

Title: Fatigue of shape memory alloys

Abstract: 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.



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Zied MOUMNI is Professor of mechanical engineering, leader of the research group “matériaux et structures” (MS) and head of the “Pôle transport” at ENSTA ParisTech. He holds a Ph.D in non-linear mechanics, (LMS Ecole polytechnique, 1995) and a HDR « habilitation à diriger les recherches » in engineering sciences from the university Pierre and Marie Curie, Paris 6 (2009). His research fields deal with the theoretical and numerical modeling of the behavior, fatigue and fracture of non-linear materials and structures presenting multi-physics and thermo- mechanical coupling, namely smart materials and structures. In 2000, he created the research group MS which is today internationally recognized for its activities in the field of smart materials and structures. He is involved in many industrial applications in the field of transportation and energy (PSA, SNCF, CNES, CEA, EDF, SNECMA, Renault). He published more than 100 papers in the best international journals in the field (IJP, JMPS, IJSS, SMS, IJF, IJES etc.). He is a 1000-talent foreign expert in China and holds since May 2012 the position of visiting Professor at the Northwestern Polytechnical University in Xi'an. He is also the coordinator of the mechanical engineering major in SPEIT (Shanghai Jiao tong University-Paristech). In 2015 Professor Ziad MOUMNI was rewarded by the prestigious **"The People's Republic of China Friendship Award"**.