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NEW BOOKS

Geometric Mechanics, Part II: Rotating, Translating and Rolling. By Darryl D. Holm, World Scientific, 2008, xvi+293 pp., \$68, pbk \$32

This book is based on a course of thirty-three lectures in geometric mechanics, taught annually by the author to fourth-year undergraduates in their last term in applied mathematics at Imperial College, London. It is a continuation of the elegant presentation of geometric mechanics of Volume 1, reviewed on the preceding page. It features one of the fundamental approaches for solving a variety of problems in geometric mechanics: the Euler-Poincaré approach, which uses Lie group invariance of Hamilton's principle to produce symmetry-reduced motion equations and reveal their geometric meaning. Chapter 1 explains Galilean relativity and the idea of a uniformly moving reference frame; Chapters 2, 3 and 4 treat rotating motion, first by reviewing Newton's and Lagrange's approaches, then following Hamilton's approach via quaternions and Cayley-Klein parameters, not Euclidean angles. The chapters are entitled as follows: 2. Newton, Lagrange, Hamilton; 3. Quarternions; 4. Quaternionic conjugacy; 5. Special orthogonal group; 6. The special Euclidean group; 7. Geometric mechanics on $SE(3)$; 8. Heavy top equations; 9. The Euler-Poincaré theorem; 10. Lie-Poisson Hamiltonian form; 11. Momentum maps; 12. Round rolling rigid bodies. The three appendices provide supplementary material: A. Geometric structure (a condensed summary of the essentials of manifolds), B. Lie groups and Lie algebras, and C. Enhanced coursework (variants of rotating motion that depend on more than one time variable, as well as rotations in complex space and in higher dimensions). There are 120 exercises and 55 worked examples distributed throughout the book, and there is a bibliography of about 150 items. The author states that the primary purpose of the book is to explain the following statement: "Lie symmetry reduction on the Lagrangian side produces the Euler-Poincaré equation, whose formulation on the Hamiltonian side as a Lie-Poisson equation governs the dynamics of the momentum map associated with the cotangent lift of the Lie-algebra action of that Lie symmetry on the configuration manifold". The author admirably succeeds in his aim.