Visual Computing Magazine

The Foreword

Welcome to the third issue of Visual Computing Magazine. In this issue, we are delighted to present two invited papers related to medical imaging.

Medical imaging, until 10 years ago, was a field in which smart researchers and engineers developed a multitude of advanced methods for automatic segmentation and registration of medical images. Examples of these approaches are levelsets and graph cuts for segmentation, diffusion algorithms for image enhancement, active shape and appearance models to integrate population statistics in segmentation approaches, and a large variety of registration approaches, where optimizers, cost functions and transformation models have been investigated. This has changed dramatically the last decade, because of the introduction of AI in medical imaging. The introduction of U-Net to the field, at MICCAI 2015 in Munich, can be seen as the start of this change. Since then, the AI started to take off, with more than 70 % of deep learning papers already at MICCAI 2018. The good thing about this change is that the field now has much more effective tools to address the imaging challenges at hand. An example here is nnU-net (Isensee et al.), which now allows even non-imaging specialists to create effective segmentation approaches, provided that good training data can be constructed. The implication for the medical imaging field is that we can focus on more complex challenges. In addition, there is more potential of bringing effective approaches to clinical translation. The mitosis detection in breast cancer is a good example of the possibilities of the opportunities that this paradigm shift has brought us.

In surgical navigation, a similar trend, though not as profound, can be witnessed. Navigation approaches have become standard for e.g., neurosurgical and orthopedic procedures. During the navigation, pre-operative imaging and planning is aligned with the patient, and subsequently the instruments can be visualized, together with planning and pre-operative imaging, on a 2D screen. These approaches allow surgeons to do advanced procedures, that may not be possible using eye-sight only. Whereas powerful, the application of these systems still is hampered by the advanced technology required, the cumbersome step of aligning the images, and the 2D visualization which is not always aligned with the surgeon's view on the patient. The introduction of see-through augmented reality devices, such as HoloLens 1 and 2 and Magic Leap, has started several groups to investigate approaches to integrate the augmented reality in navigation, or even using such devices for stand-alone navigation, and using the sensors of these devices to simplify image-to-patient registration. These approaches are not as sophisticated as their AI counterparts yet, it is however expected that the further introduction of augmented reality in surgical navigation may improve both the usability of current navigation approaches, and enable navigation in procedures that are now done without navigation. The manuscript on AR for Medical Imaging is a thorough introduction to the techniques that are involved in this transition.

Dr. Ir. Theo Van Walsum
Principal Investigator
Department Radiology & Nuclear Medicine
Erasmus MC, University Rotterdam, the Netherlands

Visual Computing: A quarterly magazine. Volume 1, Issue 3, 2023
***ISSN:* 2830-9820**
Chief Editor: Prof. Slimane LARABI