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Technion Research &
Development Foundation

Technion - Israel
Institute of Technology
Senate Building
32000 Haifa. Israel

T/ +972.4.829.4851
F/ +972.4.832.0845
T3info@technion.ac.il
http://T3.technion.ac.il

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ViRob- an autonomous crawling micro-robot

Introduction

In recent years focus had been set on research of miniature robots for minimally invasive medical treatments and diagnosis within the body. Micro-robots for medical use presented in professional literature can be categorized into two main groups, those that are designed for swimming and those that crawl gripping the inner pipe walls. The first group might suit medical applications where almost no flow exists, while crawling micro-robots withstands even massive flows. Nevertheless crawling robots that had been designed and fabricated are of impractical sizes for medical use. The robot hereby has the ability to crawl within cavities with similar characteristics as the typical human body's veins and arteries. The miniaturization achievement is unprecedented, as is the ability to control the robot's activity for unlimited period of time, for any medical procedure.

Robot features

Robot Miniaturization is made possible since actuation power and control are not onboard. Actuation power is given by external magnetic field subjected onto the robot, while crawling velocities are determined using different external magnetic field frequencies. Furthermore, the robot advances regardless of the magnetic field actuation direction, which dismisses the need for exact localization and direction retrieval. The robot has a small cross sectional area which allows fluids to flow with minimal interference, thus intra-vascular motion is feasible. The new robot consists of a central torso from which minuscule arms stretch out, allowing the robot to grip the vessel walls. The operator can manipulate the robot to move in increments, and its unique structure allows it to crawl within a variety of vessels with differing diameters. As indicated, different human body's cavities differ from each other in diameter, making it extremely important for the robot to be able to adjust accordingly. The robot had been fabricated using MEMS technology and as depicted is having a diameter of 1[mm] and can be further reduced. Crawling speed is up to 9[mm/sec] if applied into bent or non-bent lumens having diameters ranging from 3[mm] up to 4[mm], It should be noted that the above capabilities also apply to biological tissues like veins and arteries. The robot's dimensions can be altered thus adjusting it for a given desired medical procedure.

ViRob prototype

Applications overview

Applications suitable for ViRob in the medical field are diverse and currently the Technion researchers are experimenting with various potential applications in Neurosurgery, Brachytherapy, visual imaging of human cavities and more. In addition the Technion researchers are exploring applications in the field of localizing leaks in urban water distribution systems.

Key Words: *crawling robot, miniature robot*