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343 | Thermo-mechanical behavior of C/SiC composite structures under extreme heating loads

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Aerocraft will be exposed to extreme aerothermal load during hypersonic flight in atmosphere. High-temperature composites such as C/C and C/SiC are widely used in the hot structures of aerocraft because of their high temperature resistance, high specific stiffness and high specific modulus. In order to evaluate the performance and integration of the hot structures, ground thermal tests are routinely conducted, and quartz lamp radiation heaters are considered as an important mean to simulate instantaneous aerothermal environment. Since the ground tests are costly, unrepeatable and difficult, simulation technology of structure thermo- mechanical test is developed. Based on the thermal network method and the Monte-Carlo theory, a numerical method is developed to study the temperature distribution of C/SiC composite structure during the transient radiation heating dynamic control process. This enabled the development of a thermo- mechanical Finite Element Analysis (FEA) incorporating an anisotropic constitutive model of C/SiC composite, which presents the anisotropic, nonlinear, double modules and pseudoplastic characteristics of the composite, to examine the thermal stress distribution of C/SiC composite structures. Finally, this prediction was validated by the experiment and a good correspondence between the model and the experimental results was found.

507 | Taylor Meshless Method for bending and buckling of thin plates

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This paper introduces a new meshless method named Taylor Meshless Method (TMM) using Taylor series to deduce the shape functions. Next the problem is discretized by point-collocation only on the boundary and without integration. The discrete boundary problem is solved by least-squares method. In this talk, this method is applied to bending and buckling of isotropic and anisotropic plates. The shape functions are polynomials that coincide with harmonic polynomials in the case of Laplace equation. These polynomials are computed numerically by solving the PDE approximately in the sense of Taylor series. Of course, this leads to an error that decreases asymptotically with the degree. TMM can be considered as a Trefftz Method, but we search approximated solutions in the sense of Taylor series while Trefftz Method is generally based on exact solutions of the PDE. As a counterpart, one is able to build this complete family of approximated solutions, whatever be the studied equation. A strong reduction of the number of degrees of freedom is the main advantage of this class of discretization techniques. The main drawback is the ill-conditioning of the final matrix, what can limit the size of the solved problem, but it was established that TMM is able to solve large scale problems. In the case of non linear PDEs as Föppl-Von Karman plate models, one applies first a linearization technique as Newton iterative technique. Here we apply Asymptotic Numerical Method. Next the resulting linear equations have variable coefficients and they are solved by TMM. Several linear and nonlinear numerical results will be presented for isotropic and anisotropic laminated plates.

114 | Anisotropy in polymeric-carbon black composites with a stochastic interphase by homogenization method

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The main aim of this paper is determination of basic probabilistic characteristics of the homogenized elastic properties for the periodic carbon black reinforced polymer with interphase [1]. The homogenization problem, solved thanks to the Stochastic Finite Element Method (SFEM) is implemented according to the stochastic perturbation, Monte Carlo simulation and semi-analytical techniques and related to the cubic Representative Volume Element (RVE) of the polymer [2]. This RVE has three different spatial distributions of the 27 carbon-black particles surrounded with a spherical interphase - equally spaced and inhomogenously spaced with small and high clustering resulting in anisotropy of the homogenized stiffness tensor. The 3D homogenization scheme is based on numerical determination of the strain energy of the composite Representative Volume Element under