Preface

Seven years have passed since the publication of the previous edition of this book. During that time, sensor technologies have made a remarkable leap forward. The sensitivity of the sensors became higher, the dimensions became smaller, the selectivity became better, and the prices became lower. What have not changed are the fundamental principles of the sensor design. They are still governed by the laws of Nature. Arguably one of the greatest geniuses who ever lived, Leonardo Da Vinci, had his own peculiar way of praying. He was saying, "*Oh Lord, thanks for Thou do not violate your own laws*." It is comforting indeed that the laws of Nature do not change as time goes by; it is just our appreciation of them that is being refined. Thus, this new edition examines the same good old laws of Nature that are employed in the designs of various sensors. This has not changed much since the previous edition. Yet, the sections that describe the practical designs are revised substantially. Recent ideas and developments have been added, and less important and nonessential designs were dropped. Probably the most dramatic recent progress in the sensor technologies relates to wide use of MEMS and MEOMS (*micro-electro-mechanical systems* and *micro-electro-opto-mechanical systems)*. These are examined in this new edition with greater detail.

This book is about devices commonly called sensors. The invention of a microprocessor has brought highly sophisticated instruments into our everyday lives. Numerous computerized appliances, of which microprocessors are integral parts, wash clothes and prepare coffee, play music, guard homes, and control room temperature. Microprocessors are digital devices that manipulate binary codes generally represented by electric signals. Yet, we live in an analog world where these devices function among objects that are mostly not digital. Moreover, this world is generally not electrical (apart from the atomic level). Digital systems, however complex and intelligent they might be, must receive information from the outside world. Sensors are interface devices between various physical values and electronic circuits who "understand" only a language of moving electrical charges. In other words, sensors are the eyes, ears, and noses of silicon chips. Sensors have become part of everyone's life. In the United States alone, they comprise a $12 billion industry.

In the course of my engineering work, I often felt a strong need for a book that would combine practical information on diversified subjects related to the most important physical principles, design, and use of various sensors. Surely, I could find almost all I had to know in texts on physics, electronics, technical magazines, and manufacturers' catalogs. However, the information is scattered over many publications, and almost every question I was pondering required substantial research work and numerous trips to the library. Little by little, I have been gathering practical information on everything that in any way was related to various sensors and their applications to scientific and engineering measurements. Soon, I realized that the information I collected might be quite useful to more than one person. This idea prompted me to write this book.

In setting my criteria for selecting various sensors for this edition, I attempted to keep the scope of this book as broad as possible, opting for brief descriptions of many different designs (without being trivial, I hope) rather than fewer treated in greater depth. This volume attempts (immodestly perhaps) to cover a very broad range of sensors and detectors. Many of them are well known, but describing them is still useful for students and those who look for a convenient reference. It is the author's intention to present a comprehensive and up-to-date account of the theory (physical principles), design, and practical implementations of various (especially the newest) sensors for scientific, industrial, and consumer applications. The topics included in the book reflect the author's own preferences and interpretations. Some may find a description of a particular sensor either too detailed or too broad or, contrary, too brief. In most cases, the author tried to make an attempt to strike a balance between a detailed description and a simplicity of coverage.

This volume covers many modern sensors and detectors. It is clear that one book cannot embrace the whole variety of sensors and their applications, even if it is called something like *The Encyclopedia of Sensors*. This is a different book, and the author's task was much less ambitious. Here, an attempt has been made to generate a reference text that could be used by students, researchers interested in modern instrumentation (applied physicists and engineers), sensor designers, application engineers, and technicians whose job is to understand, select, and/or design sensors for practical systems.

The previous editions of this book have been used quite extensively as desktop references and textbooks for the related college courses. Comments and suggestions from the sensor designers, professors, and students prompted me to implement several changes and correct errors.

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