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Brainlesion: Glioma, Multiple Sclerosis, Stroke and Traumatic Brain Injuries

4th International Workshop, BrainLes 2018
Held in Conjunction with MICCAI 2018
Granada, Spain, September 16, 2018
Revised Selected Papers
Part II

Springer

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Preface

This volume contains articles from the Brain-Lesion Workshop (BrainLes), as well as the (a) International Multimodal Brain Tumor Segmentation (BraTS) challenge, (b) Ischemic Stroke Lesion Segmentation (ISLES) challenge, (c) grand challenge on MR Brain Image Segmentation (MRBrainS18), (d) Computational Precision Medicine (CPM) challenges, and (e) Stroke Workshop on Imaging and Treatment Challenges (SWITCH). All these events were held in conjunction with the Medical Image Computing for Computer Assisted Intervention (MICCAI) conference during September 16–20, 2018, in Granada, Spain.

The papers presented describe research of computational scientists and clinical researchers working on glioma, multiple sclerosis, cerebral stroke, traumatic brain injuries, and white matter hyper-intensities of presumed vascular origin. This compilation does not claim to provide a comprehensive understanding from all points of view; however, the authors present their latest advances in segmentation, disease prognosis, and other applications to the clinical context.

The volume is divided into seven parts: The first part comprises three invited papers summarizing the presentations of the keynote speakers; the second includes the paper submissions to the BrainLes workshop; the third through the seventh parts contain a selection of papers presenting methods that participated at the 2018 challenges of ISLES, MRBrainS, CPM, SWITCH, and BraTS, respectively.

The first chapter in these proceedings describes invited papers from the four keynote speakers of the MICCAI BrainLes 2018 workshop (www.brainlesion-workshop.org). The overarching aim of these papers is to give an updated review of the work done in (a) the domain of machine learning applied in neuro-oncology diagnostics, (b) connectomics of traumatic brain injury and brain tumors, (c) computational/memory considerations for deep learning in medical image analysis, and (d) computed tomography perfusion. The sequence of these papers reflects the order that they were presented during the workshop.

The aim of the second chapter, focusing on the BrainLes workshop submissions, is to provide an overview of new advances in medical image analysis in all of the aforementioned brain pathologies. Bringing together researchers from the medical image analysis domain, neurologists, and radiologists working on at least one of these diseases. The aim is to consider neuroimaging biomarkers used for one disease applied to the other diseases. This session did not have a specific dataset to be used.

The third chapter contains descriptions of a selection of algorithms that participated in the ISLES 2018 challenge. The purpose of this challenge was to directly compare methods for the automatic prediction of stroke lesion outcome from CT-perfusion imaging. A dataset consisting of CT-perfusion image volumes acquired at acute and 3-month follow-up was released for training. A dedicated test set of cases was used for evaluation. Test data were not released, but participants had to submit their segmentation results to: www.isles-challenge.org.

The fourth chapter includes a number of papers from MRBrainS 2018. The purpose of this challenge is to directly compare methods for segmentation of gray matter, white matter, cerebrospinal fluid, and other structures on 3T MRI scans of the brain, and to assess the effect of (large) pathologies on segmentation and volumetry. Over 30 teams participated and the challenge remains open for future submissions. An up-to-date ranking is hosted on: http://mrbrains18.isi.uu.nl/.

The fifth chapter presents a selection of papers from the leading participants in the two CPM 2018 challenges in brain tumors (http://miccai.cloudapp.net/competitions/). The "Combined MRI and Pathology Brain Tumor Classification" challenge used corresponding imaging and pathology data with the task of classifying a cohort of "low-grade" glioma tumors (n = 52) into two sub-types of oligodendroglioma and astrocytoma. This challenge presented a new paradigm in algorithmic challenges, where data and analytical tasks related to the management of brain tumors were combined to arrive at a more accurate tumor classification. In the challenge of "Segmentation of Nuclei in Digital Pathology," participants were asked to detect and segment all nuclei in a set of image tiles (n = 33) of glioblastoma and lower-grade glioma extracted from whole slide tissue images. Data from both challenges were obtained from The Cancer Genome Atlas/The Cancer Imaging Archive (TCGA/TCGA) repository.

Finally, the sixth chapter of these proceedings contains scientific contributions of the SWITCH workshop, which aims to bring together clinicians and medical imaging experts to discuss challenges and opportunities for medical imaging in stroke care and treatment. In 2018, three clinical keynote speakers addressed various aspects of stroke and ischemic stroke treatment: Prof. Aad van der Lugt discussed imaging biomarkers related to stroke, Prof. Matt Gounis shared his research on the development for stroke devices, and Prof. Roland Wiest presented stroke mimics and chameleons. The scientific contributions of the medical imaging field, addressing topics such as perfusion parameter estimation and the relation between diffusion MRI and microstructural changes in gray matter, were presented at the workshop in oral and poster presentations. All accepted full paper contributions are part of these proceedings.

The seventh chapter focuses on a selection of papers from the BraTS challenge participants. BraTS 2018 made publicly available a large (n = 542) manually annotated dataset of pre-operative brain tumor scans from 19 institutions, in order to gauge the current state-of-the-art in automated glioma segmentation using multi-parametric structural MRI modalities and to compare fairly between different methods. To pinpoint and evaluate the clinical relevance of tumor segmentation, BraTS 2018 also included the prediction of patient overall survival, via integrative analyses of radiomic features and machine learning algorithms (www.cbica.upenn.edu/BraTS2018.html).

We heartily hope that this volume will promote further exciting research on brain lesions.

December 2018

Alessandro Crimi
Spyridon Bakas

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Ischemic Stroke Lesion Segmentation (ISLES) Challenge

Søren Christensen	Stanford University, USA
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Maarten G. Lansberg	Stanford University, USA
Mauricio Reyes	University of Bern, Switzerland
David Robben	KU Leuven, Belgium
Roland Wiest	Inselspital Bern, Switzerland
Stefan Winzeck	University of Cambridge, UK
Greg Zaharchuk	Stanford University, USA

Grand Challenge on MR Brain Segmentation 2018 (MRBrainS18)

Edwin Bennink	University Medical Center Utrecht, The Netherlands
Hugo Kuijf	University Medical Center Utrecht, The Netherlands

Stroke Workshop on Imaging and Treatment Challenges (SWITCH)

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