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Tele-robotic systems in medicine: Challenges and potential

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Statement of the Problem: Medical robotic systems have been employed in various fields including general surgery, neurosurgery, and orthopedics. Tele-operated robots perform diagnostic and interventional tasks utilizing wired and/or wireless communication networks. A classification into short and long-distance tele-robotic systems has been adopted, depending on the distance from which they are operated. A representative paradigm of the short-distance case is the da Vinci surgical system. An example of the long-distance tele-robotics concept is the MELODY system for tele-echography. Challenges concern the key enabling technologies involved namely robotic manipulation, telecommunications and vision systems.

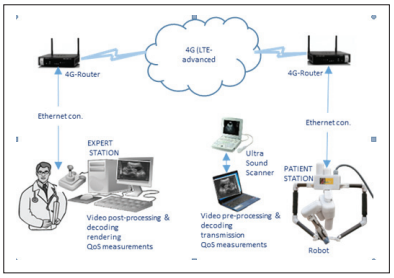

Figure-1: Structure of the tele-robotics system for ultrasonography using the MELODY system.

Methodology & Theoretical Orientation: A systematic review of existing systems identified the challenges as well as the potential of tele-robotics. Moreover, a tele-echography platform with a portable robot (MELODY system) for remote cardiac ultrasonography was set up. Different video coding standards for cardiac ultrasound applications were compared in a real-time setup using 4G wireless networks and machine-to-machine communications.

Findings: Tele-robotics has already been employed for various applications in different medical disciplines. Even though some general-purpose tele-robotic systems have been developed the majority are application/anatomy specific. Moreover, manipulation systems used for tele-robotic applications are diverse in terms of kinematic structure, degrees-of-freedom and actuation methods. Despite remarkable achievements demonstrated by many tele-robotic systems only a few of them have been commercialized and adopted in clinical practice. Also, the majority of existing systems have been short-distance ones and the potential of operating them remotely remains largely unexploited. Based on the depicted experimental setup, mobile tele-echography using commercially available Long-Term Evolution (LTE) wireless networks and state-of-the-art video compression standards provide solid foundations for adopting remote long-distance examinations in standard clinical practice.

Conclusion & Significance: Further efforts are required to address both clinical and technological challenges before the full potential of tele-robotics can be exploited. Benefits of using long-distance tele-robotics will particularly apply to rural areas, emergency incidents, military operations and in developing countries, where specialized medical personnel is not available.

Recent Publications

1. S Avgousti, et al. (2016) Cardiac ultrasonography over 4G wireless networks using a tele-operated robot. *Healthc. Technol. Lett.;* 3(3): 212-217.

Biography

Sotiris Avgousti is currently working as an instructor Nursing Department at the Cyprus University of Technology, Limassol, Cyprus. He has received his PhD in Tele-robotics Engineering from the University of Orleans, France and his MSC in Computer Networks and Data Communication from Brunel University London, UK. He has extensive research experience in the fields of data communications and telemedicine with particular emphasis on tele-echography, eHealth and mHealth, medical imaging and nursing informatics. He is registered as a Chartered Engineer (CEng) at the Engineering Council of the UK and he is a Member of the Institution of Engineering and Technology, UK.

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