Proposal of Bioinstrumentation Using Shape Deformation of Amputated Upper Limb

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Abstract—Some upper limb amputees have been annually supplied with a myoelectric prosthesis by social rehabilitation promotion services. However, the persons supplied with the prostheses are limited slightly due to the difficulty in engineering. Accordingly, we propose a new bioinstrumentation using the shape deformation of amputated upper limb without using a myoelectricity generated on the skin of the upper limb. The repeatability is superior to the myoelectricity because the shape deformation is directly measured by strain gages and also the cost is superior to the one extremely.

I. INTRODUCTION

A myoelectric prosthesis for an upper limb amputee is technically superior to a cosmetic glove and a body-powered prosthesis. Therefore, some upper limb amputees have been annually supplied with a myoelectric prostheses by social rehabilitation promotion services within the jurisdiction of Ministry of Health, Labour and Welfare[1]. However, according to the sixth artificial limbs prosthesis expert meeting reports, 25 of 95 applicants for the grant system are not supplied in the past 4 years[2].

The background of the low supply rate is considered as follows: 1) It is hard for the amputees to purchase the prostheses without the grant system because the exclusive German commercial products are high price. 2) It is hard to generate the myoelectricity stably. 3) It depends on the differences among individuals. Considering the above, the electric prosthesis without relying on electromyogram signals are needed.

Accordingly, we propose a new bioinstrumentation using the shape deformation of amputated upper limb for electric prosthesis without using a myoelectricity generated on the skin of the upper limb in this study. This paper takes a different approach toward most of the previous studies in which most electric prosthesis use EMG signals for configurations and movements. The repeatability is superior to the myoelectricity because the shape deformation is directly measured by strain gages and also the cost is superior to the one extremely.

II. PROPOSAL OF BIOINSTRUMENTATION USING SHAPE DEFORMATION OF AMPUTATED UPPER LIMB

If some muscles and nerves remain in an amputated upper limb, rotational motions (a pronation and a supination) of bones (a radius and an ulna) of a forearm can be generated. In particular, the bones near the stump of amputated upper limb can be dynamically rotated and the skin surface can be greatly transformed. Thus, the realization of high repeatability on the shape deformation of skin surface involving the rotational motions is possible.

We focus on the feature of a strain gage which has been known that it is very light and thickness. It is applied to the shape deformation sensor of the skin surface. If a amplified voltage change of the sensor is used as a differencial input of motor, an operational intention can be transmitted to an electric prosthesis directly and intuitively.

III. CLINICAL TESTS

A subject of an experiment is one adult male who undergone amputation (a long stump) of the left forearm. It is confirmed that he enables to transmit his operational intention (the strength and direction of rotational speed) to the motor directly and intuitively according to the results of clinical tests.

IV. CONCLUSION

We proposed a new bioinstrumentation using the shape deformation of amputated upper limb for electric prosthesis without using a myoelectricity generated on the skin of the upper limb, performed clinical tests for an upper limb amputee, and confirmed the validity of proposed method. The detailed results of clinical tests are presented on the day.

REFERENCES

[2] The sixth artificial limbs prosthesis expert meeting reports (2012)