

Spatial Discretization Used In SEL

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Collaborators:

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Presented at

Future Directions for M3D, PPPL

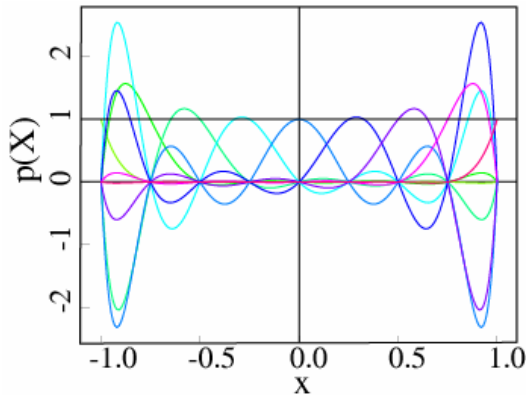
Princeton, NJ, March 19, 2007

Spatial Discretization

- High-order C^0 spectral elements, modal basis.
- Logically rectangular grid.
- Harmonic grid generation for adaptation and alignment

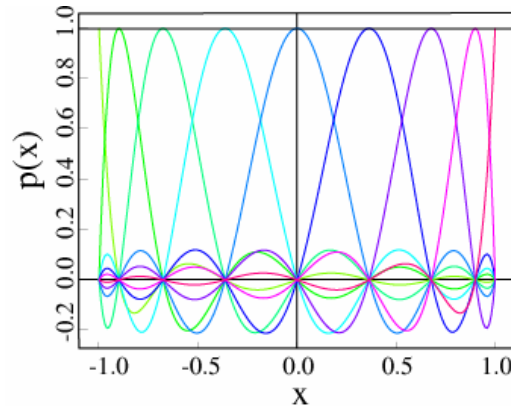
Alternative Polynomial Bases

Uniform Nodal Basis



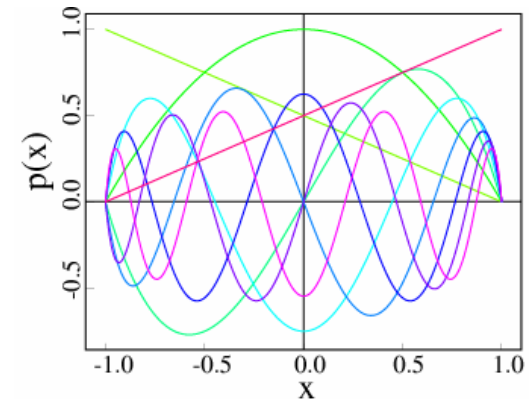
- Lagrange interpolatory polynomials
- Uniformly-spaced nodes
- Diagonally subdominant

Jacobi Nodal Basis



- Lagrange interpolatory polynomials
- Nodes at roots of $(1-x^2) P_n^{(0,0)}(x)$
- Diagonally dominant

Spectral (Modal) Basis



- Jacobi polynomials $(1+x)/2$, $(1-x)/2$, $(1-x^2) P_n^{(1,1)}(x)$
- Nearly orthogonal
- Manifest exponential convergence

Methods of Adaptive Gridding

Adaptive Mesh Refinement

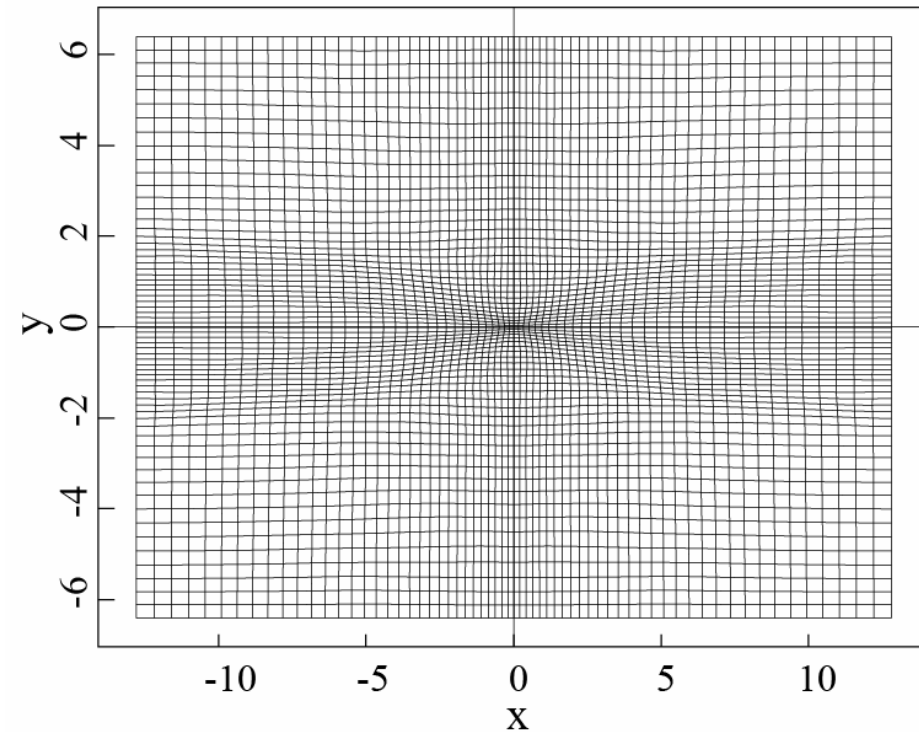
1. Coarse and fine patches of rectangular grid.
2. Complex data structures.
3. Oblique to magnetic field.
4. Static regrid.
5. Explicit time step; implicit a research problem.
6. Berger, Gombosi, Colella, Samtaney, Jardin

Harmonic Grid Generation

1. Harmonic mapping of rectangular grid onto curvilinear grid.
2. Logically rectangular
3. Aligned with magnetic field.
4. Static or dynamic regrid.
5. Explicit or implicit time step.
6. Liseikin, Winslow, Dvinsky, Brackbill, Knupp

Computational Grids

Peak of Reconnection Rate, $t = 20.0625$



Peak of Kinetic Energy, $t = 20.0625$

