A MINIMALLY INVASIVE SURGICAL TOOL FOR ROBOTIC SURGERY WITH DISENGAGED DEGREES OF FREEDOM

IITM Technology Available for Licensing

Problem Statement

- Generally Robotic Surgical tools have 4 DOF compared to 2 DOF in manual laparoscopic surgery where extra DOF **provides surgeons increased dexterity and reduced fatigue but mechanical design turns complicated** due to the additional DOFs.
- Hence, there is **need to address the issue of coupled DOF in robotic surgical tools to simplify control strategies** and enhance the effectiveness of these advanced medical instruments

Technology Category/ Market

Category– Medical and Surgical Devices
Applications – Biomedical and surgical systems, Robotics, Manufacturing
Industry – Healthcare, Manufacturing
Market -The global surgical robots market in terms of revenue was estimated to be worth $8.5 billion in 2022 and is poised to reach $18.4 billion by 2027, growing at a **CAGR of 16.6% from 2022 to 2027**.

Intellectual Property

- **IITM IDF Ref. 1235**
- **IN390007-Granted**

Key Features / Value Proposition

❖ ***Technical Perspective:***

❑ **Minimally invasive surgical tool** that features **4 independently controlled and disengaged Degrees of Freedom (DOF), simplifying the control strategy.**

❑ The decoupling of DOFs is achieved by directing the tether through the grasper joint's rotational axis, **ensuring constant tether tension throughout the tool's working range**

❖ ***User Perspective:***

❑ **Simplified tool, user friendly with tether driven mechanism**

Technology

The present invention discloses **a minimally invasive surgical tool for robotic surgery with disengaged Degrees of Freedom (DOF)** consists of:

- ***A hollow shaft***
- ***Four driving motors with integrated encoders at the base***
- ***A tool tip***

Further, the said tool tip comprises:

- **A pair of graspers**
- **A pair of pulleys**
- **Four pairs of tethers for the 4 DOF wound over cylinders**
- **Tether guides to guide the ropes as the tool's grasper pitches**

❑ The said tethers are attached to the motors, with three pairs of tethers passing through the hollow shaft to **actuate the graspers at the tool's end.**
❑ Further the **tether guides ensures that the midplane of the grasper pulley aligns** with the tether's symmetry line to **minimize wire fraying.**

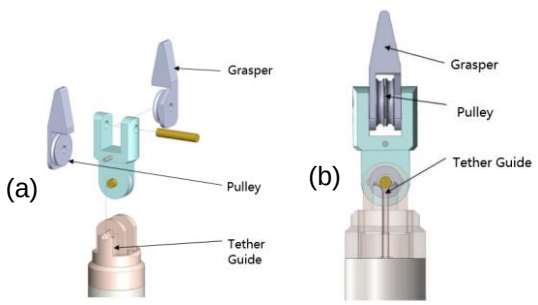

Fig. 1(a) and (b) depicts a design of the tool with an exploded and an assembled view of the tool tip showing grasper, pulley, and tether guide.

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- The tether is **0.7 mm** in diameter with a minimum **breaking strength of 120N**
- Tether guides helps to guide the rope as the tool's grasper pitches, where **tether wraps over these guide and slides past them when actuated.**
- The tethers are characteristically crimped at the position of the grasper **ensuring a positive drive without slippage.**
- Further, provides an alternate proposal for routing the tethers without using a tether diverting pin, where **circular guides are offset by a distance equal to the distance between the mid-planes of the grasper pulleys ensures law of belting**

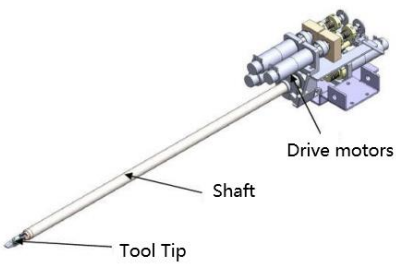

Fig. 2 depicts the tool assembly showing drive motors, shaft and tool tip

TRL (Technology Readiness Level)

TRL- 4,Technology Validated in the lab

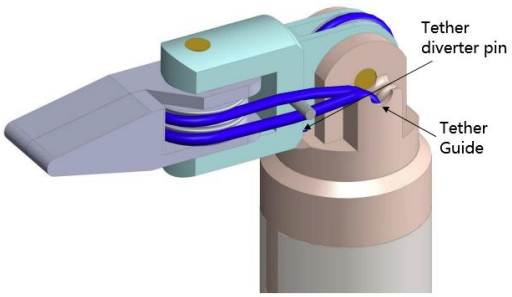

Fig. 3 illustrates a design proposal for tethers routing for graspers showing tether diverter pin and tether guide

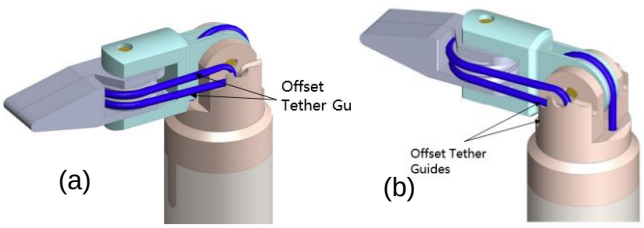

Fig. 4(a) illustrates an alternate tether route proposal for graspers showing offset tether guides and 4(b) illustrates offset tether guides with antisymmetric arrangement

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