Book Reviews

Optical Methods in Dynamics of Fluids and Solids, M. Pichal (editor), Springer-Verlag Inc., New York, 1985, 385 pp., $45.00.

This book reports on the Proceedings of an International Symposium, sponsored by the International Union of Theoretical and Applied Mechanics, and held at the Institute of Thermomechanics, Liblice, Czechoslovakia, November 17-21, 1984. The meeting dealt with applications of optical methods in fluid mechanics and solid mechanics, in an effort to bring together scientists using optical methods in all phases of dynamics. Emphasis in the book is placed on experimental fluid mechanics dealing with transition from laminar turbulent flow, compressible flow, and non-equilibrium phenomena, and the interaction of fluid flow with solid boundaries and bodies. Contributions in the areas of mechanics and solids focus on optical methods for measurement of wave propagation in shock loaded bodies, phenomena connected with fracture mechanics, non-stationary vibrations of elements, and non-stationary strains in structures.

Among the 47 technical papers presented in this volume, 14 papers are devoted to various areas of solid mechanics, including six on photoelasticity, six on various types of interferometric methods (holography, Moiré, LDV, micro-interferometry, and differential interferometry), and a paper each on x-ray tomography and the photoelastic methods. The areas of application include dynamic fracture, instrumentation for impact testing, elastic stress wave propagation, metal forming, data deformation analysis, and vibration analysis.

About two-thirds of the articles deal with measurements in fluid mechanics. They consider various means including holography, Raman scattering, laser Doppler velocimetry, laser dual focus velocimetry, particle size measurement from light scattering, x-ray diffraction measurements, speckle photography, flow visualization, color Schlieren technique, interferometric methods, tomography, photography, refraction by shocks, and flow-induced luminosity. These techniques are applied to measurements of bubbles, combustion flows, aerosols, cavitating flows, compressible flows with shock waves, fluidized beds, and metal castings.

Articles in this volume have been photo-reproduced and are relatively short contributions averaging five to seven pages. Several new ideas, many extensions of established methods, and some novel and clever techniques are described. Because of the brevity of each paper many of the articles are incomplete, and a number of them are still in the idea stage. Contents of the book primarily reflect current European, and particularly Czechoslovakian, research in the area of optical methods. Current optical methods in the dynamic of solids and fluids, such as the optical method of caustics, laser speckle interferometry, some types of interferometry for dynamic plasticity, high speed photography, and particle image velocimetry would have made this book more balanced.

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Dynamics: Theory and Applications, by T. R. Kane and D. A. Levinson, McGraw-Hill Book Company, New York, 1985, 379 pp., $49.95.

As a text intended for a first-year graduate course on general classical dynamics, this book is unusual in at least four fundamental respects: 1) Its emphasis is almost exclusively on rigid-body mechanics. There is little on single-particle dynamics. 2) From the outset, frames of reference (regarded as massless rigid bodies) are emphasized together with a special notation. 3) There is a unified point-of-view in that all phenomena and problems are to be considered as based on a particular general set of equations, valid for nonholonomic, as well as holonomic, constraints. 4) Instead of, e.g., the customary Lagrange equations (with multipliers), the fundamental equations in (3) are taken to be "Kane's equations," which express a balance of "generalized active forces" and "generalized inertia forces." These involve, for example, generalized speeds and partial velocities. The equations are, in general, a set of coupled first-order ordinary differential equations in the generalized coordinates and generalized speeds.

The authors state that their main purpose is to present comparatively simple procedures for formulating the equations of motion in the kind of complex systems such as might occur in modern-day problems in industry, e.g., multibody spacecraft. (A book on this latter subject by the authors, with P. W. Likins, has recently been published.)* Thus, out of the seven chapters, the first six essentially cover methods of formulation. They are:

*See review of *Spacecraft Dynamics*, *AIAA Journal*, Vol. 21, June 1983, p. 928.

Kinematics (including derivatives of vectors in reference frames, generalized coordinates, angular velocity, partial angular velocity, generalized speeds, acceleration, etc.); Mass Distribution (including moments of inertia and the inertia dyad); Generalized Forces (including generalized active forces and generalized inertia forces, and contributing and noncontributing forces); Energy Functions (potential energy and kinetic energy, both treated in a quite general way, in terms of generalized coordinates and generalized speeds); Formulation of the Equations of Motion (including Kane's equations, a detailed discussion of Foucault's pendulum, linearization of the equations, steady motions, and systems at rest and resembling rest); Extraction of Information from the Equations of Motion (including energy and momentum integrals, numerical integration of the equations, generalized impulses, collisions, determination of constraint forces and torques, and systems governed by linear differential equations).

An agreeable feature of the text is that each section is systematically organized so that the main theory and results are stated first, followed by a derivation of these results and then by at least one illustrative example. The examples in all cases are interesting and substantial. The same is also true of the set of problems given at the end of the text corresponding to the various sections.

Because of the rather unique nature of the text (outlined previously in 1-4), the authors' fairly concise style and the emphasis on presenting all basic equations formally in their most general form, this is not a book which can be read casually. A reader must be prepared to follow each page carefully, and to adopt (at least while reading) the authors' viewpoints, definitions, and notations. The text is an example of the fact that, as in most fields, there are many ways, with many different kinds of emphasis, in which the principles and applications of dynamics can be presented. The approach in this book is consistent and sound. Whether one agrees or disagrees with the author's opinion that their means of presentation of the principles and equations of dynamics is simple and more fruitful than the more customary presentations, the text does appear to be a worthwhile contribution to the literature on dynamics, and a book which might be profitably perused by students or workers in dynamics.

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