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## On the occasion of the anniversary of Professor Vladimir An. Levin



Vladimir An. Levin is a Distinguished Professor in the Department of Computational Mechanics at the Faculty of Mechanics and Mathematics at Lomonosov Moscow State University. He is an active, persistent, and productive scientist who significantly contributed to fundamental and applied continuum mechanics science. In fundamental science, V.A. Levin is a well-known expert in solid mechanics. His research is related to the problems, for which it is necessary to take into account the presence of large deformations in the body and describe their redistribution during loading. He created and developed in detail the theory of repeatedly superimposed large deformations. The theory made it possible to consider and solve fundamentally new classes of static and dynamic problems at large deformations, in which the boundaries (including the multi-connected ones), boundary conditions, and the properties of a part of the body material change abruptly or continuously during the loading. The theory makes it possible, in particular, to describe large deformations during the loading process, in which the mass of a body changes by removing or adding (loaded or unloaded) parts from the same or different materials.

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The theory of multiple superimposed large deformations was created and developed at the initial stage under the patronage of Academician L.I. Sedov. He also wrote an extremely capacious preface to the first monograph by V.A. Levin, defining the place of the theory of multiple superimposed large deformations in the mechanics of deformable solids.

Based on the theory of multiple superpositions of large deformations, V.A. Levin, together (in some cases) with his students and colleagues, obtained the following results in the field of fundamental science:

- The main result in the field of finite-deformation strength theory is a model of the development of a defect in a body with finite deformations that takes into account the formation and evolution of pre-fracture zones, which for the first time allowed taking into account the redistribution of finite deformations during the development of a defect. He proposed options for a nonlocal strength criterion for finite deformations. The formulated model made it possible to describe the ductile crack growth of nonzero openings at finite strains, taking into account their redistribution.
- The modeling of the stress-induced solid-state phase transitions, describing, in particular, the formation of stable nanostructures, as well as the model of the changes in the mechanical characteristics of a polymer under loading that has been modified for the case of redistribution of large deformations.
- A model for large strains was developed to describe a new class of problems on the stress–strain state in bodies with stress concentrators; two- and three-dimensional problems on the forced formation and growth (or decrease) of cavities and inclusions in a loaded body with finite deformations were solved, including problems in which the shape of the cavity that is formed in the loaded body and the shape of the body itself are known in the final configuration.
- A method has been developed for evaluating the effective mechanical and strength characteristics of inhomogeneous elastic and inelastic materials (porous, composite, metamaterials, “digital core sample”) under finite deformations and their redistribution.
- Exact solutions have been obtained for many problems in elasticity theory under large deformations and their redistribution, including the problems of sequential connection of preloaded body parts: problems of bending a beam (including for the Cosserat continuum) formed by joining several pre-compressed or stretched layers, including the presence of distributed dislocations in the layers, the case of connecting cylinder sectors, after deformation becoming flat; problems of torsion of a composite rod with a pre-deformed inclusion; the Lamé–Gadolin problem is generalized to the case of large deformations and solved.

The results have been published in 355 papers, including 8 monographs. V.A. Levin is the key author and scientific editor of the five-volume set of monographs “Nonlinear Computational Mechanics of Strength.” The preface to the series of monographs was written by Academician G.I. Marchuk.

The main result of V.A. Levin’s work in the field of applied science is the CAE FIDESYS industrial package, created under his scientific and technical guidance, which is used in various industries, including oil & gas and mining (<https://cae-fidesys.com/>). This package is developed on the base of fundamental scientific results. For cases related to the implementation of the theory of multiple superpositions of large deformations, the package is unique, allowing for high-quality calculations for some high-tech types of industrial problems. Such problems include: strength analysis of products manufactured using additive technologies; modeling in the process of creating new materials (including “smart” materials, structural materials, and metamaterials); strength analysis of structural elements from them; and modeling the behavior of structures under supercritical loading scenarios.

At the initiative of V.A. Levin and his students at CAE FIDESYS, the spectral element method was implemented for the first time in an industrial package along with the finite element method, which gives significant advantages in accuracy and speed over the existing packages.

Considering the demand for CAE FIDESYS, under the scientific and technical guidance of V.A. Levin, the cloud service <https://prove.design/> has been created for the world market. This service is focused on the mass user (designers of small enterprises, start-ups, etc.) with an additional unique (high-tech) ability to carry out calculations when the CAD model contains a “defect in design” (gaps and overlaps).

The CAE FIDESYS package is integrated with major CAD systems.

V.A. Levin introduces the obtained scientific and technical results into the educational process, supplementing the reading of classical courses with courses related to creating digital means of production for strength engineering analysis.

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Considering that the jubilee is the head of a large family, the father of six children (42 years, 16 years; twins 6 years; 4 years, and 10 months), and the grandfather of two grandchildren, the editorial board wishes him long years of fruitful active scientific work, productive pedagogical activity, and joys in his personal life.

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