Kick-Off PRIN 2008
Shape memory alloy advanced modeling for industrial and biomedical applications
Roma La Sapienza, 15 Novembre 2010

SMA advanced modeling for industrial and biomedical applications

Decorrenza: 22/03/2010

Material level:

- Definition of a consistent thermo-dynamic modeling framework and development of suitable mathematical analysis tools
- Study and modeling of material cyclic response, training, fatigue, thermo-mechanical treatment effects
- Study and modeling of SMA-based composite materials
- Model extension to finite strains
- Model interfacing with commercial finite element codes

Structural level:

- Analysis of structural elements such as beam, plates, shells, 3D solids
- Structural analysis of devices (for civil, industrial and biomedical engineering)
- Analysis of composite structures

WP 1: Constitutive modeling and numerical algorithms

Task 1.1 (Pavia, year: 1, semester: 1):
Identification of effective SMA constitutive models from the literature, performance comparison with models currently adopted by project research units, selection of an optimal candidate.
Development of suitable mathematical analysis tools for advanced modeling.

Task 1.2 (Roma2, year: 1, semester: 1-2):
Definition of a consistent thermo-dynamic framework for advanced modeling including thermo-mechanical material treatments, cyclic response, material training, fatigue.

Task 1.3 (Cassino, year: 1, semester: 1-2):
Study of thermo-mechanical treatment effects from micro-scale point of view and micro-macro modeling with emphasis on SMA-based composite materials.

WP 1: Constitutive modeling and numerical algorithms

Task 1.4 (Pavia, year: 1, semester: 1-2):

Model improvement/extension to take into account important issues for the analysis of actuators and biomedical devices such as cyclic response, material training, and fatigue collapse (at both low or high number of cycles).

Model extension to finite strains.

Task 1.5 (Pavia, year: 1, semester: 2):

Model interfacing with commercial finite element codes. This point is essential in order to be able to move to the following phase and a particular care needs to be devoted to the algorithm robustness and to its convergence testing in different situations.

WP 2: Analysis of structural elements and devices

Task 2.1 (Roma1, year: 1, semester: 1-2):
Development of a SMA tuned-mass damper concept and development of path-following techniques to describe the dynamical response.

Task 2.2 (Roma2, year: 2, semester: 1-2):
Analysis of structural elements such as beams and shells in finite deformation with emphasis on algorithmic and numerical efficiency.

Task 2.3 (Roma1, year: 2, semester: 1-2):
Analysis of structural elements such as beams and plates distinguishing between finite displacement, rotation, strain effects with emphasis on dynamical response for the case of bridges.

Task 2.4 (Pavia, year: 2, semester: 1-2):
Numerical analysis of devices with emphasis on development of reliable simulations for the design of actuators and biomedical devices (e.g. stents, cardio-filters, etc.)

Task 2.5 (Cassino, year: 2, semester: 1-2):
Micro-macro modeling with emphasis on SMA-based composite structures.