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Sobolev Type Equations of Higher Order. Theory and Applications

This report surveys the author's results concerning Sobolev type equations of higher order. The theory is constructed using the available facts on the solvability of initial (initial-final) problems for the first-order Sobolev type equations. The main idea is a generalization of the theory of degenerate (semi)groups of operators to the case of higher-order equations: decomposition of spaces and actions of the operators, construction of the propagators and the phase space for the homogeneous equation, as well as the set of valid initial values for the inhomogeneous equation. We use the phase space method, which is quite useful for solving the Sobolev type equations and consists in a reduction of a singular equation to a regular one defined on a certain subspace of the original space. As an application we reduce several mathematical models to initial (initial-final) problems for abstract Sobolev-type equations of higher order. The results may find further applications in the study of optimal control problems, nonlinear mathematical models, and in the construction of the theory of Sobolev-type equations of higher order in quasi-Banach spaces and stochastic spaces of noises.