

# Preface

We began the research that led to this book with the sole intent of formulating probe-corrected planar near-field measurement techniques for electromagnetic antennas (and electroacoustic transducers) that are excited by wide-band pulses rather than by a single-frequency (or narrow-band) signal. As the title of the book indicates, however, the scope of the research expanded beyond its initial intent and finally encompassed a general plane-wave theory for time-domain fields. In working toward the initial goal of formulating time-domain measurement techniques, we found it necessary to systematically derive Green's function formulas and plane-wave spectrum representations in the frequency domain, and to keep the frequency dependence of all the expressions explicit. This systematic development of frequency-domain representations for electromagnetic and acoustic fields is contained in Chapter 3 and the corresponding representations for static electric and magnetic fields are given in Chapter 4. Chapter 5 develops the Green's function and plane-wave representations for time-domain fields, and investigates various wave phenomena, such as "electromagnetic missiles," encountered only in the time domain. Within Chapters 3 and 5 are the formulas needed for planar near-field measurements without probe correction in the frequency domain and time domain, respectively.

With the help of the plane-wave spectrum representations of Chapter 3, the formulas required for the probe-corrected planar near-field measurement of antennas and electroacoustic transducers in the frequency domain are derived in Chapter 6. In Chapter 7 we derive the analogous time-domain, probe-corrected planar near-field measurement formulas that apply to pulsed electromagnetic and acoustic radiators. Chapter 8 contains the sampling theorems, reconstruction formulas, and computation schemes that determine the space-time sampling increments required to accurately and efficiently evaluate far fields from near-field data.

The plane-wave theory of time-domain and frequency-domain fields in Chapters 3 through 8 rests on the fundamental classical equations of electromagnetics and linear acoustics. Thus, Chapter 2 introduces these fundamental equations for time-domain and frequency-domain fields. We have made a special effort to develop linear acoustics along the same lines as electromagnetics, since linear acoustics is usually treated as an addendum to fluid mechanics or general acoustics. Chapter 2 also includes a great deal of background material that is either new or omitted in the classic textbooks. With Chapter 2 especially, we found that the writing fostered more research, which in turn led to a longer chapter than we had originally anticipated.

