Fast Structured Spectral Methods

Yingwei Wang

SAS Institue Inc.

Spectral methods have been used extensively in numerical PDEs due to their higher order of accuracy when compared to finite differences and finite elements methods. However, other low order methods usually lead to sparse linear systems while spectral methods often suffer from a huge computational complexity caused by dense matrices. In this talk, I will show that although the matrices arising from spectral methods are dense, they enjoy a hidden low-rank structure. This property could be exploited to dramatically reduce the computational cost and give birth to direct solvers with nearly optimal complexity and memory, thanks to the hierarchically semiseparable (HSS) representation for structured matrices. Both theoretical analysis and numerical experiments verify the efficiency and accuracy of our proposed methods.