SP5-1 TOWARD TOTALLY ENDOSCOPIC CABG

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The focus of development in endoscopic CABG over the last two years has shifted to adequate stabilization of the target site and performance of an endoscopic arterial anastomosis between the internal mammary artery and coronary artery target. Again, technological advances have ultimately resulted in the ability to perform the anastomosis both in the animal model as well as in the clinical realm. Specific enabling technology has included prominently the use of robotics for performance of the anastomosis. Stabilization of the target site has been possible using either standard heart-lung techniques on an arrested heart as well as initial performance of the asastomosis in the stabilized beating heart.

Currently, two systems are available to aid in the performance of the anastomosis. These include the Zeus system from Computer Motion and the Intuitive system from Intuitive Surgical. Both systems allow the operating surgeon to control endoscopic instruments remotely. Both systems use a computer interface to improve instrument control inside the chest cavity. The Intuitive Surgical system also incorporates additional degrees of freedom of instrumentation inside the chest cavity utilizing endo-wrist technology. This allows the surgeon to operate using multiple instrument angles.

Improved visualization systems have focused on providing the surgeon with a three dimensional view. In addition, some of the newer systems also provide superior magnification with up to 10x at a near field.

It is anticipated that additional improvement in stabilization will be realized in the next one to two years. Ultimately it is envisioned that routinely a precise coronary anastomosis will be performed on a stabilized beating heart.

The challenges continue to be stabilization of the target site, a precise anastomosis, and the ability to perform this technique on more than one target site. Currently clinical experience with endoscopic CABG has focused on revascularization of the left anterior descending coronary artery. With further evolution, it is now possible to truly expect that totally endoscopic coronary artery bypass to multiple coronary target sites will become a reality in the next few years.

SP5-2 AN OVERVIEW OF THE TELESURGICAL WORKSTATION PROJECT

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MILLIROBOTICS FOR MINIMALLY INVASIVE SURGERY

Intelligent Medical Care Delivery Systems

Decentralized Architecture Using Inter-Agent Coordination

-Permits sparser allocation of scarce resources

-May alter strategic plans after site evaluation

Emergent Behavior

-Guaranteed conflict-free medical care to all remote patients

-Dual use technology options

Human-Machine Interfaces

-Telesurgery/telemedecine allows many interactions to occur remotely

-Detailed simulation can be used to train human operators

The telesurgical workstation is a teleoperation system: our research objective is the development of improved tools for endoscopic manipulation, sensing and human interfaces for a teleoperative surgical workstation.

The surgeon is physically remote from the operation site and interacts through manipulators and video display : these tools could be used within the operating room or remotely for procedures in hazardous environments such as the spacestation, minefields, battlefields, etc.

Our telesurgical workstation will incorporate two robotic manipulators with dexterous manipulation and tactile sensing capabilities, master devices with force and tactile feedback, and improved imaging and 3D display systems, all controlled through computers.

Surgical operations are performed with minimally invasive technique: insertion of instruments and viewing equipment into the body through natural orifice or punctures created by a the surgeon. Virtual reality training simulator for minimally invasive surgery : Telesurgery techniques can be taught on a virtual reality training simulator.

SP5-3 Surgical Technology in the 21st Century

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Minimally invasive surgery is stabilizing in its clinical application, and other competing technologies are beginning to emerge. Laparoscopy, which was once considered as a major change in surgery, may actually have been a transition in the pathway to even more minimally invasive and even non- invasive surgical procedures. Newer technologies of robotics, telepresence surgery, remote manipulation and dexterity enhanced surgery, virtual reality for endoscopy and surgical simulation, and the numerous telemedicine applications may also be on the pathway to wherever the future is taking us. In addition the other components of surgery, such as pre-operative planning, interoperative navigation, and surgical education and training must not only evolve along with the technical components of the operative procedures but also integrate the entire spectrum of healthcare. In order to keep pace with the transition, it is essential to understand the fundamental concept involved in thinking in Information Age terms, rather than the traditional Industrial Age mindset. This enables entirely new capabilities in the new generation of medicine, which also includes the infrastructure of telemedicine, medical informatics, high performance computing, 3-D visualization and point of service helathcare with ubiquitous realtime access through telecommunications. These applications are mediated through the computer and information networks and as such are the essence of the paradigm shift in the field of medicine. This infrastructure supports a number of enabling technologies which will usher in and support the next generation of medical interventions. These include real-time image acquisition, point of care data acquisition, 3-D visualization, computer enhancement remote manipulation and telepresence, and distributed networking. In order to move beyond minimally invasive procedures and completely benefit from the computer aided revolution, we must take the broadest interpretation and a strategic global view where the integration of technologies results in capabilities beyond those of the individual devices. However, we must balance the technology with human compassion and empathy and with these technologies we can provide an enhanced quality of medical care for each and every patient.

SP6-1 ネットワークロボティクスの現状と将来

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バーチャルリアリティは現実のエッセンスをもった人工環境を生成するものであり，ロボティクス特にテレイグジスタンスとは表裏一体をなす．バーチャルリアリティは，アミューズメントの分野での利用が先行したが，医療分野にみられるように次第に本来の目的である実問題への適用が志向され始めている．そのような中，ネットワークとロボティクスを融合させ真の意味での人間中心のテレイグジスタンス社会を目指すアールキューブ構想が策定されている．アールキューブ（Real-time Remote Robotics：実時間遠隔制御ロボット技術）はネットワーク環境を利用したパーソナルなテレイグジスタンス社会をめざした研究開発構想とそのための基礎研究と位置づけられる．そのアールキューブの要ともいうべき「人間協調共存型ロボット」の研究開発が通産省の産業科学技術プロジェクトとして 1998 年から開始された．人間型のロボットとそれを操作するためのコックピットを開発し，それらを一種のプラットフォームとして種々の応用に利用可能とする研究開発である．情報のみが行き交う現在のネットワークを作業の伴うものとする試みともいえる．本基調講演ではテレイグジスタンス，アールキューブおよび人間型ロボットの現状と将来について概観する．