# Ambient heat-transfer effects on magnetic shape memory alloy actuators

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## ABSTRACT

Magnetic Shape Memory Alloy (MSMA) is a promising candidate for high-frequency large-stroke actuators applications as it is able to provide a large recoverable deformation with high-frequency magnetic-field-induced Martensite Reorientation (MR). Recent experiments [1, 2] revealed that the thermo-magneto-mechanical coupling effect needs to be considered to obtain a reliable performance of MSMA actuators. Particularly, the heat generation from the energy dissipation of the high-frequency martensite twin-boundary motions causes a temperature rise in the material [3], which influences the temperature-dependent MR process and/or triggers the temperature-induced martensite-austenite phase transformation so that the output strain can be varied significantly. Therefore, besides the usual magneto-mechanical conditions (such as the magnetic field frequency, the applied mechanical stress and the system mechanical stiffness [3–5]), the ambient heat-exchange efficiency between MSMA actuator and the ambient (which counteracts the temperature rise) is important in controlling the output strain amplitude under the high-frequency magnetic actuation. In this paper, we control the ambient heat-transfer efficiency by applying an ambient airflow (whose velocity can be tuned via a compressed air source) to systematically study the optimized thermo-magneto-mechanical conditions to achieve the maximum output strain amplitude (as a large-stroke actuator). The results are helpful not only for the optimization design of the MSMA actuators, but also for the insight into the principles of the multi-physics coupling in similar smart materials.

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