (Online) Journal homepage: <http://www.tandfonline.com/loi/tciv20>

## 1st MICCAI workshop on deep learning in medical image analysis

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To cite this article: Gustavo Carneiro, João Manuel R. S. Tavares, Andrew P. Bradley, João Paulo Papa, Jacinto C. Nascimento, Jaime S. Cardoso, Zhi Lu & Vasileios Belagiannis (2018) 1st MICCAI workshop on deep learning in medical image analysis, Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization, 6:3, 241-242, DOI: [10.1080/21681163.2018.1457242](https://doi.org/10.1080/21681163.2018.1457242)

To link to this article: <https://doi.org/10.1080/21681163.2018.1457242>



Published online: 05 Apr 2018.



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EDITORIAL



## 1st MICCAI workshop on deep learning in medical image analysis

Deep learning methods are quickly receiving a great deal of attention by the machine learning and computer vision communities for several reasons, such as the facility of deep learning algorithms to produce effective features, to transfer learned features between different databases, to analyse multimodal data. Additionally, deep learning has produced promising results outperforming some state-of-the-art approaches for a couple of problems, such as face detection and recognition, speech recognition and image classification. Given these advantages, it is expected that these algorithms can have a large impact on medical image analysis applications, such as computer-aided diagnosis, image segmentation, image annotation and retrieval, image registration and multimodal image analysis. However, only a few works have used deep learning methods in the context of medical-oriented applications, such as breast cancer and skin lesion detection, organs recognition and image-based disease identification.

Additionally, there is a little effort on model selection of deep learning techniques, which poses an interesting problem, since we may face hundreds of parameters, being a near-exhaustive search on this high-dimensional search space impractical. The problem gets worse in large image-based data-sets, which have been commonly used in several recent papers. Given the large amount of parameters, some authors have argued that a random search may perform well for some applications. However, a hand tuning of the parameters may limit our understanding about how well the techniques can generalise and describe data.

'Deep Learning in Medical Image Analysis (DLMIA): From Random Search to Optimization Heuristics' is the first workshop organised under the auspicious of the *International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)* dedicated to the presentation of works focused on the design and use of deep learning methods in medical image analysis applications. Another important objective of the workshop is to increase the connection between software developers, specialist researchers and applied end-users from diverse fields related to Medical Image and Signal Processing, which are the main scope of *MICCAI*.


The first edition of the workshop was held in *MICCAI 2015* from October 5 to 9, Munich, Germany, and received more than 30 submissions that were reviewed by at least 4 reviewers. Based on the scores and comments made by the reviewers, 10 submissions were accepted. The submissions with the best top four reviews were selected for oral presentations and the remaining six as poster presentations. Finally, the Workshop Chairs voted for the best contribution based on the Reviewers' scores and

comments, and the best paper prize of *DLMIA 2015* went to *Siqi Bao and Albert Chung* for the contribution entitled 'Multi-scale Structured CNN with Label Consistency for Brain MR Image Segmentation'.

This special issue of the journal *Computer Methods in Biomechanics and Biomedical Engineering: Imaging & Visualization* contains the final manuscripts of the 10 contributions presented at *DLMIA 2015*, which were reviewed according to the journal policy. The included manuscripts present and discuss methods, techniques, challenges and new trends related to Deep Learning in Medical Imaging Analysis: (1) *Gao et al.* propose a method to classify interstitial lung diseases imaging patterns on CT images (article in Volume 6, Issue 1); (2) a novel method for brain MR image segmentation is suggested by *Bao and Chung* (article in Volume 6, Issue 1); (3) *Dubrovina and co-authors* propose a supervised deep learning-based framework for region classification in mammography images; (4) *Cheng and collaborators* suggest a deep similarity learning method that trains a binary classifier to learn the correspondence of two image patches; (5) *Barbu et al.* compare four different loss functions for deep convolutional neural networks in the context of computer-aided abdominal and mediastinal lymph node detection and diagnosis using CT images; (6) the feasibility of detecting pathology in chest X-rays using deep learning approaches based on non-medical learning is study by *Bar and co-workers*; (7) *Achilles and collaborators* address the use of convolutional neural networks for epileptic seizure detection in real time; (8) *Janowczyk and co-workers* suggest a resolution adaptive deep hierarchical learning scheme for nuclear segmentation of digital pathology images; (9) an automatic framework for kidney segmentation with convolutional networks in contrast-enhanced CT scans is proposed by *Thong and collaborators*; and finally, (10) *Xie et al.* suggest fully convolutional regression networks for microscopy cell counting and detection.

The Guest-Editors wish to thank all the *DLMIA 2015* Authors and members of the Program Committee for sharing their expertise, *The MICCAI Society* for having hosted and supported the workshop within *MICCAI 2015* and also to the *CMBBE: Imaging & Visualization Editors and Reviewers* for helping improving the manuscripts accepted.


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