

國立陽明交通大學應用數學系

演講公告

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講 題：Newton-Type Methods, Stiffness, and Nonlinear
Preconditioning: A Dynamical View

時 間：115 年 4 月 28 日(星期二) 下午 14:20 –15:20

地 點：(光復校區) 科學一館 213 室

Abstract

Newton-type methods are among the most effective tools for solving large-scale nonlinear systems arising in scientific computing. Despite their fast local convergence, their global behavior can be unpredictable, with common issues such as overshooting, stagnation, and sensitivity to problem scaling—especially in stiff or highly unbalanced systems.

In this talk, we present a dynamical systems perspective for understanding these behaviors by interpreting Newton iterations as discrete approximations of an underlying continuous-time flow. This viewpoint provides an intuitive characterization of nonlinear imbalance in terms of stiffness, offering insight into why classical globalization strategies, particularly line search, may become ineffective or overly restrictive.

Motivated by this perspective, we revisit line search methods and introduce improved strategies, including curve search techniques, that better align with the intrinsic dynamics of the nonlinear system. We further show that nonlinear preconditioning can be naturally interpreted as a transformation that reduces stiffness and restores balance, leading to improved robustness and convergence.

Numerical examples from nonlinear PDEs illustrate how this framework not only enhances performance, but also provides a unified viewpoint for understanding globalization, acceleration, and stabilization in Newton-type methods.

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