Fakultät Maschinenbau
Lehrstuhl für
Maschinenelemente und Konstruktionslehre
Prof. Dr.-Ing. Dipl.-Wirt. Ing. Tim Sadek

RUHR
UNIVERSITÄT
BOCHUM

Langbein, S.

Design of highly integrated systems on the basis of programmed shape memory alloy components

Proceedings of the ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems (SMASIS), Oxnard, USA. -2009-

Abstract

Shape Memory Alloys (SMA) have essential advantages in comparison with conventional actuators, in particular its high power density and its silent mode of operation. However, this material has not gained acceptance in technical applications yet. The main reasons are the missing simulation tools and a lack of knowledge of materials as well as the companies' uncertainty of how to handle the SMAs. The resetting of the SMA element to generate a repeatable movement is often a defined problem. To this, reset springs of steel are conventional solutions. However, the spring characteristic of steel springs is a disadvantage. To reach a high level of power output and hence a high degree of efficiency, a reduction of the pre-load is necessary. A solution to this problem is an adaptive resetting.

One possibility to generate an adaptive resetting is given by the agonist-antagonist principle. 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. The solving of these problems with constructive or control-oriented solutions is a further aim of this study.

The main aim of this study is to show the properties of the agonist-antagonist design. Besides, it provides methods and the knowledge to support the development process of such resetting principles. The development of these methods is based on the analysis of different designs and requirements. Based on the results, instructions for the conception of agonist-antagonist systems have been created.