Silicon artificial neural networks locomotion rhythm generator for MEMS microrobot system

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Microrobot could play an important role in paramedical use such as cleaning inside the blood vessel. However, thin artery of human is about 5 mm and artery structure of human differs greatly in individuals. Therefore, further miniaturizations and higher functionalization on the microrobot system are required to play an important role in paramedical use. We will talk about less than 5mm width, length, and height in size hexapod locomotive type microrobot system. The microrobot system consisted by micro-mechanical systems which were fabricated by the micro fabrication technology and micro-electro systems which was constructed by the CMOS IC technology. Micro-mechanical systems were equipped with small size rotary type actuators, body frame, link mechanisms, and 6 legs to realize the ant-like switching behavior. Micro-electro system was biologically inspired locomotion rhythm generator of the microrobot using artificial neural networks. Both systems were made from silicon wafer. Therefore, both systems could integrate on same silicon wafer using micro-electro-mechanical systems (MEMS) technology. Artificial neural networks consisted by 4 cell body models and 12 inhibitory synaptic models. Cell body model was analog circuit model which could output oscillatory patterns such as the biological neuron. Cell body models were connected mutually by the inhibitory synaptic models. Thus, artificial neural networks could generate the locomotion rhythms using synchronization phenomena of the cell body models such as biological neural networks. Locomotion rhythm generator using artificial neural networks realized the locomotion of the robot without using any software programs or analog digital converters. As a result, MEMS microrobot performed forward and backward locomotion, and also changes direction by inputting an external single trigger pulse to the artificial neural networks.

Keywords: CMOS IC; Artificial Neural Networks; Sillicon; MEMS; Microrobot

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