Guest Editorial

Introduction

Welcome to this special issue of Computer Aided Surgery, which contains expanded versions of papers presented at the 2005 International Society for Computer Aided Surgery (ISCAS) meeting, held in Berlin as part of the Computer Assisted Radiology and Surgery (CARS) conference. The six papers selected (five in this issue and one in the next) focus on the use of technology that may improve the outcomes of minimally invasive interventions. In this editorial, we will describe the ISCAS/CARS meeting and the papers in this special issue.

The International Society for Computer Aided Surgery (ISCAS) and the Computer Assisted Radiology and Surgery (CARS) Meeting

The International Society for Computer Aided Surgery (ISCAS) is a non-profit organization whose mission is to encourage the scientific and clinical advancement of computer aided surgery and related medical interventions throughout the world. The goals of ISCAS include: 1) promoting basic technical and clinical research; 2) supporting evaluation and validation studies of technological advances; and 3) considering ethical and societal aspects of these developments. ISCAS strives to bridge the gap between scientific and clinical disciplines through congresses, symposia, seminars, and other meetings. The scope of ISCAS encompasses all fields within surgery, including biomedical imaging and instrumentation, and digital technology employed to facilitate imaging in diagnosis, therapy, and surgery.

The Computer Assisted Radiology and Surgery (CARS) conference is one of the key meetings in this field and strives to bring together both the scientific and clinical community. The conference includes several tracks, including the ISCAS meeting. CARS 2005 was the 20th anniversary meeting of the conference. It was also the ninth ISCAS meeting. Over the last several years, the conference has attracted between 1,000 and 1,400 participants, and has a strong international emphasis, with over 45 countries represented and program committee members from Europe, the United States, and Asia.

From the 525 submissions to CARS 2005 in Berlin, approximately 230 oral presentations and 150 posters were accepted. For the ISCAS meeting, there were 72 oral presentations and 47 posters. From the oral presentations, about 20 were recommended as possible candidates for this special issue and six of those were selected. Because of space limitations, five papers are published in this issue and one paper will be published in the next issue.

Contents of this issue

The papers selected for this issue demonstrate how the state of the art has advanced over the nine years that the ISCAS conference has been held. Whereas papers in the early years of the ISCAS conference often focused mostly on technical developments, the papers presented here all have a strong clinical focus, indicating advancements in the field. All papers include both scientific and clinical authors, another good example of the collaboration that characterizes the ISCAS meeting. Additionally, all papers include evaluation studies, either in organ model physical phantoms (Deguchi et al., Mularski et al.), system model physical phantoms (Zhang et al.), animal trials (Zhang et al.), or even clinical trials (Borgert et al., Koulechov et al.). Four of the six papers incorporate electromagnetic tracking of the anatomy, showing the potential of this technology for minimally invasive procedures.

The first paper by Deguchi et al. describes a method for bronchoscope tracking using an electromagnetic position sensor and image registration. The combination of these two techniques provides accurate guidance in real time. Experimental results using a rubber phantom model showed a tracking rate of 2.5 frames per second. The second paper by Borgert et al. uses the same electromagnetic tracking system to investigate respiratory motion compensation during biopsy procedures. Position data from two electromagnetically tracked sensors, one on the patient’s sternum and one incorporated into a biopsy needle, were used to derive an affine motion model between internal and external anatomy. The third paper by Zhang et al. continues the electromagnetic tracking theme, and reports on the development of an image-guided system for abdominal interventions. Three registration techniques are presented
along with a prototype navigation system which has been evaluated in phantom and swine animal studies. The fourth paper by Mularski et al. examines tracking of vertebral body movement using implantable, electromagnetically tracked sensors. Root mean square registration errors in the range of 0.57 to 1.2 mm were reported along with positioning errors of 1.3 mm and 2.5 degrees in angulation. The fifth paper by Koulechov et al. describes the concept of navigated control, which originated in surgical navigation systems. The application of this technique to functional endoscopic sinus surgery is presented and the results of a clinical trial incorporating 10 patients are given. The sixth paper by Joskowicz et al., which will be published in the next issue, describes an image-guided system with a miniature parallel robot for precise positioning and automatic targeting in minimally invasive keyhole neurosurgery. The robot, which is affixed to a head clamp or directly to a patient’s skull, automatically positions a mechanical guide with respect to predefined targets in a preoperative CT/MRI image by registering an intraoperative 3D surface scan of the patient’s facial features and a registration jig. The reported in-vitro target registration error is 1.7 mm (SD = 0.7 mm).

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