【Grant-in-Aid for Scientific Research(S)】
Science and Engineering (Engineering Ⅰ)

Title of Project : Super-microsurgical robotic platforms and investigation of precise manufacturing technologies

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Research Area : Mechanical Engineering, Intelligent mechanics/Mechanical systems
Keywords : Robotics, Medical Robots, Surgical Robots, Microsurgery

【Purpose and Background of the Research】

This project aims to develop robotic platforms for microsurgical applications providing highly advanced treatments. Super-microsurgery is difficult to perform, even for skilled surgeons. Thus, surgical robotic and precision manufacturing technologies can contribute to the realization of less invasive and more accurate microsurgery. We will integrate our previous achievements and develop new platforms for use in several surgical fields.

【Research Methods】

We propose three robotic platforms: (1) a surgical robotic platform for handling soft tissue, (2) a bone-cutting robot, and (3) intravascular microrobots. The first year will be dedicated to the development of the robotic platforms. Miniaturized components, manufactured using the latest technologies, will be implemented before the development of advanced robotic controls. This project is a multi-disciplinary research project, involving partners from universities, hospitals, and companies. Our collaboration will lead to early clinical applications as well as the prompt commercialization of results.

【Expected Research Achievements and Scientific Significance】

(1) Surgical robotic platform for handling soft tissue (Fig. 1)

We will develop multi-DOF forceps using miniaturized components. The forceps will be mounted on a master–slave surgical robotic platform. Robotic control and force–feedback control methods will be investigated to advance a new discipline in microsurgical robotics.

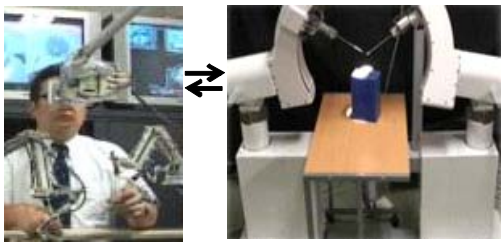

Fig.1 Master–slave surgical robotic platform

(2) Robot for bone-cutting and machining bio-materials (Fig. 2)

We have investigated some micro-scale phenomena of bone cutting. In this project, we will develop optimized bone-cutting techniques, facilitating the regeneration of bone tissue after cutting. We will also integrate tool path generation methods to minimize operation time and skin incision.

Fig. 2 Bone-cutting robot

(3) Intravascular microrobots (Fig. 3)

We will develop the electromagnetic control of tetherless microrobots and investigate their further miniaturization using the latest manufacturing technologies.

Fig. 3 Microrobots

【Publications Relevant to the Project】

・Ida, Y., Sugita, N., Ueta, T., Tamaki, Y., Tanimoto, K., Mitsuishi, M., A microsurgical robot to assist vitreoretinal surgery, International Journal of Computer Assisted Radiology and Surgery, 2011, in press.
・Sugita, N., Nakano, T., Abe, N., Fujiwara, K., Ozaki, T., Suzuki, M., Mitsuishi, M., Toolpath Strategy Based on Geometric Model for Multi-axis Medical Machine Tool, CIRP Annals, Vol.60, No.1, pp.419-424, 2011.

【Term of Project】 FY2011–2015

【Budget Allocation】 165,800 thousand yen

【Homepage Address and Other Contact Information】

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