MATH-IMS Joint Applied Mathematics Colloquium Series
The Chinese University of Hong Kong

This MATH-IMS Joint Colloquium Series is organized by Center for Mathematical Artificial Intelligence (CMAI), under Department of Mathematics and Institute of Mathematical Sciences (IMS) at The Chinese University of Hong Kong. The colloquium series focuses on mathematics and applications of artificial intelligence, big data and related topics.

Date: May 28, 2021 (Friday)
Time: 16:00-17:00 (Hong Kong Time)
Zoom Link: https://cuhk.zoom.us/j/92775210812

Convergence and Non-Convergence of Algebraic Iterative Reconstruction Methods

Speaker: Professor Per Christian Hansen
Technical University of Denmark

Abstract: Algebraic iterative reconstruction methods - such as ART (Kaczmarz), SART, and SIRT - produce good results for underdetermined X-ray CT problems, and they can easily incorporate non-negativity and box constraints. Hence they are quite popular alternatives to filtered back projection. When these iterative methods are implemented on with a focus on computational efficiency, different discretization schemes are used for the forward projection and the backprojection. In the underlying "language" of linear algebra, this means that there is a mismatch between the backprojection matrix B and the transposed of the forward projection matrix A. The use of such an unmatched A, B–pair has two consequences: the accuracy (compared to when using a matched pair) deteriorates, and the iteration may fail to converge. In this talk, we illustrate these issues with recent theoretical and computational results, and we present a novel approach to "fixing" the non-convergence with only a small computational overhead.

Bio: Prof. Hansen got his MSc in Electrical Engineering and PhD in Numerical Analysis at Technical University of Denmark (DTU) in 1982 and 1985. He became the Professor at Department of Applied Mathematics and Computer Science at DTU in 1996. Prof. Hansen is an applied mathematician. He has made tremendous contributions in the fields of numerical analysis, numerical linear algebra, iterative reconstruction methods, and computational methods for inverse problems. He has authored more than 100 scientific publications in leading journals, and several widely used books on numerical methods for inverse problems. He has also developed several related software packages, of which Regularization Tools is a popular toolbox for the analysis and solution of discrete inverse problems. Prof. Hansen has received numerous honours and awards. He received the BIT Prize for distinguished paper on numerical analysis in 1990. In 1994, he received the Statoil Prize in recognition of his work in numerical analysis. In 2005, he was recognized by the ISI Web of Knowledge award as most cited Danish mathematician. In 2015, he became the SIAM Fellow in recognition of his contributions to algorithms for rank-deficient and discrete ill-posed problems and regularization techniques.