Preface

Mechanisms and robots have been and continue to be essential components of mechanical systems. Mechanisms and robots are used to transmit forces and moments and to manipulate objects. A knowledge of the kinematics and dynamics of these kinematic chains is most important for their design and control. MATLAB® is a modern tool that has transformed the mathematical calculations methods because MATLAB not only provides numerical calculations but also facilitates analytical calculations using the computer. The present textbook uses MATLAB as a tool to solve problems from mechanisms and robots. The intent is to show the convenience of MATLAB for mechanism and robot analysis. Using example problems the MATLAB syntax will be demonstrated. MATLAB is very useful in the process of deriving solutions for any problem in mechanisms or robots. The book includes a large number of problems that are being solved using MATLAB. The programs are available as appendices at the end of this book.

Chapter 1 comments on the fundamentals properties of closed and open kinematic chains especially of problems of motion, degrees of freedom, joints, dyads, and independent contours. Chapter 2 demonstrates the use of MATLAB in finding the positions of planar mechanisms using the absolute Cartesian method. The positions of the joints are calculated for an input driver angle and for a complete rotation of the driver link. An external m-file function can be introduced to calculate the positions. The trajectory of a point on a link with general plane motion is plotted using MATLAB. In Chap. 3 the velocities and acceleration are examined. MATLAB is a suitable tool to develop analytical solutions and numerical results for kinematics using the classical method, the derivative method, and the independent contour equations. In Chap. 4, the joint forces are calculated using the free-body diagram of individual links, the free body-diagram of dyads, and the contour method. MATLAB functions are applied to find and solve the algebraic equations of motion. Problems of dynamics using the Newton–Euler method are discussed in Chap. 5. The equations of motion are inferred with symbolical calculation and the system of differential equations is solved with numerical techniques. Finally, the last chapter uses computer algebra to find Lagrange's equations and Kane's dynamical equations for spatial robots.

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