

Modeling, Evaluating and Teaching Skilled Dexterity: Toward a "Language of Surgery"

Gregory D. Hager

*Computer Science Department
Johns Hopkins University, Baltimore, USA*

With the rapidly growing popularity of the Intuitive Surgical da Vinci system, robotic minimally invasive surgery (RMIS) has crossed the threshold from the laboratory to the real world. As a consequence, there is now an emerging interest in methods for evaluating and teaching RMIS surgical technique. Our group has been developing statistical methods for modeling RMIS using techniques borrowed from speech and language. We consider surgery to be composed of a set of identifiable tasks which themselves are composed of a small set of reusable motion units that we call "surgemes." We thus speak of a "Language of Surgery."

In this talk, I will describe our progress at developing techniques for recognizing surgemes in continuous motion recorded during benchtop models of RMIS tasks. We have demonstrated that it is possible to recognize surgemes reliably in a diverse corpus of user motion and video data. Further, we have begun to develop methods for comparing the performances of subjects to evaluate skill at both the task and surgeme level. In particular, we now have strong evidence suggesting that a simple notion of string distance on the output of a language model is a natural way of measuring similarity in the space of surgical skill. These models lead naturally to a set of methods for effective training of RMIS using automatically learned models of expertise, and toward methods for automating component actions in surgery.

Biography

Gregory D. Hager is a Professor of Computer Science at Johns Hopkins University. He received the BA degree, *summa cum laude*, in computer science and mathematics from Luther College in 1983, and the MS and PhD degrees in computer science from the University of Pennsylvania in 1985 and 1988, respectively. From 1988 to 1990, he was a Fulbright junior research fellow at the University of Karlsruhe and the Fraunhofer Institute IITB in Karlsruhe, Germany. From 1991 until 1999, he was with the Computer Science Department at Yale University. In 1999, he joined the Computer Science Department at Johns Hopkins University, where he is also the Deputy Director of the Center for Computer Integrated Surgical Systems and Technology. Professor Hager has authored more than 180 research articles and books in the area of robotics and computer vision. His current research interests include visual tracking, vision-based control, medical applications of vision and robotics, and human-computer interaction. In 2006, he was elected a fellow of the IEEE for his contributions in Vision-Based Robotics.