

### A5

## Gripping mechanism based on self-sensing shape-memory actuators

*Kenny Pagel, A. Bucht, C. Rotsch, H. Kunze*

*Fraunhofer Institute for Machine Tools and Forming Technology, Dresden, Germany*

Due to the significant improvement of the material properties, the use of thermal shape memory alloys as actuators in mechatronic devices is more and more focused in application oriented research activities. With the high specific workload, the simple integrability into mechanical structures and the good biocompatibility shape-memory-alloys seems to be an attractive alternative drive concept for gripping mechanisms. Recent research at Fraunhofer IWU is focused on methods to use shape memory alloys to actuate artificial limbs.

The exemplarily presented artificial hand consists of three fingers and a thumb. The kinematic degrees of freedom are coupled with passive wires in such a manner that one shape memory actuator controls the displacement of one finger. The kinematic equations are delivered and the actuator requirements are extracted.

To control the displacements of the fingers, the shape-memory-actuators are used in a feedback-control-loop. To design the controller a simple model based on the energy flows in the actuator is derived. Instead of using an external position sensor the controller is driven by the measured resistance of the shape memory wire. The controller is implemented on a rapid prototyping system. For validating the functionality of the artificial hand system a defined cylindrical body can be gripped in two different ways.

The result of the development is a gripping mechanism on the basis of a "self-sensing actuator". This technical solution offers different approaches to complement existing drive systems in the field of exo-prosthetics and orthotics, but also permits the use of actuators in other interdisciplinary areas, such as technical gripper for industrial robots.



Figure - Gripping mechanism with self-sensing shape memory actuators