

Evaluation of Existing AMR Frameworks

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CIG

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Everyone Asks for AMR

- While CIG has already released codes that run on large machines, a persistent wish list item is for AMR versions.
- CIG is now at the point where we can begin working on it.

How to Proceed

- If you were young and foolish, you might consider retrofitting an existing code with AMR.
 - Typically, you end up rewriting the whole code anyway.
 - Getting an AMR package to scale on parallel machines is a Herculean task
- Fortunately, there are a number of existing packages out there.

Too Many

- Sundance
- Sumaa3D
- Sierra
- KeLP
- AGRIF
- Nirvana
- CTH-AMR
- Sfumato
- Athena
- Amiga
- FeTK
- Rhea
- deal.II
- LibMesh
- Sieve
- AMROC
- DAGH/Grace
- DukeAMR
- CCSE
- Paramesh
- Charm++
- HPC-MW
- Trellis
- Pyramid
- Cactus
- Overture
- Enzo
- RAMSES
- Cart3D
- SAMRAI
- Chombo

Available for Free

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- KeLP
- AGRIF
- Nirvana
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- Athena
- Amiga
- FeTK
- Rhea
- deal.II
- LibMesh
- Sieve
- AMROC
- DAGH/Grace
- DukeAMR
- CCSE
- Paramesh
- Charm++
- HPC-MW
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- Pyramid
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- Overture
- Enzo
- RAMSES
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- SAMRAI
- Chombo

Actively Developed

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- Nirvana
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- Athena
- Amiga
- FeTK
- Rhea
- deal.II
- Sieve
- LibMesh
- AMROC
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- Paramesh
- Charm++
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- Pyramid
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- Overture
- Enzo
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- SAMRAI
- Chombo

Scales

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- Rhea
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- AMROC
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- Paramesh
- Charm++

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- Pyramid
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- Overture
- Enzo
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- SAMRAI
- Chombo

Elliptic and Parabolic Eqs

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• Pyramid

• SAMRAI

• Chombo

• Paramesh

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• Paramesh

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• SAMRAI

• Chombo

The Contenders

- Paramesh
- SAMRAI
- Chombo

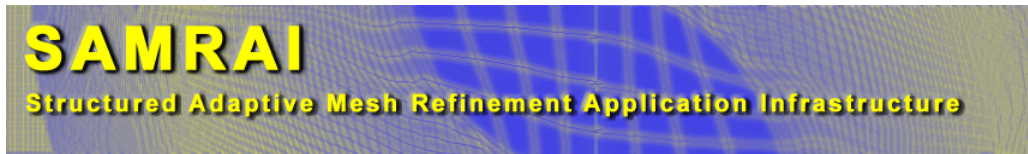
- None of these support finite elements well. The best library tuned for finite elements would either be Pyramid or deal.II.
- All have many users
- None of these are one-man shows

Paramesh

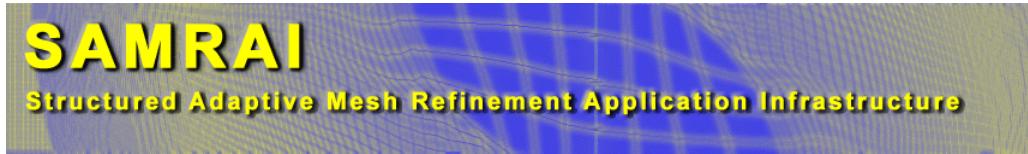
- http://www.physics.drexel.edu/~olson/paramesh-doc/Users_manual/amr.html
- Fortran 90
- Nasa open source license (BSD)

Paramesh

- Gold standard: Scales all the way up
- Multigrid is alpha
- Flash supports particles and may have better solvers, but can not be redistributed.



- <http://www.llnl.gov/casc/SAMRAI/software/software.html>
- Lawrence Livermore
- C++
- no commercial use
- Latest release was in 2006, but the website has been updated in May 2007 and there are many add-on projects that have more recent releases.



- Scales well
- Interfaces with many solvers (petsc, hypre, kinsol, pvode)
- Supports stitching together multiple grids
- Visualize with Vizamrai, Visit or ChomboVis



- <http://seesar.lbl.gov/ANAG/chombo/index.html>
- Lawrence Berkeley Lab
- C++
- BSD

- Latest release was this month (October 2007)



- Scales to 1000 processors
- Some interfacing with Hypre (somewhere?)
- Previous versions supported particles
- Comes with ChomboViz

Conclusions

- If I had to write a new code **today**, then I would try out Chombo while keeping an eye on SAMRAI.
- However, when the Rhea developers produce their code, very little would be reused.