Preface

The goal of this book is to describe, from my point of view, the most powerful methods for evaluating multiloop Feynman integrals that are currently used in practice. This book supersedes my previous Springer book 'Evaluating Feynman Integrals' and its textbook version 'Feynman Integral Calculus'. After the publication of these two books, powerful new methods have appeared and existing methods have been improved in essential ways. One more qualitative change is that most of the methods and the corresponding algorithms have been implemented in computer codes which are often public. In such situations, I prefer to describe these algorithms, rather than to provide 'hand-made' solutions, as I did in my two previous books. However, I do not explain how to use the corresponding codes and just refer to Internet pages and papers where tutorials and examples can be found.

In comparison to my two previous books, three new chapters have been added: One chapter is on sector decomposition, while a second describes a new method by Lee. The third new chapter concerns the asymptotic expansions of Feynman integrals in momenta and masses, which were described in detail in my other Springer book 'Applied Asymptotic Expansions in Momenta and Masses'. In this chapter, I first present a short summary of existing strategies for obtaining an expansion of a given Feynman integral in a particular limit. Then I describe, following papers that appeared after the publication of this book, how one can reveal algorithmically the regions relevant to a given limit within the strategy of expansion by regions. The chapter on Baikov's method has been reduced, in the present book, to a section in the chapter on integration by parts. The chapters on the method of Mellin-Barnes representation and on the method of integration by parts are written in a new way, with an emphasis on the corresponding algorithms and computer codes. The chapter on the method of differential equations has a new section and a new conclusion.

Although all the necessary definitions concerning Feynman integrals are provided in the book, it would be helpful for the reader to know the basics of perturbative quantum field theory, e.g., by following the first few chapters of the well-known textbooks by Bogoliubov and Shirkov and/or Peskin and Schroeder.

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