In the domain of Computer-Assisted Interventions we aim to develop tools that augment and complement the physician's ability to understand the spatial relationships between anatomical structures and instruments. The key technologies facilitating development of such tools include: (1) medical imaging and image processing; (2) data visualization; (3) segmentation; (4) registration; (5) tracking; and (6) human computer interaction. In this two part talk we will touch upon several of these technologies. We will describe clinically viable interactive initialization approaches for 2D/3D (x-ray/MR, x-ray/CT) registration, and a x-ray fluoroscopy simulation system we have developed for training radiology residents.

The main challenge hindering the transition of 2D/3D registration into the operating room is the requirement for accurate initialization. We will describe a gesture based approach utilizing the Microsoft Kinect, and an augmented reality based approach utilizing a tracking system to perform registration initialization. Both approaches are based on visual assessment, with the operator positioning a volume rendering of the anatomy so that it is aligned to the intraoperative x-rays. Our methodology was evaluated using three publicly available data sets and obtained results that are sufficiently accurate (mean error <10mm), in a clinically acceptable timeframe (<3min).

The current training approach in medicine is based on the apprenticeship model, often referred to as "see one, do one, teach one". It has been shown that trainees using real-time x-ray imaging for diagnostic purposes expose patients to higher doses of radiation than experienced operators. This is of great concern in the pediatric population. We will describe a simulation system we have developed which is based on monocular tracking of markers and real time simulation of x-ray images from a spatio-temporal CT. This system was qualitatively evaluated by 11 clinicians and was found to be sufficiently realistic for training purposes.

Bio: Ziv Yaniv is a principal investigator at the Sheikh Zayed Institute for Pediatric Surgical Innovation, Children's National Hospital, Washington DC. He obtained his Ph.D. in computer science from The Hebrew University of Jerusalem, Jerusalem Israel, in 2004. He actively supports the development of open source software, and is leading the development of the free open source Image-Guided Surgery Toolkit (IGSTK) and a contributor to the Insight Registration and Segmentation toolkit (ITK). Dr. Yaniv is a member of the MICCAI society and the IEEE Engineering in Medicine and Biology and IEEE Computer societies. He has served on the program committee of several international conferences (MICCAI, IPCAI, SPIE, EMBC) and was chair of the SPIE Medical Imaging: Image-Guided Procedures, Robotic Interventions, and Modeling conference in 2013 and 2014.