Preface

Thanks to the advances in micromachining fabrication technologies and significant cost reduction due to mass production, miniature sensors of angular rate, or gyroscopes, found their way into the everyday life of every user of modern gadgets, such as smart phones, tablets or even wristwatches. Often without realising, many of us are carrying in our pockets fully equipped with all necessary sensors complete inertial navigation systems that not so long ago were available only for advanced vehicles in sea, land, air or space. Accelerometers and gyroscopes are found in specifications of any gadget supposed to react to user movements. And one of the most commonly used type of gyroscopes used to developed these systems is Coriolis vibratory gyroscope (CVG).

Needless to say that such a progress is a rewarding result of still ongoing research and development work of many scientists around the world. There are many books on design and fabrication of micromachined inertial sensors published by now, covering many important aspects of creating miniature inertial sensors. This book is intended to complete them with such aspects of gyroscopes development as theoretical analysis, mathematical modelling and analytical design, when desired performances are achieved by mathematical model analysis, rather than by trial and error in prototyping. Mathematical models and theoretical analysis are used both for optimal design of sensitive elements, as well as development of signal processing and control.

Chapter 1 gives an overview and classification of the most commonly used designs of CVG sensitive elements. Chapter 2 deals with deriving sensitive elements motion equations, and combining them into a single set of equations, covering most of the sensitive elements types. In Chap. 3 these generalised motions equations are solved for terms that can be used for angular rate measurements. Chapter 4 covers all aspects of CVG mathematical modelling in terms of demodulated envelope signals, thus providing the means for efficient analysis of sensitive elements dynamics as well as control and signal processing systems development. Calculation of major CVG performances is demonstrated in Chap. 5, along with an analytical approach to sensitive element design. The final Chap. 6 covers signal processing and control systems development. The latter Chaps. 5 and 6 are based on

the results from previous chapters, and are the only two chapters that can be read independently of each other.

This book requires from the reader at least basic knowledge of higher mathematics, mechanics and control systems theory. So unfortunately, not everyone interested in vibratory gyroscope theory would be an intended reader, but rather graduate students and higher. At the same time, readers will not be required to follow the references and obtain additional information elsewhere as there are no references in this book. Many results presented in the book could be referenced to the previous publications of the author, but these references were intentionally omitted in order to relieve the reader from the burden of searching for important information on the subject elsewhere. Nevertheless, a time ordered list of recommended important publications on Coriolis vibratory gyroscopes is given at the end for those who may need it.

Finally, there is no finish line in research, development and writing books about them. So feel free to express your opinions, give suggestions and ask questions. Hope you will have plenty of them.

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