Summary

The aim of the work is the development of engineering applications that offer new solutions for existing problems in drive-technology by using thermal activated Nickel-Titanium (NiTi) actuators within the extrinsic two-way effect. The implementation of actuators in transmissions, to reduce the backlash, or in clutches, which realise a thermal activated switching behaviour, transfers the theoretical results into practical applications. The developed concepts and the designed and manufactured prototypes are observed on the test bench regarding their functionality. To prove the quality of the developed equations, the measuring results are compared with the calculated transformation behaviour.

The implementation of these NiTi-actuators demands the knowledge about the thermal transformation behaviour during the phase transformation from the martensitic low-temperature-phase to the austenitic high-temperature-phase. Especially the non-linear stress-strain behaviour in martensitic condition is simplified by a division into two regions and a linearization of them. Due to this simplification it is possible, to calculate the adjustment travel or the increase of the actuating force of an actuator system, working within the extrinsic two-way effect, with analytic methods. In addition to the basic extrinsic two-way effect, the influence of external forces that work on the actuator system is considered. The pre-compression of the actuator elements expands the range of applications of these actuator systems and offers the possibility of a very precise setup of a demanded adjustment travel. Especially the dimensioning of applications, which demand a defined adjustment travel on the one hand and a defined working force on the other hand, can be simplified by this mean. The calculation of stage-actuators, which show a two-stage transformation, complete the theoretical part.

The work on hand offers calculation tools to dimension NiTi-actuator systems without a detailed knowledge about the complex material behaviour of NiTi. The developed applications show the potential of NiTi-actuators and they show that the use of these innovative concepts leads to complete new solutions in drive technology.