Institute of Information and Communication Technologies – BAS

Seminar
„Parallel Algorithms and Scientific Computations"

On 16 October 2012 at 14:00 in room 218 at the Institute of Information and Communication Technologies, BAS, Acad. G. Bonchev St., Block 25 A, **Stanislav Stoykov** will give a presentation on the following topic:

Nonlinear Vibrations of 3D Beams

The geometrically nonlinear vibrations of 3D beams are investigated using the *p*-version finite element method. The beams may vibrate in space, hence they may experience longitudinal, torsional and non-planar bending deformations. The model is based on Timoshenko's theory for bending and assumes that, under torsion, the cross section rotates as a rigid body and is free to warp in the longitudinal direction, as in Saint-Venant's theory. The geometric nonlinearity is taken into account by considering Green's nonlinear strain tensor. Isotropic and elastic beams are investigated and generalized Hooke's law is used. A model for rotating beams about a fixed axis is developed and the rotation is taken into account in the inertia forces. The equations of motion are derived by the principle of virtual work.

Free and forced vibrations of beams, in the frequency domain, are investigated. The differential equations are discretized into a nonlinear algebraic form by the harmonic balance method and solved by an arc-length continuation method. The stability of the solutions is investigated by Floquet's theory. Couplings between modes are investigated, internal resonances are found and the ensuing multimodal oscillations are described. Some of the couplings discovered lead from planar oscillations to oscillations in the three-dimensional space.

The influence of the speed of rotation on the bending linear modes of vibration is presented. Nonlinear forced vibrations of rotating beams are investigated in the time domain, using direct integration of the equation of motion and considering constant and non-constant speed of rotation.