Radio Wave Propagation

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An Introduction for the Non-Specialist

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Preface

Understanding the propagation of radio waves in the vicinity of the earth's surface can be quite complex, especially if detailed theoretical knowledge is required. The transmission path is complicated by atmospheric, tropospheric and ionospheric effects, and the earth's surface itself, and other obstacles, can interact with the passage of radiation between a transmitter and receiver. Time of day and season of the year can also be important.

A full treatment of these aspects usually requires a detailed understanding of electromagnetic theory and Maxwell's celebrated equations and yet many practitioners, even electrical engineers, may not have that background in sufficient depth. Nevertheless, with the proliferation of wireless applications, particularly in the VHF and UHF ranges, there is often the need for the non-specialist to gain a working knowledge of the properties of radio waves and how they are affected by factors such as those outlined above. That is the purpose of this book. It treats the essential elements of radio wave propagation without requiring recourse to advanced electromagnetic concepts and equations; however it provides sufficient detail to allow those concerned with wireless systems to acquire quickly a practical working knowledge of the important concepts.

The treatment commences with an analysis of how *energy* (and power) is conveyed in free space, taking essentially a radiative transfer approach and thus avoiding the need to understand electric and magnetic field propagation at the outset. It then examines in some detail how the proximity of the earth and the atmosphere cause the radiation travelling from a transmitter to a receiver to follow one or more of three mechanisms – the surface, sky and space waves. Most attention is given to the space wave since it is the mechanism most commonly encountered in contemporary applications.

Radio wave propagation is placed in a practical context by considering the design aspects of communications systems at microwave frequencies. That requires an understanding of noise and its importance in systems design.

We take the unusual step of including a fuller consideration of the electromagnetic properties of materials late in the book rather than as an introductory chapter as

found in more theoretical treatments. It is placed here so that the contexts in which the knowledge of material properties is important have already been established.

The material is based on a single semester overview course suitable for later year undergraduate students in engineering or science.

Canberra, Australia 2007 *John A. Richards*

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