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Book Review

Introduzione alla Cinematica dei Meccanismi, by Augusto Di Benedetto and Ettore Pennestrì. Volume I., 1993, 452 pp., ISBN 88-408-0761-6, Volume II, 1993, 308 pp., ISBN 88-408-0792-6, Volume III, 1999, 582 pp., ISBN 88-408-0962-7

REVIEWED BY GIOVANNI BIANCHI

The text, totaling over 1,300 pages, is divided into three volumes, all of them dedicated to the kinematics of plane mechanisms. The first volume, ''Structure and Finite Movements'' begins with an introduction, ''Historical Notes,'' recalling in particular scientists who made important contributions to the discipline in the eighteenth and the nineteenth century.

The three chapters that follow are devoted to the kinematic structure of mechanisms, to the rigid motions for one or two finite displacements, and to the rigid motions for three or four finite displacements. The three chapters of the second volume, ''Infinitesimal Motions,'' deal with polar curves, significant loci and points in infinitesimal rigid motions, plane rigid motions for two infinitesimal displacements, and rigid motions for three or four infinitesimal displacements.

In the third volume, ''Methods of Analysis,'' the first chapters review the basic concepts of kinematics, with particular attention (chapters seven and eight) for kinematic characteristics of the third order (jerk). Three chapters on graphical methods, graphoanalytical methods, and analytical-numerical methods for plane mechanisms follow. The last two chapters consider two particular classes of plane mechanisms: inverters, and mechanisms for intermittent motions.

Each chapter in the three volumes is followed by a section of Exercises and Complements, longer than the chapter itself. The solutions are provided for almost all the exercises, while the complements present many applications, and develop theses which, given their peculiarity, were not considered suitable for the general part of the book.

This encyclopedic work presents much material contained in the basic classical literature. However the appendices and complements provide valuable treatments of topics too often neglected. For instance, in Volume II, Sylvester's method of dialytic elimination, a very useful technique for the solution of nonlinear equations, is presented. When this volume was published (1993), an application of the method could be found only in a paper by Roth and Freudenstein, although more recently it has been treated in robotics textbooks by Lung-Wen Tsai and Angeles.

Other interesting items are: the solution of algebraic equations of the fourth degree (found only in some algebra textbooks); the method for the evaluation of the independence of the constraint equations; the theorem of the existence of implicit functions, useful for the determination of the degrees of freedom of a mechanism; and the systematic treatment of jerk.

The prefaces state that the text is intended, for students and researchers, as well as the professional engineer. In particular the authors insist on the usefulness of graphical methods in engineering practice. But while for synthesis a graphical method may be of interest (provided it is not too complex—otherwise the advantage over complex, but more powerful, analytical methods is lost), graphical methods of analysis are practically no longer employed in the industrial world. They really have only a didactic importance (and even that is sometimes questioned by teachers of mechanics of machines).

Today—one might say ''unfortunately''—industrial design makes large use of computational codes based mostly on analytical methods. The theory underlying these codes remains, as a rule, unknown to the designer. The importance of analytic-numerical methods is, on the other hand, clearly recognized throughout the book. In particular algebraic-numerical methods of kinematic analysis are discussed in the third volume, and many computational programs are also presented in the ''Exercises and Complements'' sections of all three volumes, together with the printouts for their implementation, (although from both the didactic point of view and that of possible technical applications, it does not seem opportune to include so many printouts of detailed computational programs that the authors themselves say could be ''optimized'').

Unexpected in a text of such dimensions and depth is the concern for the didactic objectives at the undergraduate level declared by the authors in the prefaces and by the publisher in his presentation of the three volumes. The text appears too demanding for undergraduate study. It is, instead, a very useful tool for researchers who wish to fathom the theory of the kinematics of plane mechanisms, and would seem suitable for graduate students preparing a thesis on the subject. The subject is treated clearly and rigorously, the historical references are ample, the drawings well done. The bibliography is rich, and appreciable the detailed treatment of topics to which texts of Mechanics of Machine usually reserve less emphasis than they merit. The systematic presentation facilitates consultation, and the wealth of examples developed in detail is certainly of great help.

The reviewer, as do the authors, would like to express the hope that these volumes shall serve as a valid defense of kinematics, a subject which often tends to be neglected.

