Theoretical Approach in the Development of Multi-Modal Sensory Feedback Controller for the SMA Actuator

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1. Introduction The Shape Memory Alloys (SMA) are materials that exhibit the characteristics of the shape memory effect which takes place when it is at low temperature. The SMA mostly remains in the form of the crystalline structure of martensite, which displays an elastic nature. When heated, the crystalline structure transforms to the austenite structure, which is less elastic thus strain induced to the SMA at the lower temperature martensite phase can be recovered in the austenite phase. One major disadvantage of the SMA is its slow response speed in actuation. In this research, we describe the effort taken in quickening the rate of heat dissipation from the SMA wire in an ambient environment together with a fast and optimum heating method for the control of the SMA.

2. Heat sinking in increasing response We propose the application of a simple, new heat sink that consists of a combination of a stainless outer tube together with silicon grease. A heat model was constructed, and the Finite Element Method was used to analyze the dissipation of heat to the environment from the SMA (Fig.1). Experiment results (Fig.2) showed that the proposed heat sink is effective as a heat sink and widens the application of the SMA wires as actuators.

3. Actuation of the prosthetic hand Currently, the SMA incorporated with the outer metal tube is used in the actuation of the prosthetic hand, a project in the research state in our laboratory (Fig.3). SMA is now being used as an alternative approach to using conventional servo-motors in actuating the fingers and wrist of the prosthetic hand, making the usage on a prosthetic easier and lighter.

Keywords: Shape Memory Alloy, heat sink, response, robotic finger actuation

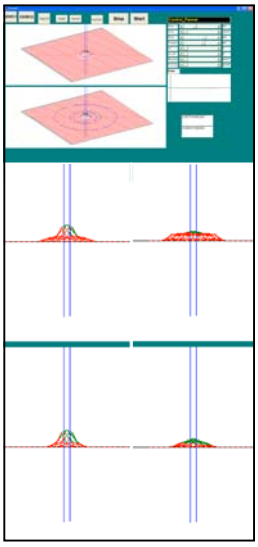

Fig.1 Heat model

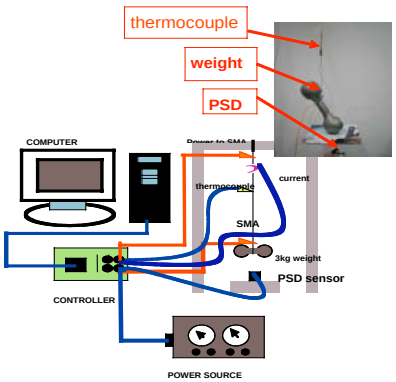

Fig.2 Experiment setting

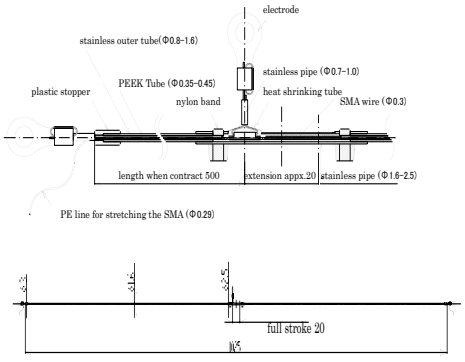

Fig.3 SMA actuator