

Development of an Endoscope Manipulator System for Laparoscopic Surgery

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We have developed an endoscope manipulator system for laparoscopic surgery to hold and position the endoscope in the place of a camera assistant. In this paper we will describe our newly-developed prototype system.

The surgeon performs the operation through small holes using long instruments and observing the internal anatomy with an endoscopic camera. The endoscope is conventionally held by a camera assistant since the surgeon must perform the operation using both hands. However it is difficult for the assistant to hold the endoscope steadily, keeping the scene upright and it's also difficult for a beginner assistant to aim the endoscope at the spot the surgeon wants to see. So we have developed a robotic assistant to solve this problem.

Then we propose a simple manipulator system: it is small, has minimum degrees of freedom and exerts low power. Redundant degrees of freedom and high power would increase the potentiality to injure patients or surgeons. A large manipulator is not appropriate to cooperate with surgeon because it would take the space near patient where the surgeon should perform operation.

Our manipulator has two degrees of freedom for panning the camera up/down, left/right. A parallel-linkage mechanism is employed in order to turn the endoscope around the entrance of abdominal wall. A zooming attachment is used to avoid dangerous in and out movements. This manipulator is wire-driven, what reduces the size of the endoscope holder. The endoscope holder is only part of the system that is placed near the patient and manipulates the endoscope and can be sterilized with EOG.

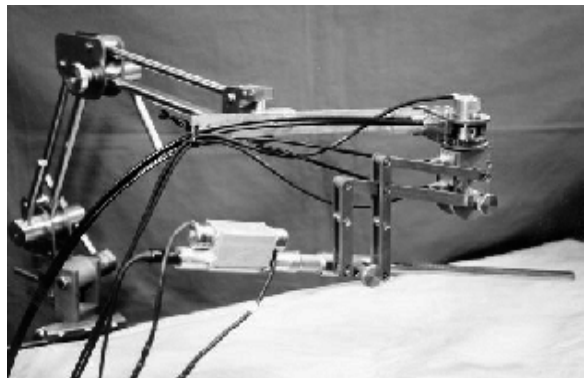


Fig. 1 Endoscope manipulator, endoscope, zooming attachment and manipulator holding arm

A voice command interface was implemented. Voice command was elected because it provides a very natural human interface. Simple motion commands like "right" or "left" are available. The system superposes a grid on the image of the monitor. Each grid point has a code like "A-1" which is displayed with the grid. Then voice-commands can use these codes to move the center of the image to the corresponding grid point. The use of this grid is straightforward since the surgeon just needs to say the code nearest to the point he wants to see. Another set of commands is used to aim the camera at memorized position.