A Master Slave Tele-operated Surgical Robotic System for Robotic Surgery Training

IITM Technology Available for Licensing

Problem Statement

- There are many limitations of **manual laparoscopic surgery** such as limited dexterity of movement, limited field of view, fatigue of surgeon during extended operation procedure, inversion of hand movement and lack of tremor compensation.
- Various patents and publications on **robotic training systems** are referenced to address the **limitations** of manual laparoscopic surgery.
- Robotic systems with **7 Degrees of Freedom (DOF)** are available, providing improved **dexterity and surgical outcomes**. However, these systems are **expensive** and training on them is **costly**.
- Simulation-based training platforms exist but do not fully prepare **surgeons** for **commercial robotic systems**. A seamless transition is needed between training and using actual systems.
- The instant innovation includes a **tele-operated** robotic surgical trainer of **master arm** with **6 DOF** and **strategically distributed masses** for balance, a compliant grasper mechanism, and **optimized tether guides** that aims to facilitate the training of new robotic surgeons, overcoming the **cost & skill** acquisition associated commercial systems.

Technology Category/ Market

Category: Assistive, Test Equipment & Design Manufacturing, Robotics & Automation

Industry: Medical Robotics, Robotic Surgery Training Systems, healthcare institutions, medical professionals

Applications: Surgical Training and Education, Patient-Specific Procedure Planning, Medical Device Testing, Military & Disaster Response, Robot-Assisted Surgery Development, Research & Development

Market: The global surgical robotics market was valued at **$8,705.3 M in 2022** and is anticipated to reach **$18,410.9 M by 2032**, witnessing a **CAGR of 7.78%** during the period **2022-2032**.

Intellectual Property

IITM IDF Number: 2241
Application Number: 202142041390

TRL (Technology Readiness Level)

TRL – 3; Proof of Concept

Research Lab

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Department of Engineering Design

Technology

The instant invention discloses novel systems, devices and methods of designing a **tele-operated robotic surgical system** that is aimed at training surgeons those are new to robotic surgery.

❖ Method:

A method of maintaining equilibrium in the **master arm assembly** of a surgical robotic training system comprising **(Refer FIG 1 & 2)** at least a pair of master arm assemblies, a pair of slave arm assemblies, comprising an adjustable passive arm assembly comprising a parallelogram based remote center of motion (**RCM**) module, an **L-arm** mounting the parallelogram based RCM module and a surgical tool placed in a first face of the RCM module and attached at a distal end, a central controller, and a camera arm assembly.

The method **comprising** the steps of:

a. **obtaining by the central controller a movement from the master arm thereof;**
b. **obtaining a one or more joint currents in the master arm assembly;**
c. **obtaining one or more joint positions and a grasper position in the master arm assembly;**
d. **calculating the total force on the grasper that is a function of the joint current;**
e. **calculating the imbalance force on the grasper based on the force of gravity on one or more joint positions and grasper position;**
f. **identifying that movement is unintentional when the total force on the grasper is in a range of values closer to the imbalance force on grasper or identifying that movement is intentional otherwise;**
g. **calculating the direction of motion of the grasper if the movement is intentional;**
h. **actuating the motors to assist motion of the master arm; and**
i. **actuating the joints using motor drives; and**
j. **locking joints with the motor torque if movement is unintentional.**

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Images

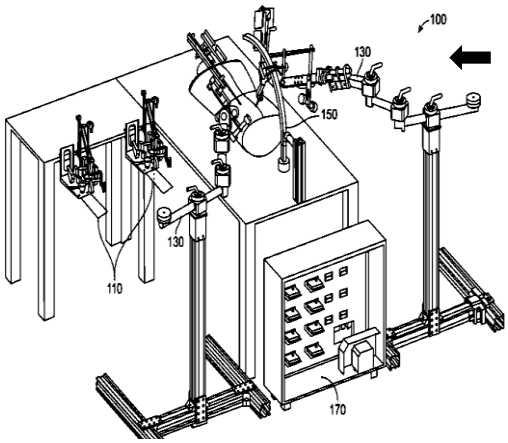
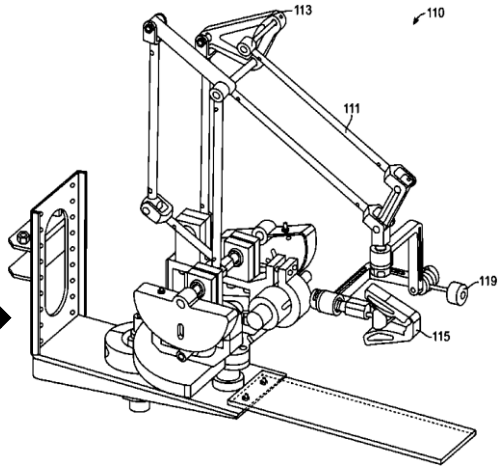


FIG. 1 (a) illustrates tele-operated robotic setup having a pair of master arm assembly, a central controller and a pair of slave arm assembly.

FIG. 1 (b) illustrates master arm assembly.



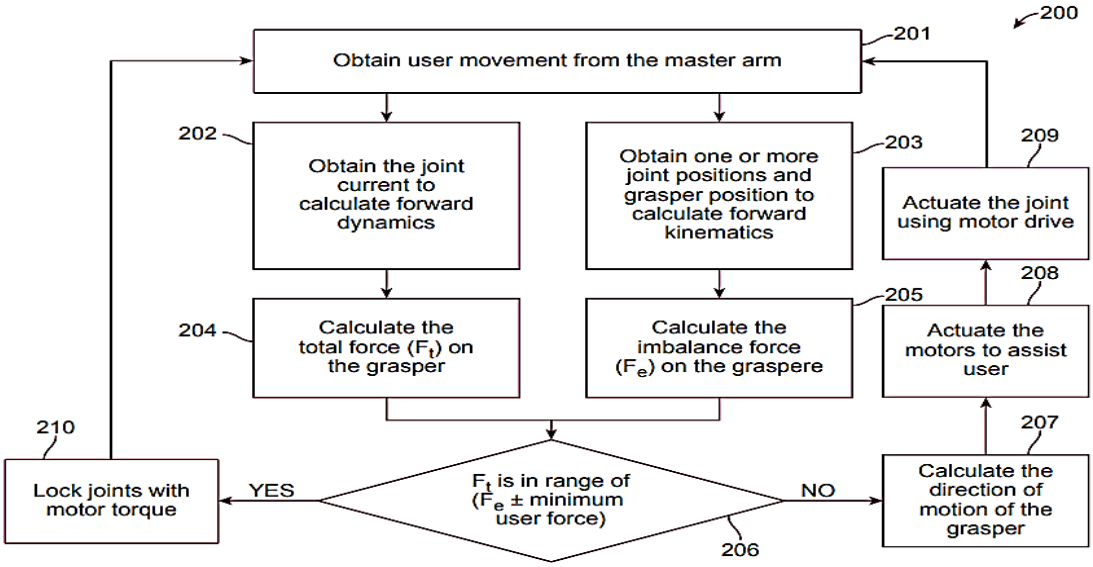


FIG. 2 shows the method of maintaining equilibrium in a master arm of the robotic training system.

Key Features / Value Proposition

1. **Effective Training:** This system makes medical training efficient, saving time and resources. Surgeons can practice safely, improving their skills.
2. **Better Patient Care:** Well-trained surgeons provide better care with fewer complications. Training reduces surgical errors, enhancing patient safety.
3. **Cost Efficiency:** The system's precision reduces errors, saving healthcare institutions money.
4. **Advanced Devices:** Manufacturers can improve their surgical devices, making them more attractive to hospitals and surgeons.
5. **Versatile Technology:** This technology isn't limited to surgery. It allows remote surgery for distant patients and provides a competitive edge for manufacturers.
6. **Innovation:** Continuous development drives healthcare innovation, expanding its applications and benefits.

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