Preface

Integrated modeling has been used for space applications for some time. In the period 1993–1995, the company Ball Aerospace and Communications Group pioneered use of integrated modeling for ground-based telescopes by setting up a simulation model of the Very Large Telescope of European Southern Observatory in Garching. Shortly thereafter, a team at Lund Observatory took up integrated modeling of ground-based telescopes for simulation of the proposed Euro50 telescope. Other groups have also been active within the field, for instance at European Southern Observatory, Jet Propulsion Laboratory and Massachusetts Institute of Technology.

In 1999, Mike Lieber, among the world-leading modeling specialists and with Ball Aerospace, gave a series of lectures at Lund Observatory in the field of integrated modeling. Subsequently, the thought of writing a book covering the area came up, although it took a few years before the plans matured further. Unfortunately, Mike could not find time to participate in the authoring but the outline of his lectures and much good advice from him has been highly important during the process of writing the book. We are in great dept to Mike for his significant input, in particular in the early phase of book writing, and for Mike generously sharing his deep knowledge with us.

Integrated modeling of telescopes is cross-disciplinary and covers both the field of telescope design and many special areas. This is, at the same time, the strength and the weakness of integrated modeling. It makes the way for simulation of large and complex opto- and electromechanical systems but also sets a limit to the depth that is possible in each discipline. We attempt to cover those areas that are imperative for setting up models but we are well aware that additional valuable information could be added and we hope to do so in possible future editions. In particular, given more time, we would have liked to include additional information related to space telescopes, attitude control of spacecraft, dynamics and orbital mechanics, scattered light, radiometry, polarization, and thermal transients.

Another problem of writing a cross-disciplinary book is related to the nomenclature for mathematical formulas. Each of the many technical fields

has, through the years, developed implicit conventions for the nomenclature pertaining to the field. Unfortunately, in a cross-disciplinary book, this leads to frequent conflicts between the different nomenclatures. For instance, in structural engineering, the symbol **D** is normally referring to a damping matrix, in control engineering it would be a feedforward matrix of a state-space system, and in optics, D generally is a standard symbol used in matrix methods for ray tracing. Rather than inventing an entirely new set of symbols, we have chosen to stay with the general practice of each discipline, and then carefully define the symbols before use. Hence, the reader should be aware that symbols may have different meanings at different locations in the book.

The book is primarily written as a handbook for professional designers of telescopes, or other optical systems, with good knowledge within one or more of the technical fields and with some knowledge in linear algebra, structural engineering, control engineering and optics. There are not many classes taught in the field, so we have not included problems or exercises. However, the book may well be used as a textbook at post-graduate level.

In all equations and formulas in this book, symbols represent physical quantities encompassing both the magnitude and the unit (if applicable). Nowhere do we implicitly assume specific units to be used. Constants and parameters are always quoted with an associated unit where applicable. The user is free to use whatever unit system that he or she prefers but obviously many analysts will wish to use a consistent set such as MKS units.

We wish to thank our dear colleague and friend, Dr. Mette Owner-Petersen, for very important assistance when writing the book. Mette is not only a gifted specialist in optics but has a profound knowledge of many fields within physics and mathematics. Mette has gone through large parts of our book and has made many suggestions for improvements or corrections. It is fair to say, that without the support from Mette, there would not have been a book today. In addition, Dr. Jacques Beckers, Dr. Albert Greve, Dr. Francesco Perrotta, and Mr. Henrik Thrane have kindly read parts of the book and given many good suggestions.

We also thank our colleague, Prof. Arne Ardeberg, for setting up the telescope team in Lund and providing us the possibility to work in this exciting field. Further, we wish to thank Dr. Harry Blom, editorial director at Springer in New York, for his important support and patience.

Last but not least, we thank our spouses for their continued encouragement and support during the long period of writing.

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