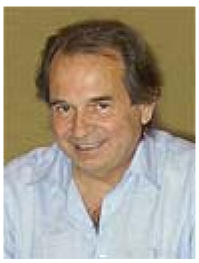
Department of Civil Engineering and Engineering Mechanics
Columbia University

Tuesday, January 31, 2012 (2:30-3:30 pm)
644 Mudd

PGD APPROXIMATIONS IN MULTISCALE STRUCTURAL MECHANICS: BASIC FEATURES AND VERIFICATION



Prof. P. Ladevèze
LMT-Cachan
ENS Cachan / CNRS / UPMC / PRES Universite Paris Sud
EADS Foundation Chair "Advanced Computational Structural Mechanics"

(Host: Prof. Jacob Fish)

Computational Mechanics carries on supplying numerous science and engineering problems which remain inaccessible to standard FE codes. Not all these problems are exotic, and many are indeed practical problems. A significant number of these engineering problems are related to today's growing interest in physics-based material models described on a scale smaller than that of the macroscopic structure, with applications such as the design of new materials, structural design and manufacturing. In addition to these large-scale, time-dependent and highly nonlinear problems, one can mention numerous problems involving multiple parameters and uncertainties (e.g. bolted assemblies), cyclic viscoplastic problems with many cycles, and real-time simulations of complex thermo-mechanical systems.

The main approach we are developing in order to solve these very-large-scale nonlinear problems (which cannot be addressed by multiscale calculation strategies alone) is the Proper Generalized Decomposition (PGD). This is an extension of POD, which we introduced in 1986 under the name "Radial Time-Space Approximation". The main idea consists in calculating shape functions and the solution itself simultaneously using an iterative procedure. A priori, these shape functions are arbitrary and must only verify a variable separation assumption.

The talk will first present the basic features of PGD and the mechanical explanation of its considerable advantages in terms of computation time and storage requirements, and also its limits. New verification tools will also be introduced. A last PGD technique will be detailed for time-dependent nonlinear multiscale problems thanks to the LATIN method , and illustrations based on engineering problems will be shown.