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Direct-Drive Robots: Theory and Practice

Haruhiko Asada, Kamal Youcef-Toumi

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This book describes the design concept and discusses the control issues related to the performance of a direct-drive robot, specifically, a direct-drive mechanical arm capable of carrying up to 10 kilograms, at 10 meters per second, accelerating at 5 G (a unit of acceleration equal to the acceleration of gravity). These are remarkable achievements compared to current industrial robots that move with speeds on the order of 1 meter per second.

Direct-Drive Robot presents the most current research in manipulator design and control, emphasizing the high-performance direct-drive robot arm in which the shafts of articulated joints are directly coupled to the rotors of motors with high torque. It describes fundamental technologies of key components such as motors, amplifiers and sensors, arm linkage design, and control system design, and makes significant contributions in the areas of power efficiency analysis, dynamic mass balancing, and decoupling theory.

The book provides a good balance between theory and practice, covering the practical design and implementation of this special robot as well as the theoretical design tools.

Contents: Part I: Direct-Drive Technologies. Introduction. Components. Part II: Arm Design Theory. Power Efficiency. Arm Design for Simplified Dynamics. Actuator Relocation. Design of Decoupled Arm Structures. Part III: Development of the MIT Arm. Mechanisms. Control Systems. Part IV: Selected Papers on Direct-Drive Robot Design and Control.

Haruhiko Asada is an Associate Professor, Kyoto University, and Lecturer at MIT He has built two prototypes of the direct-drive arm described here. Kamal Youcef-Toumi is an Assistant Professor, Department of Mechanical Engineering, System Dynamics and Controls Division at MIT. He has worked for three years with Asada on the development of the MIT high speed directdrive robot.

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