

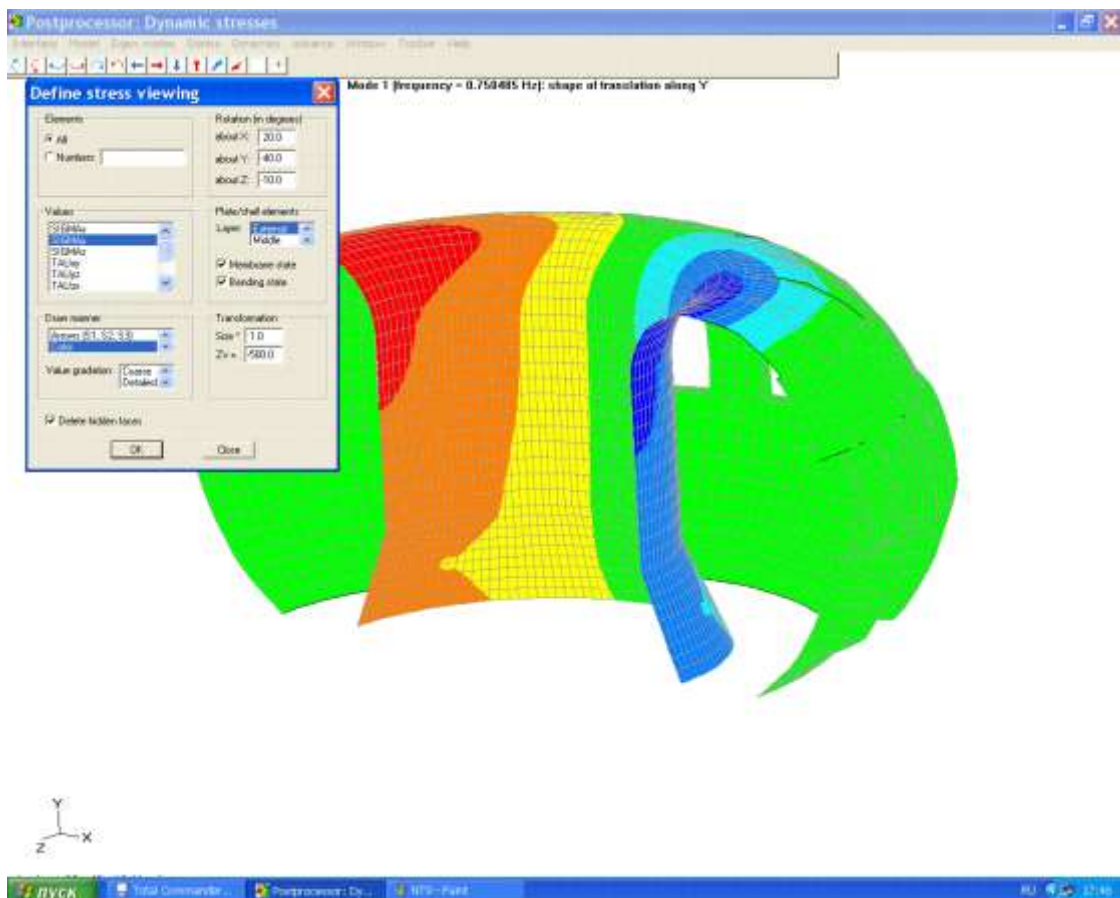
FEM-based analysis of nonlinear statics and dynamics of structures

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This numerical analysis method is a further development of the author's [method for analyzing dynamic loads on items of mass during an aircraft emergency landing](#). The analysis of nonlinear statics and dynamics of structures covers engineering objects from vehicles to energy facilities and a wide range of loading cases. The development, based on finite element modeling of the analyzed structure, was carried out from 1988 to 2003 and led to the creation of a sufficiently universal methodology implemented in the *NewTone* software system.

Using *NewTone*, the following problems can be solved:

- calculation of the response of a 3D structure to static or dynamic loads specified by applied forces or kinematic parameters, taking into account large displacements and plastic flow of the material;
- analysis of the dynamics of a structure that collapses when it collides with an obstacle;
- analysis of the dynamics of a structure when separating into parts (for example, during separation of the launch boosters);
- calculation of eigen modes of a pre-stressed structure;
- calculation of eigen modes of a structure immersed in fluid and (or) containing it in internal cavities;
- linear static analysis;
- calculation of forced vibrations of a structure in linear statement under stationary or non-stationary loading.



User interface of *NewTone* by example: Calculation of forced vibrations of the ITER back plate. Postprocessing: Dynamic stresses

The developed method and software involve the use of both conventional 1D, 2D and 3D finite elements with Hermite shape functions, and **special elements for solving dynamic problems, including nonlinear ones, based on unconventional approximations.**

Additional information can be found in the following publications:

- Spirochkin YK (1993) Komp'yuternoe modelirovanie dinamiki konstruktssii pri avariakh (Computer simulation of structural dynamics in accidents). Matematicheskoe modelirovanie (Mathematical models and computer simulations) 5(6):85-103. http://www.mathnet.ru/php/archive.phtml?wshow=paper&jrnid=mm&paperid=1984&option_lang=rus
- Spirochkin YK (1994) NewTone/386. Konechnoelementnaya sistema programm dlya raschyota nelineinoi statiki i dinamiki konstruktssii: Uchebnik (Finite element software system for analyzing nonlinear statics and dynamics of structures: Manual). Versions 1.1 S, 1.1 M, 1.1 L. Research and engineering company *Dynamika*, Kaliningrad, Moscow region
- Vasil'ev NN, Roschin NV, Spirochkin YK (1993) Issledovanie dinamicheskogo otklika konstruktssii korpusov segmentov blanketa reaktora ITER na impulsnyu nagruzku, voznikayuschuyu pri razvitii v plazme neustoiichivosti sryva (Study of dynamic response of the ITER blanket segments' structures to the pulse load caused by development of the plasma disruption instability). Voprosy atomnoi nauki i tekhniki. Seriya: Termoyadernyi sintez (Rossiiskii nauchnyi tsentr "Kurchatovskii institute") (Problems of atomic science and technology. Series: Thermonuclear fusion (Russian Scientific Center *Kurchatov Institute*)), Issue 1–2, p 34–40
- Spirochkin YK (1994) Spetsialnye konechnye elementy dlya zadach dinamiki konstruktssii (Special finite elements for structural dynamics problems). Matematicheskoe modelirovanie (Mathematical models and computer simulations) 6(8):85-91. http://www.mathnet.ru/php/archive.phtml?wshow=paper&jrnid=mm&paperid=1899&option_lang=rus
- Spirochkin YK (1997) NewTone. Programmnoe obespechenie dlya konechnoelementnogo raschyota nelineinoi statiki i dinamiki konstruktssii na PC 486/Pentium: Tekhnicheskaya informatsiya (Software for finite element analysis of nonlinear statics and dynamics of structures on PC 486/Pentium: Technical information). *Novaya Tekhnologiya*, LLC, Korolyov, Moscow region
- Spirochkin Y (2011) Special finite elements in structural dynamics. Vibration Problems ICOVP 2011. Supplement. The 10th International Conference on Vibration Problems. Technical University of Liberec, Liberec, Czech Republic, p 168-173.

Some individual components of this method and software were applied in [FEM-based analysis of coupled vibrations](#)

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