Appl. Comput. Math. **2** (2003), no. 1, pp. 86-87

Book Review

MULTIBODY SYSTEM MECHANICS: MODELING, STABILITY, CONTROL AND ROBUSTNESS†

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Mathematics and Its Applications(Sofia) Union of Bulgarian Mathematicians, Sofia, 2001. xxii+288 pp. ISBN954-880-09-1

The book is devoted to problems of a mechanics, which on the one hand already are "classical", and on the other hand still interest for both scientists and engineers. The plant of examinations also is "classical" - it is multibody system. For such system two large problems are still actual. It is possible to name them so: i) how to derive equations of motion of multibody system; ii) how to control its motion.

The first of these problems has gained a particular importance during last 20 - 30 years. It calls forth necessity of high-technology branches (robotics, aviation, space-system engineering, etc.) in development of software for analytical computations. The second of above mentioned problems solve within the framework of numerous directions, which evolve the different scientific schools.

The main body of this book may be divided into two topics. Within the framework of the first topic (chapters 1 - 4) the outcomes of development of new mathematical formalism for multibody systems are systematically expounded. In chapter 1 the kinematics of such systems is examined. Here the basic concept of the parastroohic matrix of a multibody system is introduced. Such matrix contains the information:
- about a mechanical configuration of system and its kinematical structure;
- about transition from quasi-coordinates to generalised co-ordinates.

The examples of constructing the basic matrixes for description of kinematics of a gyroscope (3 DOF = a number of quasi-co-ordinates), double pendulum (3 DOF), six-component manipulator (3 DOF), walking machine (24 DOF) and test bench (48 DOF) here are shown. In the chapters 2 and 3 the algorithms of a deducing of equations of motion (dynamics) of multibody system are explained. In these chapters the systems with a tree similar structure and holonomic constraints are considered. In chapter 4 the obtained earlier algorithms of deriving of equations of motion are developed for systems with nonholonomic constraints. Thus, in the first part of the book fundamentals of an especial direction of mechanics of multibody systems - an "aggregative mechanics" are given in a compact form. Mainly Russian scientists evolved this direction.

The general feature of structure of the first part of the book consists that in the above mentioned chapters a lot of new definitions are introduced. Therefore, these chapters are closely interlinked with each other and practically require a consecutive reading, but not selective one. Among complexities, which will be met by the reader, for example, it is possible to mention a usage of matrixes with 4...5 indexes. Apparently, the first part of the book would score, if comparison of computational consumption of offered algorithms and algorithms, used in modern robotics (on the basis of a transformation of Denavit - Hartenberg [1-3]) was carried out.

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Within the framework of the second topic in this book the problems of a stability, controllability and robustness of multibody systems are considered. In the chapters 5 - 7 the V.I.Zubov's ideas, for example, [4] are extended and advanced. Note, that the V.I.Zubov's basic outcomes, which are prolonged and advanced by the author and are presented in the reviewed book, also are published mainly in Russian literature.

The chapter 8 is devoted to control problems of attitude of a rigid body, and chapter 9 - is devoted to one algorithm of a filtration.

The book mainly is based on the authors investigations and gives good representation about outcomes published mainly in Russian issuings and which are insufficiently known for western reader. It is necessary to note, that for this reader it would be easier the using of relevant references, if in them the original issues, instead of translated, as in the book were indicated.

As a result, it is possible to make conclusion, that this interesting book will be useful to each reader of Int. J. APPLIED AND COMPUTATIONAL MATHEMATICS, who studies a mechanics of multibody systems.

References

[1] Denavit J., Hartenberg R.S. A Kinematic, *Notation for Lower-Pair Mechanisms Based on Matrices*, ASME J. Appl. Mech., 1955, vol. 22, pp. 215-221.

[2] Fu K.S., Gonzalez R.C., Lee C.S.G., *Robotics: Control, Sensing, Vision, and Intelligence*, McGraw - Hill Book Company, New York, 1987.

[3] Shahinpoor M. A., *Robot Engineering Textbook*, University of New Mexico, Harper & Row, Publishers, Inc. New York, 1987.

[4] Zubov V.I., *Lectures in Control Theory*, Nauka, Moscow, 1975 [in Russian].