Method and system for force estimation in utilizing minimally invasive robotic surgery system

Description

The present invention concerns the field of robotically assisted Minimally Invasive Surgery (MIS) and, more precisely, the real-time estimation of contact forces at the tip of a surgical instrument and at the access port of the instrument in the patient body.
Accurate force feedback is considered as a crucial feature to ensure operation safety and improve the quality of procedure carried out by robotically assisted MIS systems. For instance, force sensing allows the palpation of organs and tissues, highly desirable in diagnostic procedures and for identifying critical areas. The current marketed robotic systems for MIS do not offer a true tactile force feedback.
The innovative system presented here allows discriminating the contact forces at the instrument tip and at the insertion point. It comprises a robot manipulator that has an effector unit equipped with a six-degree-of-freedom (6-DOF) force/torque sensor and a minimally invasive instrument mounted thereto (whose second end is located beyond by an external fulcrum, which limits the instrument motion and is located within an access port installed at an incision in the body of a patient). By means of the 6-DOF force/torque sensor and the principle of superposition, it is possible to calculate the forces exerted onto the second end of the instrument. The system is endowed with a programmable computing device aiming at determining the instrument position, processing the measurements and calculating force estimate. Measurement precision is ensured by a proper signal filtering technique that couples noise reduction with fast processing time (required for real-time applications).

Innovative aspects and main advantages

➢ Estimation of forces at the instrument tip using a sensor installed at the manipulator wrist;

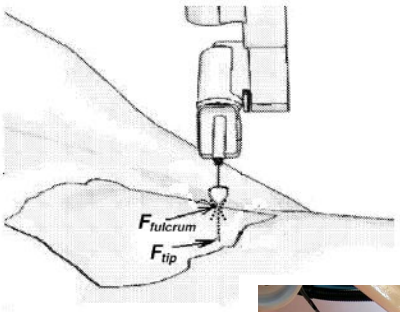
➢ Tactile sensing, allowing the surgeon operating the robot at a remote console to "feel" the forces at the instrument tip ("force-feedback")

➢ High precision in measuring force exerted onto the instrument tip, thanks to a signal filtering technique.

Areas of application

➢ Minimally invasive surgery (MIS) applications

➢ Non-medical robotic systems applications



Stages of development

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Technology licensed.

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