



# **Selected Asymptotic Methods with Applications to Electromagnetics and Antennas (Synthesis Lectures on Computational Electromagnetics)**

*George Fikioris, Ioannis Tastsoglou, Odysseas N. Bakas*

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This book describes and illustrates the application of several asymptotic methods that have proved useful in the authors' research in electromagnetics and antennas. We first define asymptotic approximations and expansions and explain these concepts in detail. We then develop certain prerequisites from complex analysis such as power series, multivalued functions (including the concepts of branch points and branch cuts), and the all-important gamma function. Of particular importance is the idea of analytic continuation (of functions of a single complex variable); our discussions here include some recent, direct applications to antennas and computational electromagnetics. Then, specific methods are discussed. These include integration by parts and the Riemann-Lebesgue lemma, the use of contour integration in conjunction with other methods, techniques related to Laplace's method and Watson's lemma, the asymptotic behavior of certain Fourier sine and cosine transforms, and the Poisson summation formula (including its version for finite sums). Often underutilized in the literature are asymptotic techniques based on the Mellin transform; our treatment of this subject complements the techniques presented in our recent Synthesis Lecture on the exact (not asymptotic) evaluation of integrals.

Throughout, we provide illustrative examples. Some of them are applications to special functions of mathematical physics. Others, taken from our published research, include the application of elementary methods to develop certain simple formulas for transmission lines, examples illustrating the difficulties in solving fundamental integral equations of antenna theory, an examination of the fundamentals of the Method of Auxiliary Sources (MAS), and a study of the near fields of certain unusual types of radiators.

Table of Contents: Preface / Introduction: Simple Asymptotic Approximations / Asymptotic Approximations Defined / Concepts from Complex Variables / Laplace's Method and Watson's Lemma / Integration by Parts and Asymptotics of Some Fourier Transforms / Poisson Summation Formula and Applications / Mellin-Transform Method for Asymptotic Evaluation of Integrals / More Applications to Wire Antennas / Authors' Biographies / Index

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