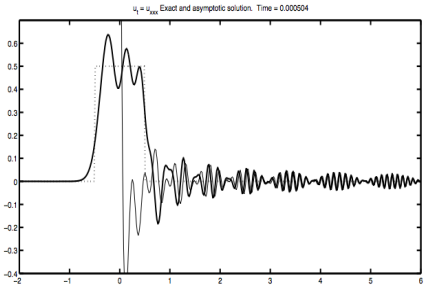
# Methods of Applied Mathematics




Asymptotic and exact solution to a dispersive PDE

Fall 2023, **MATH-GA 2701**
Mon+Wed, 11-12:15am, room 517 WWH.
Instructor: Oliver Bühler, room 1129 WWH
obuhler@cims.nyu.edu

Office hours: 3-5pm, 1129 WWH.

A graduate course for PhD and Master students interested in pursuing research in Applied Mathematics.

Prerequisites: undergraduate Linear Algebra and ODE.
Also, PDE is strongly recommended.

There is no assigned textbook for the course, but this downloadable book contains a reasonable cross-section of topics:

MH Holmes, *Introduction to Perturbation Methods,* Springer, 2nd edition 2013.
Free download from NYU via SpringerLink

Supplementary reading:

*Perturbation Methods,* E.J. Hinch, [Short & clever.]
*Linear and Nonlinear Waves*, G.B. Whitham; [Long & classic text on the topic]

Grading: this course will be graded based on approximately nine homework sets.

**Syllabus:**

Regular and singular perturbations of algebraic equations, asymptotic expansions, integral asymptotics, connection to linear ODEs with constant coefficients.

Method of multiple scales for ODEs, Duffing's equation, averaging, Kapitza's pendulum.

Dimensional analysis, scaling. Similarity solutions for PDEs. Matched asymptotic expansions, boundary layers, matching rules.

Green's function asymptotics, near-field, far-field, and multipole expansions.

Fourier methods for dispersive PDEs, group velocity, stationary phase asymptotics, WKB approximation. Geometric wave theory, eikonal and transport equations, ray tracing for inhomogeneous media, caustics.

Possible additional topics (depending on time and class interest): Gaussian random functions, stochastic processes, calculus of variations.