Smart actuators with the use of shape memory alloys

Shape memory alloys (SMAs) are a class of smart materials that are able to recover their original shape after deformation, exhibit large reversible strains, and switch between solid-state phases in response to loadings or temperature changes, enabling unique actuation and sensing behaviors. Across diverse fields, including mechanical engineering, aerospace, civil structures, robotics, and biomedical devices, SMA elements have been used to provide multifunctional operations in the products. In medicine, they appear in stents, orthodontic archwires, and minimally invasive surgical tools; in engineering, they support vibration control, adaptive structures, and miniature actuators; and in consumer and micro-systems technologies, they enable compact motion control and thermal sensing.

In current research on shape memory alloys, thermal valves, morphing wings, and heat engines are currently studied. Thermal valves employ SMA springs that expand when heated and push against a conventional spring to regulate flow automatically. Morphing-wing structures rely on embedded SMA elements that, upon heating, induce controlled deformation and enable adaptive aerodynamics. Pulley-type heat engines use a continuous SMA wire loop that contracts in hot regions and relaxes in cold ones, creating cyclic motion that drives rotation.

For more details, please write to:
mahmoud.kadkhodaei@giu-berlin.de.