特邀清华大学数学科学系贾仲孝教授作学术报告

报告题目：Theoretical and Computable Optimal Subspace Expansions for Matrix Eigenvalue Problems

报 告 人：贾仲孝 教授

报告时间：2023 年 6 月 26 日（星期一）上午 10:00-11:00

报告地点：藕舫楼 629

报告摘要：In this talk, we consider the optimal subspace expansion problem for the matrix eigenvalue problem $Ax=\lambda x$: Which vector w in the current subspace $\mathcal{V}$, after multiplied by A, provides an optimal subspace expansion for approximating a desired eigenvector x in the sense that x has the smallest angle with the expanded subspace $\mathcal{V}_w=\mathcal{V}+\mathrm{span}\{Aw\}$, i.e., $w_{opt}=\arg\max_{w\in\mathcal{V}}\cos\angle(\mathcal{V}_w,x)$? This problem is important as many iterative methods construct nested subspaces that successively expand $\mathcal{V}$ to $\mathcal{V}_w$. An expression of w_{opt} by Ye [*Linear Algebra Appl.*, 428 (2008), pp. 911-918] for A general, but it could not be exploited to construct a computable (nearly) optimally expanded subspace. He turns to deriving a maximization characterization of $\cos\angle(\mathcal{V}_w,x)$ for a *given* $w\in\mathcal{V}$ when A is Hermitian. We generalize Ye's maximization characterization to the general case and find its maximizer. Our main contributions consist of explicit expressions of w_{opt}, $(I-P_V)Aw_{opt}$ and the optimally expanded subspace $\mathcal{V}_{w_{opt}}$ for A general, where P_V is the orthogonal projector onto $\mathcal{V}$. These results are fully exploited to obtain computable optimally expanded subspaces within the framework of the standard, harmonic, refined, and refined harmonic Rayleigh-Ritz methods. We show how to efficiently implement the proposed subspace expansion approaches. Numerical experiments demonstrate the effectiveness of our computable optimal expansions.

报告人简介：贾仲孝，1994 年获得德国比勒菲尔德大学博士学位，清华大学数学科学系二级教授，第六届国际青年数值分析家--L. Fox 奖获得者(1993)，国家“百千万人才工程”入选者(1999)。现任北京数学会第十三届监事会监事长。主要研究领域：数值线性代数和科学计算。在代数特征值问题、奇异值分解和广义奇异值分解问题、离散不适定问题和反问题的正则化理论和数值解法等领域做出了系统性的、有国际影响的重要研究成果，所提出的精化投影方法被公认为是求解大规模矩阵特征值问题和奇异值分解问题的三类投影方法之一。在 Mathematics of Computation，Numerische Mathematik，Inverse Problems，SIAM 系列等国际著名杂志上发表论文 70 余篇，研究工作被 41 个国家和地区的 900 多名专家与研究人员在 19 部经典著作、专著和教材(国外)及 760 多篇论文中他引 1350 篇次。

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数学与统计学院

2023 年 6 月 25 日