Preface

Parallel mechanisms (PMs) are the systems with closed-loop chains. Since they have advantages of compactness, high speed, high stiffness, high accuracy, high load-to-weight ratio, and low moving inertia, PMs have attracted an intensive attention from the academic and industrial communities. They have been and are being used in a wide variety of applications such as industrial robots, surgical robots, motion simulators, macro-, micro-, and nano-manipulators haptic devices, and even parallel kinematic machines (PKMs).

In recent years, the research and application have evolved from general six-DOF PMs to lower-DOF PMs. In particular, the kinematics of lower-DOF PMs has become a hot issue due to their inherit characteristics, which may lead to more successful applications than their 6-DOF counterparts. The relating topics include mobility analysis and type synthesis and kinematic analysis and optimal kinematic design. These fundamental issues, namely, parallel kinematics in short, are all the focus of this book.

This book is a summary and an extension of the work accomplished by the authors in the field of kinematic design of parallel mechanisms and parallel kinematics machines over the last 15 years.

The whole book includes three parts. The focused topic is type, kinematic analysis, and optimal design, respectively. Part I (Chaps. 1 and 2) presents a systematic classification and evolution-based-type synthesis of PMs available in practical applications. Part II (Chaps. 3, 4, 5, and 6) involves several fundamental issues on kinematic analysis of parallel mechanisms with 2–6 DOFs, including position, velocity Jacobian, singularity, and workspace. Part III (Chaps. 7, 8, and 9) presents kinematic synthesis and optimal design of parallel mechanisms in terms of different kinematic performance evaluation criteria, accompanied with a few typical design cases.

The main features of the book include:

- *This book not only includes the main aspects and important issues of conventional parallel kinematics but also presents many novel conceptions and approaches, i.e., type synthesis based on evolution, performance evaluation and*

optimization based on screw theory, and singularity model taking into account motion and force transmissibility.

- *This book covers the systematic classification of PMs as well as providing a large number of mechanical architectures of PMs available to be used in practical applications.*
- *This book focuses on the kinematic design of parallel mechanisms. In particular, it selects parallel kinematic machines, one successful application of parallel mechanisms in the field of machine tools, as a design case.*
- *A large number of case studies and numerical analyses help the audience master the main ideas of the book at both theory and practice level.*

While this book is primarily intended for researchers and engineers working on parallel kinematic machines, parallel manipulators, parallel robots, and other parallel devices, we hope that it will also be of interest to a broader class of readers: (a) graduate students involved in the above areas since the methods proposed are mainly based on linear algebra and basic skills in kinematics, which they are familiar with, and (b) researchers in screw theory since the book acts as a successful application of screw theory in mechanism design. In brief, this book can be a textbook for graduate students as well as general scientific technique personnel.

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