

Minimally Invasive Telerobotic Platform for Transurethral Exploration and Intervention

Summary

This technology, developed in Vanderbilt University's Advanced Robotics and Mechanism Applications Laboratory, uses a minimally invasive telerobotic platform to perform transurethral procedures, such as transurethral bladder tumor resection and surveillance. This robotic device provides high levels of precision and dexterity that improve patient outcomes in transurethral procedures.

Challenges in Transurethral Procedures

- ◆ Visualization in the bladder is difficult with current technologies, and surface imaging is insufficient for locating the margins of tumors with underlying submucosal invasion
- ◆ Rigid tools that are currently used have trouble maintaining precision while following the complex curve of the bladder during resection
- ◆ Submillimetric precision is required during resection passes to avoid perforation of the bladder

Technology Description

This robotic system consists of an actuation unit that manipulates a central stem that can be extended the length of the urethral channel and into the bladder. A dexterous arm is inserted through the central stem that is also controlled with a high degree of precision by the actuation unit. The dexterous arm moves with the degrees of freedom necessary to perform procedures along the curved walls of the bladder and provide instrumentation channels that allow surgeons to incorporate a variety of surgical tools, such as a camera system, a grasper, or a laser ablation system, suited for the procedure at hand.

Commercial Applications

This device is useful for a wide range of transurethral procedures, most importantly those involving urinary bladder cancer diagnosis and treatment. Bladder

cancer is the most costly cancer to treat per patient because of the high recurrence rates of tumors missed during surveillance, inaccuracy in tumor resection, and new tumor sites seeded during resection. Bladder cancer accounts for 1 in every 20 cancer diagnoses and there are over 70,000 new cases each year. Despite its prevalence, there are fewer therapies for bladder cancer than most other cancer types, and diagnostic tools remain relatively inaccurate, leaving bladder cancer with an unacceptably high rate of recurrence and misdiagnosis. This technology fills this gaping hole in treatment of bladder cancer while also showing promise for future expansion into a wider range of transurethral procedures.

Unique Features

- ◆ This robotic device provides the dexterity and precision necessary to operate effectively along the curvature of the bladder
- ◆ The dexterous arm is constructed so that several surgical tools can be used simultaneously reducing the time and complexity of a transurethral procedure
- ◆ The dexterous arm's mobility enables visualization of the entire bladder wall, with the use of a camera system, allowing for more effective cancer diagnosis
- ◆ The robotic precision of this device allows the surgeon to completely remove a tumor by resection without perforating the bladder, greatly reducing the potential for recurrence

Intellectual Property Status

- ◆ US Patent Application: [US20140316434A1](#)
- ◆ Publications: [IEEE Transactions on Biomedical Engineering \(Vol. 60, Issue 4\), Ex-Vivo Evaluation of Telerobotic Transurethral System](#), [Telerobotic System in Ex-Vivo Bovine Bladder Video Example](#)

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