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On the thermomechanical response of superelastic NiTi alloys under cyclic loading and thermoelastic regime.

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Nitinol is a shape memory alloy exhibiting superelasticity above a defined transformation temperature. The ability to recover from high deformations of the order of 6-8 % has facilitated the development of collapsible/expandable cardiovascular medical devices. Post-deployment operative conditions of NiTi implants determines a predominant austenite phase within the implant structure, which undergoes cyclic loadings primarily driven by blood pressure variations during the cardiac cycle.
It is, therefore, relevant to investigate the thermomechanical response of stable austenitic nitinol under cyclic loading. This loading scenario is characterised by low load amplitudes which are not sufficient to activate or further progress phase transformation and the associated elastocaloric effect. The Tehermoelastic effect is then assumed to be the main thermo-mechanical heat source.
Previous experimental studies have evidenced significant departures from the temperature changes predicted by the classic Thermoelastic Effect theory. In the present study, the modulation of the temperature under sinusoidal loading has been analysed, allowing to identify an inversion of the thermoelastic signal response that is actived during the load cycle as the mean stress value increases.
It is in particular postulated that there is a gradual shifting from a thirst order to a second order thermoelastic response which is confirmed by fitting the temperature fluctuation with the existing thermoelastic analytical laws.

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