

Preface

This textbook is a compendium of material covered in a course offered by D. L. Hysell to advanced undergraduates and graduate students in the Department of Earth and Atmospheric Sciences in the College of Engineering at Cornell University. Hysell's course evolved from another one offered in the Department of Electrical and Computer Engineering for many years by Professor Emeritus D. T. Farley. In developing his course, Farley combined material from three other courses that were offered at one time in the Electrical Engineering curriculum: one on radar, another on antennas, and a third on radio wave propagation. The fundamentals of signal processing were also introduced on an as-needed basis. The goal of combining material in this way was to provide students with an integrated understanding of all of the factors involved in the design of radar experiments and the interpretation of the measurements they produce.

The present-day course at Cornell serves students with interests ranging from radar meteorology to planetary radar to satellite-based remote sensing to ground-penetrating radar. As the students come from different colleges armed with diverse backgrounds, the course and this text endeavor to build a radar curriculum from first principles, from the ground up, imposing minimal requirements on familiarity with signal processing, electromagnetics, radio hardware, or specific radar applications. A solid grounding in undergraduate mathematics is taken for granted, however.

A typical, semester-long course might cover the material in Chapters 1–8, inclusive. This material is rather fundamental and common to most any radar application. Subsequent chapters address more specialized content that might be covered occasionally to varying levels of depth, based on student interest. Chapter 9, for example, presents a fairly detailed treatment of magneto-ionic theory, which would normally only be of interest to students studying the Earth's upper atmosphere. Chapter 10 addresses overspread targets, another highly specialized topic that is seldom treated in introductory radar texts but is crucial for certain problems. Chapters 11 and 12 deal, respectively, with weather radar and radar imaging, two very popular applications. While neither chapter is meant to offer a complete treatment of the subject in question, either should be sufficient to propel interested students in the direction of more advanced and specialized classes. A review of electromagnetics

sufficient for most radar-related intents and purposes can be found in the Appendix, and should be useful for students without background in this area.

The problems (Exercises) at the end of every chapter are meant to help students test their understanding of the most important concepts. Many of them are best solved with the help of numerical computations. Over the years, different computer languages and packages have fallen in and out of favor with our students. Present-day students seem to have little trouble tackling the problem sets using Python.