Preface

The high quality and ramifications of the production processes, the complexity of technological infrastructure, and software systems currently demand the design of reliable and efficient integrated automatic control systems. It is well known that a single fault can develop into multiple defects if the operator ignores or misunderstands the warning signals. These reasons have motivated the development of advanced automatization technologies by including supervision and monitoring tasks with fault detection and diagnosis facilities. This implies the design and implementation of automated devices based on physical principles, knowledge, and data-driven techniques. As a result of the aforementioned current demand, multidisciplinary diverse groups have been integrated that design diagnostic tools for specific applications by considering control and estimation theory, artificial intelligence tools, and engineering knowledge of the critical physical system in question. This development has led to the crucial concepts associated with fault diagnosis during the last 40 years. Advanced tools have been conceived in cooperation with researchers, engineers and technicians concerned about the safety, reliability and health performance of physical systems for society's benefit. Thus, critical fault scenarios for each engineering field have been studied and the fields' diagnosis tools have been implemented. Vulnerable industries such as aeronautic, nuclear, transportation, petrochemical, and electrical are examples where real-time fault diagnosis requirements are mandatory. By considering wireless communications and digital devices, one can comment that the advanced supervision systems with fault diagnosis allow improvements in aircraft maintenance, complex processes, rotating machines, autonomous vehicles, and service infrastructures, such as water, electricity and wireless communication. As a consequence, this technology can be extended to all physical systems, and it produces better environmental protection, more effective maintenance schedules, and better product quality.

The main objective of this monograph is to provide a set of technical contributions related to the critical subject of safe automatic control systems. In particular, advanced fault detection and isolation solutions, as well as fault-tolerant controls, are addressed, and some applications exemplify the advantages of the safe control technology implemented by software. The topics of this manuscript related to safe control have been studied by academic colleagues and postgraduate students of 10 institutions who have regularly attended the workshop Fault Diagnosis and Tolerant Control from the Spanish *Diagnóstico de Fallas y Control Tolerante* initiated and organized by academics over the last four years. Based on the material introduced in the workshop, some applications were selected that will be presented and discussed by using experimental results. Thus, this project is the result of the academic relationship between authors, and part of the content was generated from much fruitful discussions within the workshop's diagnostic and monitoring group and invited academic colleagues. The title of the monograph, **Fault Diagnosis and Tolerant Control: Applications**, was chosen to reflect the broad scope of the current fault diagnosis methods and the experience of our community. Seven case studies and their solutions were selected, where some fault diagnosis and control techniques will be discussed by using experimental results. The authors are all specialists in their subject, and the distribution of the chapters was selected based on their experience.

The presentation of the topics is accessible but formal, and a reader with a background in automatic control systems and signal processing can easily follow it. Within this monograph, all the procedures are introduced by considering the real cases, and each chapter can be read independently. In this way, the project also indirectly strives to promote the advantages of some feasible applications where advanced fault diagnosis tools and the fault-tolerant control can be used to improve the safety and reliability of critical physical systems.

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