Inverse Stefan Problems (Mathematics and Its Applications)

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In this monograph the theory and methods of solving inverse Stefan problems for quasilinear parabolic equations in regions with free boundaries are developed. The study of this new class of ill-posed problems is motivated by the needs of the mod eling and control of nonlinear processes with phase transitions in thermophysics and mechanics of continuous media. Inverse Stefan problems are important for the perfection of technologies both in high temperature processes (e.g., metallurgy, the aircraft industry, astronautics and power engineering) and in hydrology, exploitation of oil-gas fields, etc. The proposed book will complete a gap in these subjects in the preceding re searches of ill-posed problems. It contains the new theoretical and applied studies of a wide class of inverse Stefan problems. The statements of such problems on the determination of boundary functions and coefficients of the equation are considered for different types of additional information about their solution. The variational method of obtaining stable approximate solutions is proposed and established. It is implemented by an efficient computational scheme of descriptive regularization. This algorithm utilizes a priori knowledge of the qualitative structure of the sought solution and ensures a substantial saving in computational costs. It is tested on model and applied problems in nonlinear thermophysics. In particular, the results of calculations for important applications in continuous casting of ingots and in the melting of a plate with the help of laser technology are presented.

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