Medical Robotics

Speaker:
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Pittsburgh has undergone a sea change over the last 30 years that took it from its reputation as a dirty steel town to its current status as a hub of business and medical activity and research. One of the city's greatest assets is its universities, among them Carnegie Mellon University (CMU), a school known particularly for its work in engineering, computer science, and robotics. Representatives of those disciplines are now contributing to a number of collaborative ventures in the city, one of which is the Medical Robotics and Information Technology for Medicine and Surgery (MERITS) program, of which the Medical Robotics Technology Center (MRTC) at CMU is a part.

Jim Osborn, the executive director of both the MERITS program and the MRTC, is enthusiastic about the emerging technologies in robotics, computer vision, information technology, and bioengineering that are the foci of research at the center and about their potential implications for health care. The challenge the researchers face is the integration of the technologies with medicine and their transfer to the bedside, the surgical suite, and the home. The center is developing technologies in computer-assisted surgery, medical devices, and imaging and image analysis. To illustrate, Osborn passed around a titanium hip-joint replacement, whose computer-assisted design he said had resulted from the collaboration of engineers, surgeons, and computer scientists.

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The MRTC also participates in research in what Osborn referred to as "surgical navigation", a kind of computerized registration method of examining the body to determine precisely where a replacement part, such as a hip replacement, should be positioned. Optimal placement helps to minimize the risk of dislocation and maximizes range of motion for the patient. Computerized systems are also used in the image-guided correction of bone deformation, a process in which fixators are readjusted like braces in an iterative process that aligns bone to help it to heal properly.

The center's collaboration with surgeons has permitted CMU computer experts to participate in studies of medical informatics to answer follow-up questions about how well an operation was carried out or how accurately it matched the surgeon's original plan. Other work in two- and three-dimensional medical image correlation permits two-dimensional x-ray images to be compared with three-dimensional computed tomographic scans of the same person. Collaborative efforts now under way should result in the application of those technologies to new procedures that will be carried out on fetuses in utero to correct heart defects before birth.

Other researchers in the MERITS program are working on the fabrication of three-dimensional bone-growth matrices, implantable bone sensors that help orthopedic surgeons to determine how well a job was done and how well bone is healing; image overlays that provide "x-ray vision" for surgeons; the use of ultrasonography for surgical navigation; content-based image analysis that allows a person to match similar images to a given image; and multispectral imaging in which Papanicolaou smears are automatically analyzed to detect cancer.

Of course, no robotics laboratory would be complete without robots, and CMU has several of them. One is the "Nursebot", a personal assistant that allows people to keep living at home rather than go to assisted-living facilities.