Parallel Robotic Machine Tools

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Dedicated to my parents: Hongtao Zhang, Yu Li who have inspired the thirst for knowledge in me all the time.

To my wife, Junmei Guo, daughter, Mengjia Zhang and son, James William Zhang for all their support.

Preface

Scope of the Book

Research and development of various parallel mechanism applications in engineering is now being performed in every industrial field. Parallel robot-based machine tool development is considered a key technology of robot applications in the future of manufacturing industries. The study described in this book is concerned with the basic theory, approaches, and algorithms in the field of parallel robot-based machine tools. A family of new alternative mechanical architectures which could be used for machine tools with parallel architecture is introduced. The kinematic analysis, stiffness analysis, kinetostatic modeling, optimization, design of these mechanism systems, and reconfigurable parallel kinematic machine tools are also discussed in the book.

The book includes the basic conceptions in parallel kinematic machines at the forefront of this field. It can be used as graduate textbook in advanced machine tools, or as a research monograph. This book is also suitable as a reference for engineers, researchers, and students who range from senior undergraduates to doctoral students who are interested in parallel robotics or advanced machine tools technology. This book gives the audience a deep understanding of the classical applications of parallel mechanisms in the field of mechanical manufacturing.

Features of the Book

- This book focuses on the junction of parallel robot and machine tools. A successful application of parallel mechanisms in the field of machine tools, which is also called parallel kinematic machines tools, has been the developing trend of advanced machine tools.
- This book results from the author's research in the field of parallel robotic machine tools over the last 10 years.
- This book not only includes the main aspects and important issues of robotic machine tools, but also references novel conceptions and approaches, i.e. the general kinetostatic model, artificial intelligence-based performance optimization, global stiffness model, and others.

- Most of the existing books regarding parallel kinematic machines were built upon the concept of traditional "Gough–Stewart" mechanism types. This suggests that most of the parallel mechanisms developed have six degrees of freedom. However, in many applications, five or less degrees of freedom are required. Hence, there is a need to study parallel mechanisms with less than six degrees of freedom, which this book focuses on.
- The analysis approaches proposed in this book are novel. If audiences can understand these issues and grasp these analytic approaches, they will open the gate to the advancing fronts of parallel robot-based machine tools.
- Other related books are complex and hard to read. As the organization principles of this book are from easy to hard, audiences can easily access the keys to understanding the theories of this book.
- A large number of case studies and numerical analyses help the audience master the main ideas of the book in both theory and practice.

Oshawa, Ontario, Canada, June 2009 Dan Zhang

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