



# Celestial Mechanics - Volume 2: Part 2: Peturbation Theory

*Yusuke Hagihara*

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The launching of space vehicles has given rise to a broadened interest in the problems of celestial mechanics, and the availability of computers has made practical the solution of some of the more numerically unwieldy of these problems. These circumstances only further enhance the importance of the appearance of *Celestial Mechanics*, which is being published in five volumes. This treatise is by far the most extensive of its kind, and it rigorously develops the full mathematical theory.

Volume II, which consists of two separately bound parts, takes up the process of iteration of successive approximations, known as perturbation theory. Together, the two parts describe the classical methods of computer perturbations in accordance with planetary, satellite, and lunar theories, with their modern modifications. In particular, the motions of artificial satellites and interplanetary vehicles are studied in the light of these theories.

In addition to explaining the various perturbation methods, the work describes the outcomes of their application to existing celestial bodies, such as the discovery of new planets, the determination of their masses, the explanation of the gaps in the distribution of asteroids, and the capture and ejection hypothesis of satellites and comets and their genesis.

Part 1 consists of three chapters and Part 2 of two. The chapters (italicized) and their subcontents are as follows: Part 1—*Disturbing Functions*: Laplace coefficients; inclined circular orbits; Newcomb's operators; convergence criteria; recurrence relations; approximation to higher coefficients. *Lagrange's Method*: variation of the elements; Poisson's theorem; Laplace-Lagrange theory of secular perturbation; secular variation of asteroidal orbits; Gauss's method; discussion of the law of gravitation. Part 2—*Delaunay's Theory*: Delaunay's theory; theory of libration; motion of satellites; Brown's transformation; Poincaré's theory; Von Zeipel's theory. *Absolute Perturbations*: coordinate perturbation; Hansen's theory; Newcomb's theory; Gylden's theory; Brown's theory; Andoyer's theory; cometary perturbation; Bohlin's theory; solution by Lambert's series. *Hill's Lunar Theory*: Hill's intermediary orbit; the motion of perigee and node; the planetary actions; application to Jupiter's satellites.

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