Rate-Independent Systems: Theory and Application (Applied Mathematical Sciences)

Alexander Mielke, Tomás Roubícek

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This monograph provides both an introduction to and a thorough exposition of the theory of rate-independent systems, which the authors have been working on with a lot of collaborators over 15 years. The focus is mostly on fully rate-independent systems, first on an abstract level either with or even without a linear structure, discussing various concepts of solutions with full mathematical rigor. Then, usefulness of the abstract concepts is demonstrated on the level of various applications primarily in continuum mechanics of solids, including suitable approximation strategies with guaranteed numerical stability and convergence. Particular applications concern inelastic processes such as plasticity, damage, phase transformations, or adhesive-type contacts both at small strains and at finite strains. A few other physical systems, e.g. magnetic or ferroelectric materials, and couplings to rate-dependent thermodynamic models are considered as well. Selected applications are accompanied by numerical simulations illustrating both the models and the efficiency of computational algorithms.

In this book, the mathematical framework for a rigorous mathematical treatment of "rate-independent systems" is presented in a comprehensive form for the first time. Researchers and graduate students in applied mathematics, engineering, and computational physics will find this timely and well written book useful.

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