1112-34-36 **Jie Shen** (shen7@purdue.edu), Department of Mathematics, Purdue University, West Lafayette, IN 47907-2061, **Yingwei Wang*** (wywshtj@gmail.com), Department of Mathematics, Purdue University, West Lafayette, IN 47907-2061, and **Jianlin Xia** (xiaj@math.purdue.edu), Department of Mathematics, Purdue University, West Lafayette, IN 47907-2061. *Fast Structured Spectral Methods.*

Spectral methods have been used extensively in numerical approximation of partial differential equations due to their bigger accuracy when compared to Finite Differences (FD) and Finite Elements (FE) methods. However, FD and FE usually lead to a sparse linear system while spectral methods often suffer from the huge computational complexity caused by dense matrices.

Fortunately, although the matrices arising from spectral methods are dense, they enjoy a hidden nice property, named low-rank structure, i.e. their off-diagonal blocks have small numerical ranks for a given tolerance which is nearly bounded or grows slowly with the sizes of matrices. This property could be exploited to dramatically reduce the computational cost and give birth to direct spectral solvers with nearly optimal complexity and memory, thanks to the hierarchically semiseparable (HSS) representation for structured matrices.

The Fast Structured Spectral Methods presented here include fast structured Jacobi transforms, fast structured spectral Galerkin methods for differential equations with variable coefficients, and fast structured spectral collocation methods. (Received June 19, 2015)