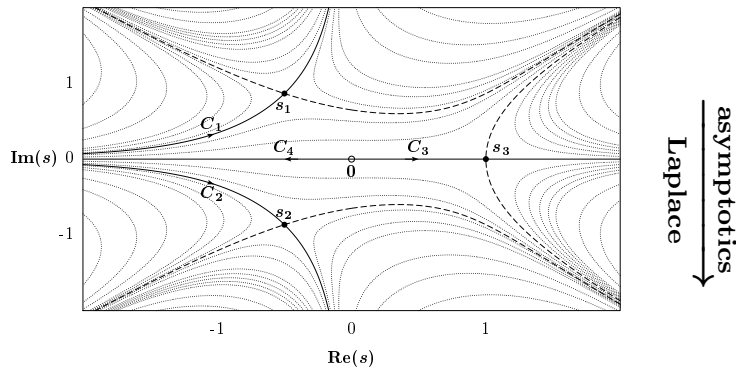


MATH 553: Asymptotics and Perturbation Methods

$$u + \frac{x}{4} \frac{du}{dx} = \frac{d^4 u}{dx^4} \quad \xrightarrow[\text{transform}]{\text{integral}} \quad u(x) = \int_C s^3 e^{-s^4} e^{xs} ds$$



$$\xrightarrow[\text{WKB}]{\text{asymptotics}} \quad u(x) \sim \sqrt{\frac{2\pi}{3}} \left(\frac{x}{4}\right)^{2/3} e^{-\frac{3}{2}\left(\frac{x}{4}\right)^{4/3}} \cos\left(\sqrt{\frac{27}{4}}\left(\frac{x}{4}\right)^{4/3} + \frac{19\pi}{12}\right)$$

Math 553 [5043]

Fall 2024, Wed, Fri 3:05–4:20 pm, Room 227 Physics Bldg

Prof. Thomas Witelski

Course outline: Asymptotic analysis and perturbation methods provide powerful techniques for obtaining simple analytical forms to reliably represent solutions to complicated problems in a range of different applied and mathematical settings.

This course will cover material on constructing asymptotic expansions for the solution of nonlinear algebraic equations, regular and singular perturbations problems, perturbations of matrix eigenvalue problems, asymptotics of integrals (Fourier and Laplace transforms), and solutions of differential equations (WKB theory, eigenvalue problems, multiple-scale analysis, boundary layers, and matched asymptotic expansions).

Prerequisites: Background in ordinary differential equations (Math 353, 356 or higher), undergraduate background in multi-variable calculus (line integrals or contour integrals from complex variables).

Textbook: *Advanced Mathematical Methods for Scientists and Engineers*
by C.M. Bender and S.A. Orszag, Springer.com (1999)

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