Interdisciplinary Mechatronics

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Engineering Science and Research Development

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Table of Contents

Preface

The term “mechatronics” was first introduced in 1969 and since then it has evolved very fast and has been used in different dimensions and applications: as practices, as technologies, as a philosophy and as an educational discipline. Mechatronics represents a unifying interdisciplinary and intelligent engineering science paradigm. It is a holistic, concurrent and interdisciplinary engineering science discipline that brings out novel possibilities of synergizing and fusing different disciplines. Mechatronics concentrates on achieving optimum functional synergy from the earliest conceptual stages of the design process. The adoption of such a synergized inter- or transdisciplinary approach to engineering design implies a greater understanding of the design process. Mechatronics systems, processes and products enable the implementation of a scalable architecture in which functional elements are equipped with local control, sensing and diagnostics, intelligence and communication features. The design of mechatronical systems must ensure an effective transfer of complexity between individual technologies, both for individual elements making the system and for the system as a whole.

This book contains materials covering the state-of-the-art research and development within the interdisciplinary mechatronics engineering science and its educational evolution. This books includes 21 chapters, divided into five groups.

The first group covered by Chapter 1, presents mechatronics as an interdisciplinary engineering science and the evolution of human adaptive and friendly mechatronics (HAFM) while looking into the evolution of its educational programs and the necessity to develop potential programs fulfilling the need of different educational levels.

The second group includes chapters 2–5. It introduces micro-nanomechatronics and biological cell assembly, biological inspiration and the use of a central pattern generator (CPG)-based locomotion, hardware neural networks, etc. In addition, it describes the modeling of a human's learning processes towards achieving a continuous learning support system.

The third group covers chapters 6–10. It presents a range of topics focusing on biomechanics, rehabilitation and the development and evaluation of mechatronical robots of different structures and mechanisms supporting different applications. In addition, Chapter 10 presents the fundamentals on the use of shape memory alloys in soft robotics.

The fourth group consists of chapters 11–18. These chapters discuss different topics related to the control issues of different robotic mechanisms and physical structures, nonlinear Kalman filtering and the integration of sensors with motion. In addition, there are a few chapters on mobile robot design, implementation, navigation, localization and control.

The fifth group includes chapters 19–21. It presents mechatronics, the educational activities, practices and the needs for the formation of mechatronics engineers.

Interdisciplinary mechatronics engineering science helps to prepare engineers and scientists who are able to develop innovative and intelligent ideas for autonomous and smart interdisciplinary products and systems to meet today's most pressing challenges.

This book is aimed at mechatronics students, engineers and scientists, and also at graduate students, robotics engineers and researchers, and practicing engineers, who wish to enhance and broaden their knowledge and expertise on the fundamentals, practices, technologies, applications and the evolution of mechatronics as an interdisciplinary engineering science.

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