Preface

This book reflects the considerable growth in the application of quasioptics to system design at millimeter and submillimeter wavelengths. The development of quasioptics has, to a certain extent, paralleled the opening of these portions of the electromagnetic spectrum. The difficulties and limitations of the conventional methods of propagation used at longer wavelengths have impelled scientists and engineers to adopt essentially free-space propagation wherever possible, but the effects of diffraction remain significant because the size of components, when measured in wavelengths, is relatively small. Gaussian beam modes and Gaussian beam propagation, with their elegance and simplicity, have brought the quasioptical approach into favor among a great many users. While it is sufficiently accurate for most applications, Gaussian beam analysis also provides the starting point for more rigorous diffraction calculations when these are deemed necessary.

Part of the impetus for the development of quasioptical systems and components has come from radio astronomy, where the requirement for low loss is paramount. However, the application of millimeter wavelengths to a variety of commercial and military problems has resulted in significant use of quasioptics in radar, remote sensing, and materials measurement systems. Thus, the use of formerly exotic quasioptical propagation has broadened considerably in the past few years, and this trend seems likely to continue.

The goals of this book are to introduce quasioptical propagation to the nonspecialist and to present the basic guidelines for the design of components and systems. Since this is an involved subject, the level of detail has necessarily been restricted. This in part accounts for the perhaps large number of publications that are referenced. My idea has been to focus on the fundamentals, giving sufficient information to enable an engineer or scientist to move directly to practical design. Theoretical subtleties as well as more exotic examples are thus referred to in the text and bibliographic notes to each chapter. Because of the widespread use of quasioptical propagation and consequent development of a wide variety of components and many systems, it is inevitable that I have overlooked or omitted work that deserved to be included, and I apologize to those whose contributions have apparently gone unrecognized.

My work in the area of quasioptics has reflected involvement in the design and analysis of many radiometers making extensive use of quasioptics, first at AT&T Bell Laboratories, in Holmdel, New Jersey, and subsequently at the Five College Radio Astronomy Observatory at the University of Massachusetts, Amherst. During ten years as vice president for research and development at the Millitech Corporation, South Deerfield, Massachusetts, I was able to participate in the development of a variety of quasioptical systems for a wide range of applications. In addition, this research benefited from time spent at the Institute of Applied Physics of the University of Bern, the Max Planck Institute für Radioastronomie in Bonn, and the Institut de Radioastronomie Millimetrique in Grenoble. A portion of this writing was carried out while on sabbatical leave at the Osservatorio Astrofisico di Arcetri, in Florence, and I thank Professor Gianni Tofani for making this productive and enjoyable stay possible. I am grateful to colleagues in all these places for their generous sharing of information and advice over many years. Tingye Li and Felix Schwering provided useful information about the historical development of resonators and beam waveguides. V. Radhakrishnan helped clarify issues relating to the work of Sir J. C. Bose. I am also indebted to the Institute of Electrical and Electronics Engineers for sponsoring a series of lectures on quasioptical system design.

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