

Preface

This book presents an account of theories of flow in porous media which have proved tractable to analysis and computation. In particular, the theories of Darcy, Brinkman, and Forchheimer are presented and analysed in detail. In addition, we study the theory of voids in an elastic material due to J. Nunziato and S. Cowin. The range of validity of each theory is outlined and the mathematical properties are considered. The questions of structural stability, where the stability of the model itself is under consideration, and spatial stability are investigated. We believe this is the first such account of these topics in book form. Throughout, we include several new results not published elsewhere.

Temporal stability studies of a variety of problems are included, indicating practical applications of each. Both linear instability analysis and global nonlinear stability thresholds are presented where possible. The mundane, important problem of stability of flow in a situation where a porous medium adjoins a clear fluid is also investigated in some detail. In particular, the chapter dealing with this problem contains some new material only published here. Since stability properties inevitably end up requiring to solve a multi-parameter eigenvalue problem by computational means, a separate chapter is devoted to this topic. Contemporary methods for solving such eigenvalue problems are presented in some detail.

Nonlinear acceleration waves in classes of porous media are also studied. The connection with this and sound propagation in porous media is analysed. The nonlinear wave analysis is performed for a class of simplified mixture-like theories and for the Nunziato-Cowin theory of elastic materials with voids.

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