Book Review

Introduction to Continuum Mechanics, by W. M. Lai, D. Rubin and E. Krempf, Fourth edition, Elsevier/BH, 2010; ISBN: 978-07506-8560-3 (hardcover)

SASCHA BRUNE¹

Continuum mechanics is essential for the mechanical description of solids and fluids; this textbook gives a coherent introduction to the topic. It has been written by engineers, with examples relating rather to structural or medical engineering than to earth sciences. Nevertheless, the representation of concepts and mathematical descriptions may be of high value for geophysicists as well.

The text is arranged very clearly, providing roughly 150 pages of general continuum principles and tensor mathematics (Chaps. 1–4), 150 pages on the elastic solid (Chap. 5) and further 150 pages on Newtonian and non-Newtonian fluids (Chaps. 6–8). The first part (Chaps. 1–4) introduces second order tensors and their arithmetic operations. Motions are formulated in both Eulerian or Lagrangian terms. Great detail is given to the different definitions of strain and stress tensors and the meaning of their components. The second part (Chap. 5) constitutes the heart of the book, dealing with the elastic solid. Stress and strain tensors are calculated in the isotropic linear case for many fundamental geometries: plane strain, plane stress, torsion of a bar and bending of a beam. Basic problems relating to the elastic half-space are solved. Finally, constitutive equations are derived for the anisotropic case while the isotropic elastic solid is discussed in relation to large deformations. The third part (Chaps. 6–8) is devoted to fluids. For the Newtonian case, characteristics of viscous and inviscid, compressible and incompressible flows are derived in diverse

flow geometries. The chapter on non-Newtonian fluids focuses on the simple and on the generalized linear Maxwell body, as well as the nonlinear viscoelastic fluid.

The textbook provides an extensive introduction to tensor mathematics and to fundamental concepts of stress and strain. No previous mathematical knowledge is required, ideal for those without much experience of linear algebra. It contains many example calculations, which is very good for understanding the involved mathematics. Thanks to short sections and extensive examples, it can be used as reference book for specific mechanical problems.

However, from the geophysical point of view, some very important topics are missing. Plasticity is not treated, nor are the standard anelastic solid or the Burgers body dealt with. The section on wave propagation is only rudimentary and temperature dependence of mechanical properties is entirely missing. Furthermore, the index is very short, making it difficult to find specific sections. A list of variable names would have been useful to provide quick accessibility of the mathematical formulations.

The material of this book would be suitable for a course in continuum mechanics on both the undergraduate and graduate levels, and so is also valuable for PhD students and researchers who are new to the topic. For geoscientists, despite some drawbacks, it provides a well-arranged and extensive introduction to general concepts of continuum mechanics.

¹ Geodynamic Modeling Section, German Research Centre for Geosciences, GFZ, Potsdam, Germany. E-mail: sascha.brune@gfz-potsdam.de