



# Homogenization of nonlinear composites based on TFA approach

Prof. S. Marfia

Dipartimento di Ingegneria, Università di Roma 3, Via Vito Volterra 62 – Roma

Composite materials often present internally complex microstructures, therefore, they require specific formulations to be developed in order to take into account the mechanical behavior of each component and its topological distribution. In particular, if the constituents are characterized by a nonlinear response the study becomes more complex as the nonlinear effects occurring in the material should also be modeled. One possibility to study the overall mechanical response of composite materials, characterized by a complex microstructures and nonlinear behavior of its constituents, is to adopt micromechanical procedures, that study a representative volume element (RVE), determining the behavior of the homogenized equivalent material.

The overall behaviour of the RVE can be determined by using the Finite Element Method, allowing to obtain satisfactorily accurate predictions. However, the computational effort usually associated to the RVE investigation is very large as it can require very fine discretizations and, consequently, a significantly large number of variables to introduce into the analyses. To abate such computational effort, Reduced Order Models (ROM) can be employed, since they allow to solve the micro-mechanical problem in a reasonable computing time.

Among ROM techniques for nonlinear material, an interesting and effective approach is the Transformation Field Analysis (TFA), that determines the behavior of the RVE of the composite taking into account the nonlinear phenomena considering the presence of inelastic strain fields.

Several TFA approaches, differing mainly for the approximation adopted for the inelastic strain and for the procedure used to evaluate the evolution of the history variables, are presented. Composites, characterized by plastic, viscoplastic, shape memory, damage effects in the constituents are studied and the results obtained by the TFA procedures are compared with the results carried out by nonlinear finite element analyses and by semi-analytical approaches. Advantages and disadvantages of the TFA procedures are underlined and possible future developments are proposed.

Giovedì 21 MARZO, ore 15:00, aula Riunioni DIMI, via Branze 38, 25123 Brescia