AMSC/CMSC460 Computational Methods   Fall 2014

Group Projects

1. *(Iterative Methods for Solving Linear Systems)*
The goal is to efficiently solve linear system $Ax = b$. Methods like Gauss elimination is costly for large system, especially when A is sparse. The idea of the iterative methods is to construct low-cost iterative procedures and solve x as the limit of the iteration procedure. Typical methods including Jacobi method, Gauss-Seidel method and Successive Overrelaxation (SOR) method. We shall investigate these methods with error analysis, Matlab implementation and experiments.

2. *(Polynomial approximation in ∞-norm)*
In the polynomial interpolation theory, there is a Runge phenomenon which states the fact that high order interpolation might suffer large pointwise error. The goal of this project is to find a polynomial which best approximate a function pointwisely. The best polynomial is the interpolating polynomial with respect to Chebyshev nodes. We will study the reason why this works and perform some Matlab experiments.

3. *(Extrapolation method for numerical integration)*
For composite Newton-Cotes type integration methods (and of course many others), an important question is, how fast does error go to zero as the cell size h becomes smaller. For instance, the composite trapezoid rule has the convergence rate $\mathcal{O}(h^2)$. Extrapolation methods are intended to make the rate larger so that the scheme will have a faster convergence. We shall investigate the Euler-Maclaurin formula, and understand how the extrapolation works. Also, we should produce some numerical experiments to verify the faster convergence rate.

4. *(Methods for eigenvalues and eigenvectors)*
Finding eigenvalues and eigenvectors for a large matrix A has lots of real world applications (e.g. Google search). There are many efficient methods which are used to find eigenpairs of a matrix. One widely used method is called power method, which is very efficient to find the largest eigenvalue and its corresponding eigenvector. Jacob method, QR method (and many more) are used to solve the complete eigen system. We shall investigate some of these algorithms and perform some experiments in Matlab.