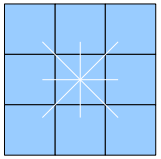
Current Hypre Build

Solving in the Fixed Grid (structhypre)



Current State

* The stencil looks like the left graph. It is a 9 point stencil instead of 5, in order to corporate cross terms.

* The stencil connections that goes into the matrix are determined by calling routine "getcoeffsfixed". It returns an array that contains the 9 connections to the neighbor cells. For example, in the self gravity problem it returns -4, 1, 1, 1, 1, 0, 0, 0, 0. For anisotropic diffusion problem, all the 9 connections can be non-zero because there is transverse fluxes.

* All the matrix and vector setups are within one simple routine.

* There is a function "boundarymod" that can modify the connections' values based on the position of the cell. currently transparent and fixed value boundary conditions are implemented, periodic boundary condition is still handled by the setperiodic routine.

* Only the PCG solver is available to be called.

* Only 2D is available now.

* Problems it can do: self gravity with periodic boundary, isotropic linear and nonlinear diffusion with periodic or transparent boundary. anisotropic MHD linear diffusion transparent boundary (there is a boundary problem not solved yet in this case, it gets the same result as the explicit solver). The nonlinear version of the MHD diffusion should be trivial to implement.

* Parallel.

Hurdles

* Implement Jonathan's new self gravity scheme so that structhypre can deal with adaptive mesh problems (also important for anisotropic MHD diffusion with AMR).

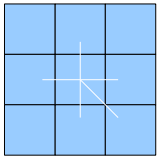
* Fixed boundary conditions in the self gravity problem. (multipoles)

* Time sub-cycling for diffusion. (not hard since the explicit diffusion solver sub-cycling can be copied over)

* Implement more solvers other than PCG.

Current Hypre Build

Solving in the AMR Grid (semistructhypre)



Current State

* The stencil looks like the left graph. It is a 5 point stencil, some of them are rather graph connections (when the connection is between different levels, or when the connection is diagonal).

* All the matrix and vector setups are within one simple routine.

* Only periodic boundary condition is implemented. But we can use "boundarymod" in this case since that routine does not rely on grid geometry.

* There are two solvers available: PCG and GMRES.

* Both 2D and 3D are available.

* Cylindrical coordinates.

* Can deal with improper nesting.

* Problems it can do: self gravity with periodic boundary, isotropic linear and nonlinear diffusion with periodic boundary. The anisotropic diffusion in this case is not easy, even with linear conductivity.

* Parallel. (with a glitch)

Hurdles

* Implement anisotropic diffusion into the semistructhypre. It may be better (less time consuming) to look at if we can do adaptive mesh in structhypre.

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