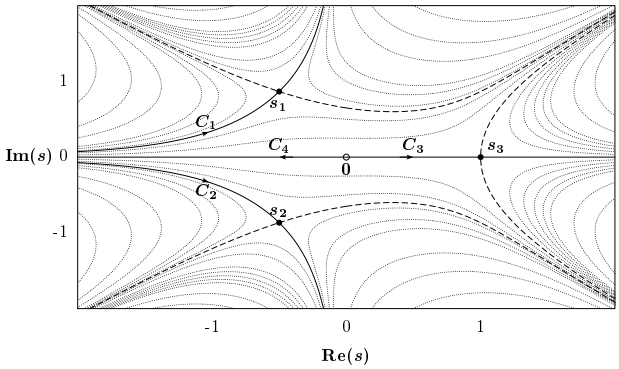
Duke UNIVERSITY Dept of Mathematics

MATH 553: Asymptotics and Perturbation Methods

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



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

Fall 2022 [4816]
Wed, Fri 5:15–6:30 pm
Room 324 Gross Hall
Prof. Thomas Witelski

Course outline: Asymptotic analysis and perturbation methods provide powerful techniques in applied mathematics for obtaining simple analytical forms to reliably approximate solutions to complicated problems in a range of different mathematical settings. The course will cover asymptotic expansions, solution of nonlinear algebraic equations, regular and singular perturbations problems, matrix eigenvalue problems, asymptotics of integrals - Fourier and Laplace transforms, and solutions of differential equations - singular points, WKB theory, multiple-scale analysis, boundary layers, and matched asymptotic expansions.

Prerequisites: Background in ordinary differential 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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