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"One-module"-actuators based on partial activation of shape memory components

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Abstract

An advantage of shape memory alloys (SMAs) is their potential to generate integrated actuator systems with a shape memory component. This can be accomplished for example by activating the thermal shape memory effect in selected regions of the SMA-component. We refer to this process as partial activation. The purpose of the present study is to find a way to create universal actuators with properties adjustable for various applications solely by partial activation. Thus, an object of investigation is the analysis of properties and capabilities of partial activation. Furthermore this study also implicates the survey of possibilities for partial power supply and electrical contacting.

One possibility to use partial activation in integrated systems is given by the agonist-antagonist design. This type of design offers the advantage that a return spring or a mechanical brake for clamping the position without feeding electrical power is not necessary. On the other hand retention force is limited by the martensitic plateau and positioning accuracy by the elastic portion of mechanical stress. To solve these problems with constructive or control-oriented solutions is furthermore an aim of this study. Another approach is to use partial activation for influencing passive superelastic structures like hinges, dampers or return elements by changing the austenitic plateau stress in integrated systems. To create a multifunctional integrated system, the NiTi-elements presented in this study offer various options since they apply partial activation both for thermal shape memory and for influencing superelasticity.