PREFACE

The present monograph is meant to complement the several excellent texts on electromagnetic theory which are available today. The contents should be of interest to graduate students in electrical engineering and physics, as well as to practising electromagneticists in industrial and academic laboratories. The overall purpose of the book is to discuss, in more detail than would a typical general treatise, the various 'infinities' which occur in electromagnetic fields and sources. To achieve this goal, the text has been divided into three parts.

The first discusses the 'distributional' representation of strongly concentrated charges and currents. It is well-known that a point charge at $r_0$ can be represented by a volume density $\rho = q\delta|r-r_0|$, i.e. the first term in a multipole expansion for $\rho$. More general sources—scalar or vectorial—require additional terms. These involve derivatives of $\delta$-functions, and are discussed at length in Chapter 2. The analysis there is based on an elementary presentation of Schwartz' Theory of Distributions, given in Chapter 1. In that chapter, as in the rest of the book, the approach is unashamedly that of the 'applied mathematician'.

Multipole expansions can be written for magnetic currents $K$ as well as electric currents $J$. It is well-known that electric currents can be replaced by equivalent magnetic currents, and vice versa. Several sections in Chapter 2 are devoted to an extensive study of these equivalences, particularly with respect to sources which are concentrated on a surface.

The second part of the book analyses the fields associated with concentrated sources. In the case of a static point charge, potential and electric field have singularities of the order of $1/|r-r_0|$ and $1/|r-r_0|^2$, respectively. When the source is time harmonic, however, stronger singularities occur. For the electric Green's dyadic, for example, they are of the order of $1/|r-r_0|^3$. The way to handle such singularities has generated an abundant—and often controversial—literature. Chapter 3 surveys the various possible approaches, but ultimately puts the accent on the distributional and modal aspects of the theory.

The third part of the book is devoted to an analysis of field behaviour near geometrical singularities such as sharp edges, tips of cones, and vertices of sectors. The mathematics involved are quite elementary, and the emphasis is laid on the presentation of numerical data useful to the practising electromagneticist.

The scope of the monograph is seen to be quite modest. It is clear that additional topics could have been included, e.g. a treatment of Green's
dyadics in non-homogeneous media (particularly layered ones), or a discussion of field behaviour near foci and caustics. These topics were deliberately left aside to safeguard the compact character of the book.

Many authors mentioned in the text took the trouble to read the paragraphs in which their work was quoted, and to suggest improvements and additions. These distinguished colleagues cannot be thanked individually, given their number. An exception must be made for Professor J. Boersma, whose extensive and critical remarks considerably increased the mathematical accuracy of many a section, particularly in Chapters 3 and 5.

Any formal qualities present in the text should be credited to the author's daughter Viveca, who applied her literary talents to a thorough criticism of the style of the original manuscript.

Finally, the author wishes to acknowledge the support given by his colleague and friend Professor P. E. Lagasse, and the competence with which two devoted secretaries, Mrs Buysse and Mrs Naessens, struggled with figures and equations.

Ghent

J.V.B.

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