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Preface

This special issue of *SCIENCE CHINA Mathematics* commemorates the 8th International Congress on Industrial and Applied Mathematics (ICIAM) held at China National Convention Center, Beijing, China from August 10 to 14, 2015. More than 3100 applied mathematicians from over 70 countries and regions attended the premier international congress in the field of applied and industrial mathematics.

The twelve articles included in this special issue are a snapshot of research in the field of applied mathematics, numerical analysis and scientific computing, as well as applications in science and engineering. We believe these articles demonstrate the state of research and ever-increasing of the field in the understanding and solution of challenging problems arising in a wide range of science and engineering areas, as well as the need for continuing research.

The first group of six articles covers mathematical theory and numerical approximations of partial differential equations:

• Xin Zhang and Aihui Zhou investigate the regularity of eigenfunctions of Kohn-Sham equations and present a singularity-based eigenfunction decomposition.

• Lin Lin and Jianfeng Lu consider a Schrödinger type partial differential equation and provide decay estimates of discretized Green's functions for the differential equation.

• Meiyue Shao, Lin Lin, Chao Yang, Fang Liu, Felipe H. da Jornada, Jack Deslippe and Steven G. Louie propose a low rank approximation to lower the cost of G_0W_0 calculations for electron excitation energies in molecules and solids.

• Heejun Choi and Jie Shen present several numerical approximation schemes for magneto-hydrodynamic equations.

• Fang Zeng, Jiguang Sun and Liwei Xu study a spectral projection method for solving a non-linear non-selfadjoint transmission eigenvalue problem arising in the inverse scattering theory.

• Weizhu Bao, Yongyong Cai, Xiaowei Jia and Jia Yin consider numerical discretizations and their error estimates for the nonlinear Dirac equation in the nonrelatistic limit regime in quantum field theory.

The second group of four articles focuses on the optimization theory and algorithms:

• William W. Hager and Hongchao Zhang develop an active set algorithm for a polyhedral constrained nonlinear optimization problem.

• Yuhong Dai and Caixia Kou provide an analysis of subspace minimization and propose an efficient Brazilai-Borwein conjugate gradient method for large scale unconstrained nonlinear optimization.

• Jiang Hu, Bo Jiang, Xin Liu and Zaiwen Wen study two examples of polynomial optimization problems over a single sphere.

• Shiqian Ma and Junfeng Yang establish theoretical results on applying the gauge duality theory to robust principal component analysis and semidefinite programming problems.

The third group of two articles is on the numerical linear algebra and matrix computations:

• Yunkai Zhou, Zheng Wang and Aihui Zhou propose filter-accelerated schemes to compute partial eigenvalue decomposition and partial singular value decomposition of large sparse matrices.

• Zhaojun Bai, Rencang Li and Wenwei Lin put forward two improvements to a locally optimal preconditioned conjugate gradient method for solving linear response eigenvalue problems.

All of the twelve articles in this special issue were invited by the guest editors, and all of them went through the regular peer-review process of the journal. We are grateful to the authors and referees

for their contributions to meet deadlines during the rigorous peer-review process. Special thanks are due to Zhihua Yang (*SCIENCE CHINA Mathematics* managing editor) and Jia Su (*SCIENCE CHINA Mathematics* copy editor) for their efforts on this special issue.

Guest editors:
Zhaojun Bai, Yu-Hong Dai, Weinan E, Chi-Wang Shu and Pingwen Zhang