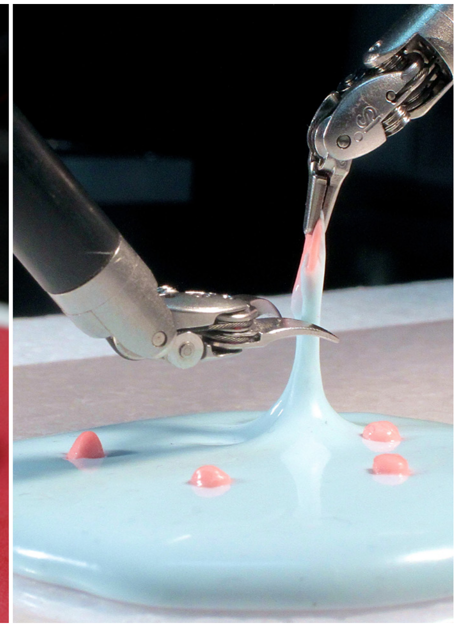
Cal-MR

CENTER FOR AUTOMATION AND LEARNING FOR MEDICAL ROBOTICS

cal-mr.berkeley.edu



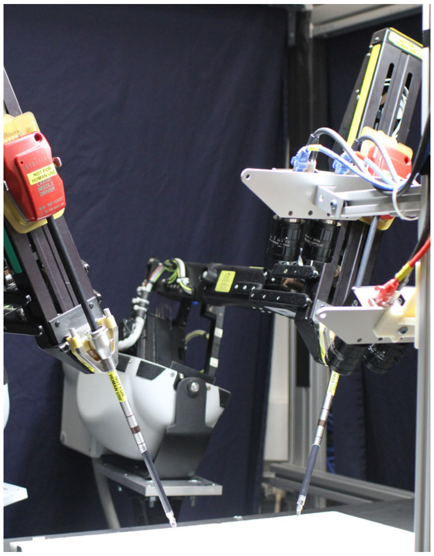
UC Berkeley's Center for Automation and Learning for Medical Robotics (Cal-MR) advances research in automation and machine learning to improve robots and devices for medicine and surgery.

Autonomous multilateral execution of surgical subtasks with the da Vinci Research Kit (DVRK).
ABOVE LEFT: Pattern cutting subtask involves cutting a specified circular pattern from a sheet of gauze.
ABOVE RIGHT: Debridement subtask involves cutting and removing target fragments embedded within a tissue phantom.

Cal-MR is co-directed by Profs. Pieter Abbeel (EECS) and Ken Goldberg (IEOR, EECS, School of Information, Art Practice at UC Berkeley, and Department of Radiation Oncology at UCSF) and Researcher Dr. Sachin Patil.

Cal-MR, established in Nov 2014, is based in the College of Engineering at UC Berkeley and is funded by a major grant from the National Science Foundation (NSF), from companies including Intuitive Surgical and Google, and from private donors. Cal-MR supports research with postdocs, grads, and undergraduate students and collaborations with leading physicians and researchers at UC San Francisco, UC Davis, UC Santa Cruz, University of Washington, Johns Hopkins, and Stanford.

One of the goals of this research center is to develop medical robots that can perform low-level and repetitive surgical tasks, freeing doctors to concentrate on the most challenging and complex aspects of the operations they perform. In May, in collaboration with surgeons at the University of California, Davis, and the Center for



ABOVE: The da Vinci Research Kit (DVRK) robotic surgical assistant

Robotic Surgery in Singapore, the researchers presented a paper detailing what they described as the first example of a robot automating surgical tasks involving soft tissue.

ROBOT-ASSISTED SURGERY

We are developing algorithms and control methods to enable the automation of surgical subtasks such as tissue debridement, cutting, and suturing. This project integrates automatic planning algorithms, learning skills from demonstrations, robot control, and human in the loop guidance. This project has the potential to improve patient health by enhancing surgeon performance, reduce tedium and thus medical errors, and reduce costs by reducing operation time. The objective is to improve speed, accuracy, and precision of existing procedures and enable new classes of surgical procedures that require dexterity and control beyond the capability of a human operator. We are evaluating our techniques on a da Vinci robot (DVRK) donated by Intuitive Surgical.

INNOVATIONS IN RADIATION ONCOLOGY

Brachytherapy is a widely-used treatment modality for fighting cancer in many parts of the body in which small radioactive sources are positioned proximal to cancerous tumors. Working with the Radiation Oncology team at UCSF, we have developed a series of dose planning algorithms and a novel method for robot-assisted insertion of "skew-line" needles. In current practice for intracavitary brachytherapy, standardized applicators with internal channels are inserted into body cavities to guide the sources. These standardized implants are prone to shifting inside the body, resulting in suboptimal dosages that might cause radiation damage to healthy organs and tissues. We are developing 3D printed customized implants (patent pending) containing customized curvature-constrained internal channels that fit securely, minimize air gaps, and precisely guide radioactive sources through printed channels and aim to significantly improve dose coverage and treatment options.

STEERABLE NEEDLES

This project encompasses a decade of pioneering research into needles that can be steered from outside the body to reach internal targets for biopsy or to deliver treatment. This work integrates adaptive modeling and planning algorithms, and real-time image-guided intraoperative control of thin, flexible needles that move through deformable tissues around critical anatomical structures to reach specified targets. This project was funded under funded under a NIH R01 EB006435 grant and the steerable needle technology has been patented (US patent no. 7,822,458) and licensed.

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