Preface

This book is a survey of basic oscillatory concepts with the aid of Mathematica® computer algebra system to represent them and to calculate with them. It is written for students, teachers, and researchers needing to understand the basic of oscillatory motion or intending to use Mathematica® to extend their knowledge. All illustrations in the book can be replicated and used to learn and discover oscillatory motion in a new and exciting way. It is meant to complement the analytical skills and to use the computer to visualize the results and to develop a deeper intuitive understanding of oscillatory motion by observing the effects of varying the parameters of the problem.

We assume the reader has some familiarity with Mathematica®, so we could focus on the physics of oscillatory motion. This book does not discuss programming in Mathematica® nor does it teach all the principles and techniques of applications using Mathematica®. However, Chapter 1 provides a basic introduction to Mathematica®, developed by Wolfram Research. New users will find that the materials in Chapter 1 enable them to become familiar with Mathematica® within a few hours. The reader can learn the essentials of Mathematica® through examples described in the book. Mathematica® commands and techniques are introduced as the need arises.

The author has used Mathematica® version 11 in the preparation of the material. All Mathematica® codes have been kept as simple as possible and should be backward compatible with earlier versions of Mathematica® or have equivalent representations. The codes should also run under later versions.

Chapter 2 deals with linear oscillatory systems which are standard discussions in most undergraduate textbooks. It ends with solutions of oscillatory systems in response to impulsive forcing functions.

A variety of numerical techniques are available in Mathematica® when solving nonlinear oscillatory systems when an analytic solution does not exist or is very difficult to find. The construction of Poincare section and the specific example of bifurcation in damped, driven, nonlinear pendulum is represented in Chapter 3, where the concept of chaos is slightly mentioned. Chapter 3 ends with an example of nonlinear system, the van der Pol oscillator.

This book is informed by the interests of the author in using Mathematica® to learn and discover physics in a new and exciting way.

The prerequisites for using this book are undergraduate courses in calculus, classical mechanics, and ordinary differential equations. Knowledge of computer programming would be beneficial but not essential.

Although extreme care was taken to correct all the misprints, it is very unlikely that I have been able to catch all of them. I shall be most grateful to those readers kind enough to bring to my attention any remaining mistakes, typographical or otherwise. Please feel free to contact me at:

GedankenBooks@gmail.com

Steven Tan