INDUSTRIAL ROBOTICS FUNDAMENTALS Theory and Applications FOURTH EDITION

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Publisher **The Goodheart-Willcox Company, Inc.** Tinley Park, IL www.g-w.com

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Manufactured in the United States of America.

Library of Congress Control Number: 2021933500

ISBN 978-1-64925-978-3

1 2 3 4 5 6 7 8 9 - 23 - 26 25 24 23 22 21

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Preface

Industrial Robotics Fundamentals: Theory and Applications is an introductory text that explores many aspects of robotics in a basic and easy-to-understand manner. The key concepts are discussed using a "big picture" or systems approach that greatly enhances student learning. Many applications and operational aspects of equipment and robotic systems are discussed.

We continually consider the needs of both students and instructors while preparing this comprehensive text. For this edition, content has been updated to reflect modern technology.

The development of the computer created what some experts have called the "Second Industrial Revolution." Many consider robots to be the prime movers of this revolution. It is more important than ever to have more than a basic knowledge of robots and robotics technology.

This text is a comprehensive approach to learning the technical aspects of robotics. It is divided into four units, covering broad areas of robotic principles, power supplies and movement systems, sensing and end-of-arm tooling, and control systems.

Unit I is devoted to the basic principles of robotic technology. Chapter 1 discusses the development and use of industrial robotics in the area of automation. A new section discusses the Fourth Industrial Revolution (Industry 4.0) and its impact on modern robotics. Chapter 2 prepares a solid foundation for understanding the characteristics and fundamentals of robotics, including basics components and operation. Chapter 3 provides a general safety overview for use in any laboratory setting. Chapter 4 provides an overview of programming languages and techniques used to program industrial robots. Chapter 5 explores the many applications for industrial robots.

Unit II addresses robotic power supplies and movement systems. Chapter 6 provides an overview of the electromechanical systems used with robots. Chapter 7 presents fluid power systems.

Unit III presents robotic sensing systems and end-of-arm tooling. Chapter 8 discusses the various sensors commonly used by robots to gain information about the external environment. Chapter 9 provides information about various end effectors and tools used to move workpieces from one location to another within a robot's work envelope.

Unit IV covers robotic control systems, basic maintenance, and implementation planning. Chapter 10 presents the basics of digital electronics, which includes information on microcomputers and microprocessors. Chapter 11 explains how the robot controller communicates with peripheral equipment found in robotic workcells, including vision systems. Chapter 12 provides an overview of maintenance procedures. Chapter 13 discusses some of the major factors to consider when using robotic systems in an industrial environment. Chapter 14 presents the use of robots outside the factory, artificial intelligence and expert systems, and suggested coursework and training related to the field of robotics. Chapter 15 helps give examples of how to build smaller robots.

About the Authors

Tim Ross is a Professor and Chair of Applied Engineering and Technology at Eastern Kentucky University, where he has taught for 18 years. He earned his doctorate in Vocational and Industrial Education from the University of Kentucky, a Master of Science in Industrial Professional Technology (Manufacturing Concentration) from Indiana State University, and a Bachelor of Science in Industrial Technology (Computer Integrated Manufacturing) from Western Kentucky University. In addition to his time at Eastern Kentucky, Dr. Ross has also had seven years of teaching experience in secondary and postsecondary systems. Tim currently teaches courses with a focus on automation, industrial applications, and career and technical education. He is also involved in conducting industry training in automation and fluid power. Dr. Ross has participated in the Association for Technology, Management, and Applied Engineering (ATMAE); International Technology and Engineering Educators Association (ITEEA); and Kentucky Association for Career and Technical Education.

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Reviewers

The authors and publisher wish to thank the following industry and teaching professionals for their valuable input into the development of *Industrial Robotics Fundamentals: Theory and Applications.*

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Mike Wilson McLane MS Robotics Engineering Academy Brandon, FL

Michael Zhang Fanshawe College London, Ontario, Canada

Acknowledgments

The authors and publisher would like to thank the following companies, organizations, and individuals for their contribution of resource material, images, or other support in the development of *Industrial Robotics Fundamentals: Theory and Applications*.

ABB Graco; Motoman **ABB** Robotics Accuray Incorporated Adept Technology, Inc. American Honda Motor Co., Inc. Anaheim Automation, Inc. Carnegie Mellon University Cisco-Eagle Daifuku Co., Ltd. De-STA-Co Edison Robot Educational Robot Company FANUC Robotics florin operea Grabit, Inc. Infrared Cameras, Inc. International Federation of Robotics iRobot Corporation Knightscope, Inc. Mack Corporation ME Labs, Inc. MobileRobots, Inc. Motoman NASA

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TOOLS FOR STUDENT AND INSTRUCTOR SUCCESS

Student Tools

Student Text

Industrial Robotics Fundamentals is an introduction to the principles of industrial robotics, related systems, and applications. The technical aspects of industrial robotics are covered in four units: Principles of Robotics; Power Supplies and Movement Systems; Sensing and End-of-Arm Tooling; and Control Systems and Maintenance. Topics included are degrees of freedom, programming, implementation planning, and system maintenance. Student learning is enhanced by the use of a systems, or "big-picture," approach to the material. End-of-chapter activities, including Apply and Analyze and Critical Thinking, build research skills that extend beyond the textbook. Features throughout the text address special interest topics, such as pioneers in the field, applications of technology, and careers.

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G-W Integrated Learning Solution



Features of the Textbook

The instructional design of this textbook includes student-focused learning tools to help you succeed. This visual guide highlights these features.

Chapter Opening Materials

Each chapter opener contains a chapter outline, a list of learning objectives, and a list of technical terms. The **Chapter Outline** summarizes the topics that will be covered in the chapter. **Objectives** clearly identify the knowledge and skills to be gained when the chapter is completed. **Technical Terms** list the key words to be learned in the chapter. The **Overview** provides an introduction and preview of the chapter content.

Illustrations

Illustrations have been designed to clearly and simply communicate the specific topic. Illustrations have been completely replaced and updated for this edition. Photographic images have been updated to show the latest equipment.

Expanding Your Learning

Inventor Spotlight introduces you to key figures in the development of robotics. **Careers in Robotics** explain different types of careers in robotics, including the education needed and the tasks related to that career. **Robotics Innovations** inform you of current and upcoming robotics technology. **Robotics in Society** show the different ways robotics technology has impacted our world.





End-of-Chapter Content

End-of-chapter material provides an opportunity for review and application of concepts. A concise **Summary** provides an additional review tool and reinforces key learning objectives. This helps you focus on important concepts presented in the text. **Know and Understand** questions enable you to demonstrate knowledge, identification, and comprehension of chapter material. **Apply and Analyze** questions allow you to research and to apply what you have learned in each chapter to real-world questions. **Critical Thinking** questions develop higherorder thinking and problem solving, personal, and workplace skills. **Activities** extend your learning and help you apply knowledge.

New to This Edition

The following changes have been made to the fourth edition of *Industrial Robotics Fundamentals: Theory and Applications* to strengthen the integrated learning solution and provide up-to-date information on the latest industry developments.

- The content of the text has been updated with new topics to reflect changes in the field of robotics technology, like the Fourth Industrial Revolution (Industry 4.0). Industry 4.0 materials have been added to help students understand changes to the industry as they happen.
- Feature images and content have been added to reflect real-world robotic applications in the industry. Updates include the latest trends and applications of robotics technology to help students connect theory from the text to what they will encounter in the industry.
- End-of-chapter materials updated using new Integrated Learning Systems (ILS) standards, which include Know and Understand, Apply and Analyze, and Critical Thinking type questions to assess learning at three cognitive levels of learning.

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