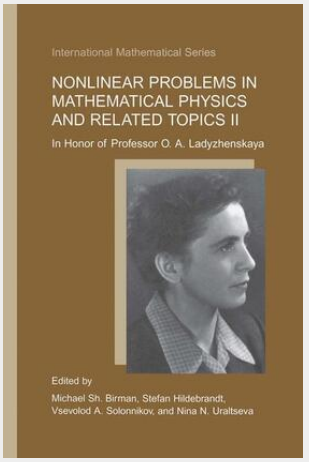
Birman / Uraltseva / Hildebrandt

Nonlinear Problems in Mathematical Physics and Related Topics II

In Honor of Professor O.A. Ladyzhenskaya



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The main topics reflect the fields of mathematics in which Professor O.A. Ladyzhenskaya obtained her most influential results. One of the main topics considered in the volume is the Navier-Stokes equations. This subject is investigated in many different directions. In particular, the existence and uniqueness results are obtained for the Navier-Stokes equations in spaces of low regularity. A sufficient condition for the regularity of solutions to the evolution Navier-Stokes equations in the three-dimensional case is derived and the stabilization of a solution to the Navier-Stokes equations to the steady-state solution and the realization of stabilization by a feedback boundary control are discussed in detail. Connections between the regularity problem for the Navier-Stokes equations and a backward uniqueness problem for the heat operator are also clarified. Generalizations and modified Navier-Stokes equations modeling various physical phenomena such as the mixture of fluids and isotropic turbulence are also considered. Numerical results for the Navier-Stokes equations, as well as for the porous medium equation and the heat equation, obtained by the diffusion velocity method are illustrated by computer graphs. Some other models describing various processes in continuum mechanics are studied from the mathematical point of view. In particular, a structure theorem for divergence-free vector fields in the plane for a problem arising in a micromagnetics model is proved. The absolute continuity of the spectrum of the elasticity operator appearing in a problem for an isotropic periodic elastic medium with constant shear modulus (the Hill body) is established. Time-discretization problems for generalized Newtonian fluids are discussed, the unique solvability of the initial-value problem for the inelastic homogeneous Boltzmann equation for hard spheres, with a diffusive term representing a random background acceleration is proved and some qualitative properties of the solution are studied. An approach to mathematical statements based on the Maxwell model and illustrated by the Lavrent'ev problem on the wave formation caused by explosion welding is presented. The global existence and uniqueness of a solution to the initial boundary-value problem for the equations arising in the modelling of the tension-driven Marangoni convection and the existence of a minimal global attractor are established. The existence results, regularity properties, and pointwise estimates for solutions to the Cauchy problem for linear and nonlinear Kolmogorov-type operators arising in diffusion theory, probability, and finance, are proved. The existence of minimizers for the energy functional in the Skyrme model for the low-energy interaction of pions which describes elementary particles as spatially localized solutions of nonlinear partial differential equations is also proved. Several papers are devoted to the study of nonlinear elliptic and parabolic operators. Versions of the mean value theorems and Harnack inequalities are studied for the heat equation, and connections with the so-called growth theorems for more general second-order elliptic and parabolic equations in the divergence or nondivergence form are investigated. Additionally, qualitative properties of viscosity solutions of fully nonlinear partial differential inequalities of elliptic and degenerate elliptic type are clarified. Some uniqueness results for identification of quasilinear elliptic and parabolic equations are presented and the existence of smooth solutions of a class of Hessian equations on a compact Riemannian manifold without imposing any curvature restrictions on the manifold is established.

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