Fatigue Analysis of Shape Memory alloys.

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Shape memory alloys (SMAs) exhibit interesting properties when subjected to mechanical or thermal loadings. For instance, they can accommodate large recoverable strains, or recover their shape by simple heating after being inelastically strained. In many applications, shape memory alloys are subjected to cyclic loadings, which could induce failure of the SMA structure by fatigue. Hence, a better understanding of fatigue of SMAs thus seems important in order to further promote the use of these materials in high-tech applications.

In this talk, we present a comprehensive approach for fatigue of SMAs developed in our research group the last 10 years. It includes four steps: i) the development of an accurate constitutive model to predict the stabilized thermo-mechanical state of a SMA structure under cyclic loading; ii) an energy-based criterion to predict **low-cycle** fatigue of SMAs, iii) a shakedown-based fatigue model to predict **high-cycle** fatigue of SMAs and iv) a **structural optimisation** procedure to design SMAs components with respect of fatigue. Our approach takes into account the main features related to the unusual SMAs behaviour such as the strong thermo-mechanical coupling resulting from the dependence of the fatigue lifetime on the loading frequency.