SMA-SNAPPER - A BI-STABLE ACTUATOR ACTIVATED BY SHAPE-MEMORY ALLOY WIRES


HINTERGRUND

Common applications for bi-stable actuators are, e.g., electrically powered switches, relays or locks. Nowadays widely used servo-motors or electromagnets implicate several disadvantages, such as non-lightweight construction and/or high power consumption. Actuators based on shape-memory alloys (SMA) offer several advantages, e.g. due to the high actuation energy density of SMA materials. A common example of SMA-actuators that are already in series production is the spoiler adjustment of sports cars.

LÖSUNG

A new actuator design has recently been developed at Saarland University and ZeMA – Zentrum für Mechatronik und Automatisierungstechnik. The sketch shows the construction principle including a bi-stable spring. In particular, the main movable part turns downwards when the blue wire is heated, as indicated by the central arrow. In this way, a switch or other bi-stable applications can easily be realized. Other configurations have also been developed (not shown here).

Schematic view of bi-stable SMA actuator design.
VORTEILE

Due to its novel design, the proposed SMA technology offers a number of advantages:

- Very small weights and sizes possible due to minimalistic and simple construction form
- High forces, in particular high energy density (force/weight)
- Frequencies: at least 10 Hz possible
- SMA has no noise emission (snap can “click” but does not have to)

ANWENDUNGSBEREICHE

The technology is suitable in particular for electric switches, relays or locks as well as other bi-stable actuation applications.

Preliminary technical data as derived from the prototypes:

- Minimum size: allows micro scale construction, e.g. 10x10x5mm³ or below
- Temperature range: up to +60-70°C as tested; above requires further assessment
- Power needed for activation: depending on wire diameter and length (resistance of wire), e.g. between 0.05 – 2 W for common applications
- Actuation characteristics: very fast actuation for 1 time actuation possible (in the ms-range)
- Durability: several million cycles

Related publication available on request.