JGSP **30** (2013) 121–123

JOURNAL OF
Geometry and Symmetry in Physics
ISSN 1312-5192

BOOK REVIEW

Introduction to Robotics, by Tadej Bajd, Matjaž Mihelj and Marko Munih, Springer Briefs in Applied Sciences and Technology, Springer, Dordrecht 2013, vii + 83 pp., ISBN 978-94-007-6100-1, doi: 10.1007/978-94-007-6101-8.

The book is devoted to robot geometry and may serve as an useful tool to those who need basic information and guide to the kinematics of robot motion.

First Chapter - *Introduction*, gives an information about different groups of robots and how they are described in the literature. Contemporary robotics is a field of research of intelligent moving systems. Some of them copy the movement of various living organisms. In another group are robotic systems whose movement was invented by humans: mobile robots (wheeled vehicles), underwater robots (like smaller autonomous submarines), flying robots (smaller autonomous aerial vehicles applied for reconnaissance missions).

Biologically, the authors divide the robots in two groups: robot mechanisms which copy the human movements (robot arms, multi-fingered grippers, bipedal robot systems) and mechanisms inspired by the world of animals (snake robots, robotic fishes, robots imitating the movements of quadrupeds, six-legged and eight-legged spiders).

In this chapter, the robots are considered as serial chains of rigid bodies and joints, where each body is connected to two neighboring bodies. It is important the fact that six parameters are required to describe the position of an object in the space - three for orientation and three - for the position. The basic reference frames (they are four) used for describing the system motions are introduced. The first one x_0, y_0, z_0 is the base reference frame, fixed in space. The last one - x_n, y_n, z_n is at the end of the chain, also called robot end-point frame, or end-effector frame, and it is displaced when the robot is in motion. The other important frames are the both which are attached to two neighboring segments of the chains, namely: $x_{i-1}, y_{i-1}, z_{i-1}$ and x_i, y_i, z_i. The joints in the chain are rotational (R) or translational (T) and each joint has one degree of freedom. The Denavit-Hartenberg formalism and the 4×4 homogeneous transformation matrices are going to be used further in the book and the forward and inverse geometric models which one needs in robot control are described in details in the next chapters.

Chapter two - *Rotation and Orientation*, is a short introduction in the rotations in three-dimensional space. Rotations about an arbitrary axis is described using Rodrigues's formula. The orientation of a robot gripper is determined by a rotation matrix through Euler angles. The classical case is the 3-1-3 one, but here the authors consider the case 3-2-3. It has to be mentioned that in the case of different physical problems, the set of Euler angles is: 1-2-1, 1-2-3, 1-3-1, 1-3-2, 2-1-2, 2-1-3, 2-3-1, 2-3-2, 3-1-2, 3-1-3, 3-2-1, 3-2-3. The numbers 1, 2, 3 mean rotations around the corresponding coordinate axes, i.e., x, y and z. The authors consider roll-pitch-jaw (RPJ) angles (3-2-1) in the examples of an airplane and of robot gripper. After introducing some basic notion from quaternion algebra, quaternion presentation of rotations is described. The usual and convenient way of calculation of the orientations using matrices here is substituted with quaternion presentation of rotations.

Chapter three - *Pose and Displacement*, describes the pose (position and orientation) or displacement (translation and orientation) of an object through homogeneous 4×4 transformation matrices. The displacement is presented with respect to a reference (fixed) frame or with respect to a relative frame (attached to the object). The usual point of the object defining its position is its center of mass or some other characteristic point.

Chapter four - *Geometric Robot Model*, describes the pose (position and orientation of a coordinate frame attached to the gripper with respect to the frame attached to the robot base. The angles of rotations and the distances of the displacements of the translation joint are measurable and in this way the geometric robot model is expressed through the joint variables. Geometric models of three robots are presented in this chapter (SCARA robot manipulator, Cylindrical robot manipulator, Spherical robot manipulator).

Chapter five - *Geometrical Model of Anthropomorphic Robot with a Spherical Wrist*, presents forward and inverse geometric model of a six degrees of freedom industrial robot. Forward models are those presented in the previous chapter - calculating the pose (position and orientation) of the gripper from the known joint variables. The inverse geometric robot model represents the calculation of joint displacements from known pose of the robot gripper. The concrete example is the Stäubli robot, which is produced after the famous American Puma robot.

This book is recommended to all undergraduate and graduate students, specializing in robotics, and to the interested scientists. For further reading we could suggest the titles [1–7] listed below.

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