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OR 2.0 Context-Aware Operating Theaters and Machine Learning in Clinical Neuroimaging

Second International Workshop, OR 2.0 2019
and Second International Workshop, MLCN 2019
Held in Conjunction with MICCAI 2019
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Proceedings

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OR 2.0 2019 Preface

Surgical robotic tools and digitally enhanced operating theaters have been giving surgeons a helping hand for years. While they provide great control, precision, and flexibility to the surgeons, they do not yet address the cognitive assistance needs in the operating theater. We are on the verge of a new wave of innovations of artificial-intelligence-powered, context-aware operating theaters. We envision future operating theaters that are holistic and seamlessly integrated in the surgery process. They will monitor their environment by gathering multi-modal data from sources such as cameras, sensors, monitoring devices, patient profile and history, and they will respond accordingly. Although this could be realized by following pre-established rules, a better and more holistic way would be to develop context-aware systems that are able to perceive and reason, make sense of ongoing processes, project outcomes of a number of possible actions that could be taken within this context, provide quantitative support to aid the decision making process, evaluate the outcomes of the action taken, and use this information for the next steps. Advances in context-awareness can answer these needs and complement the surgical team by assisting the surgical procedures, providing real-time guidance during complex tasks and unexpected events.

This workshop aims to highlight the potential use of, with a particular focus but not limited to, machine vision and perception, robotics, surgical simulation and modeling, multi-modal data fusion and visualization, image analysis, advanced imaging, advanced display technologies, human-computer interfaces, sensors, wearable and implantable electronics and robots, visual attention models, cognitive models, decision support networks to enhance surgical procedural assistance, context-awareness and team communication in the operating theater, human-robot collaborative systems, and surgical training and assessment.

OR 2.0 2019 was the Second International Workshop on Context-Aware Surgical Theaters, organized as a satellite event of the Medical Image Computing and Computer Assisted Intervention (MICCAI 2019) conference in Shenzhen, China. The first International OR 2.0 Context-Aware Operating Theaters Workshop was held in September 2018, in Granada, Spain in conjunction with MICCAI 2018. As we received quite positive feedback from our participants, especially from early career researchers both from academia and industry, and we also received submissions from research labs all over the world, we decided to organize a second workshop. Our workshop is highly correlated with MICCAI 2019's focus on implementation of, and training for, computer-assisted intervention approaches. This year, we expanded our board with an Industrial Board from various companies that work on related topics. We also introduced bench to OR awards along with our best paper awards, which are given to works that bring novel concepts to operating theaters that will increase context-awareness, and have potential to be easily translated into clinical applications. With our workshop, we aim to define the future technologies of the operating theater.

We wish to thank all the OR 2.0 2019 authors for their participation and our board for their feedback and commitment to the workshop. We are very grateful to our sponsor Intuitive Surgery for their support since the beginning of our workshop series.

The proceedings of the workshop are published as a joint LNCS volume of satellite events organized in conjunction with MICCAI 2019. The OR 2.0 2019 proceedings contain six high-quality papers that were selected through a double-blind peer-review process. All submissions were peer reviewed by at least three reviewers who are experts on related topics. Awards were based on the nominations made by the reviewers, and the votes of the Industrial Board. In addition to the papers presented in this LNCS volume, the workshop featured three keynote talks from Dr. Qi Dou (Imperial College London, UK), Dr. Murilo M. Marinho (University of Tokyo, Japan), and Dr. Guangzhi Wang (Tsinghua University, China), who also served as the vice president of the Chinese Society of Biomedical Engineering and the Chinese Association of Medical Imaging Technology.

This volume features accepted papers on topics of a laparoscopic scene segmentation model with modified Xception as encoder, and a decoder for feature aggregation, an automatic trajectory planning method for endovascular procedures using shape regularized U-Net and statistical optimization, a surgical image desmoking method that does not require the use of synthetic data generation, and utilizes cycle-GAN and atrous convolutions, an unsupervised temporal video segmentation method as an auxiliary task to improve the performance of remaining surgery duration prediction, an end-to-end deep learning pipeline for multi-spectral image analysis to obtain intra-operative functional information in real-time, and cyber-physical system concepts for the intelligent operating theater. More details on our workshop program are available on our website: <https://or20.univ-rennes1.fr/>.

October 2019

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MLCN 2019 Preface

Recent advances in neuroimaging and machine learning provide an exceptional opportunity for researchers to discover complex relationships between the brain, behaviors, and mental disorders. Neuroimaging techniques such as structural and functional magnetic resonance imaging (s/fMRI) can measure non-invasively the morphology as well as the resting state or task-induced neural correlates from different brain regions in a limited period. While classical univariate statistics are unable to exploit complex multivariate patterns in neuroimaging data, advanced machine learning approaches can be employed to benefit from this wealth of information to provide a deeper understanding of the underlying neurobiological mechanisms and improve clinical decision making. Although machine learning techniques were first successfully applied to clinical neuroimaging data a decade ago, to date, there has been limited translation to the clinic. Reasons for this include the lack of available labeled clinical data, a reduction in quality for clinical imaging set-ups, and a lack of harmonization for related clinical data sets acquired from different sites.

The Second International Workshop on Machine Learning in Clinical Neuroimaging (MLCN 2019) was held in conjunction with MICCAI 2019, with a special focus on addressing the problems of applying machine learning to large and multi-site clinical neuroimaging datasets. The workshop aimed to bring together experts in both machine learning and clinical neuroimaging to discuss and hopefully bridge the existing challenges of applied machine learning in clinical neuroscience.

The call for papers for the MLCN 2019 workshop was released on April 14, 2019, with the manuscript submission deadline set to July 14, 2019. The received manuscripts went through a double-blind review process by MLCN 2019 Program Committee members. Each paper was thoroughly reviewed by at least four reviewers and the top six papers were qualified for publication. The accepted contributions addressed the application of machine learning to generally small sample size neuroimaging data through novel methodologies for data harmonization and transfer learning.

In the end, we would like to thank the MLCN 2019 Steering Committee for their enlightening guidance in organizing this event. We wish to also thank all authors for their valuable contributions and the MLCN 2019 Program Committee for their precious effort in evaluating the submissions.

October 2019

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