Robotic patient simulator for medical skills training

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Abstract—Simulation medical training is one of the most popular training methods of clinical skills. Conventional simulators have many limitations such as lack of quantitative feedback and poor variety of training scenarios. We have then developed the suture evaluation simulator and humanoid for airway management training.

I. INTRODUCTION

Simulation medical training is one of the most popular training methods of clinical skills. Many kinds of clinical skills, such as suturing, venepuncture, laparoscopic surgery, or airway management, have been trained using simulators nowadays. Many simulators have been developed and used in these trainings. However, conventional simulators have many limitations such as lack of quantitative feedback and poor variety of training scenarios. Thus, we started development of novel patient simulators using RT (Robot Technology). We have then developed the suture evaluation simulator and humanoid for airway management training. Our robotic simulators have several sensors and provide scores for trainee’s skills. In addition, these simulators provide functions to simulate not only one specific patient but also patients with different anatomical features.

II. SUTURE EVALUATION SIMULATOR [1]

The suture evaluation simulator was designed for trainings of medical students and young surgeons. A camera and force sensors are implemented into the simulator. When a trainee makes sutures on the simulator, applied forces are measured during suturing. Wound condition after suturing is also measured. The simulator then calculates performance score for suturing as feedback to the trainee.

![Fig. 1 Suture evaluation simulator on a parallel manipulator](image)

A parallel manipulator to simulate organs motion was also developed for scenario training. It is designed to make the suture evaluation simulator represent respiratory or beating motion (Fig. 1). This function is useful for scenario based training.

III. HUMANOID FOR AIRWAY MANAGEMENT TRAINING [2]

The humanoid for airway management training was designed for trainings of intubation which is routinely conducted in department of anesthesiology and emergency medicine. Force sensors are implemented into the simulator. When a trainee performs intubation, applied forces on the teeth, TMJ, neck and tongue are measured. The simulator then calculates performance score for intubation according to measured values as feedback to the trainee.

In addition, this simulator changes its anatomical features driving actuators which are implemented into the TMJ and neck joint. Impedance control is implemented to change stiffness of each joint. Using this function, the simulator represents patient with lock jaw, small jaw, large jaw and lock neck which affects difficulties of intubation.

![Fig. 2 Humanoid for airway management training](image)

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