SAND2007-7594P

Eigensolvers in Salinas/Sierra

JPL/Sandia Technology Exploration

Nov 16, 2007

Garth Reese

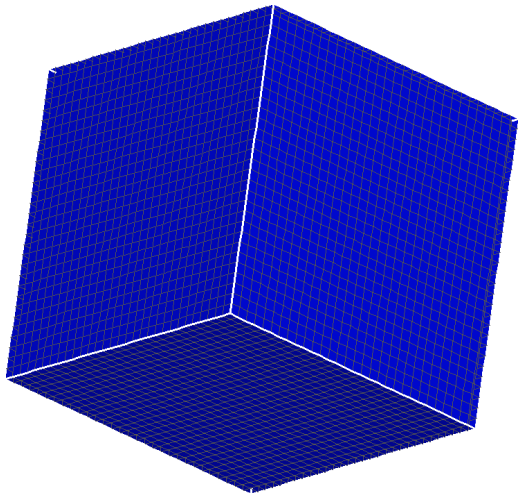
- What are current capabilities?
- How are these accomplished?
- What is the software status?

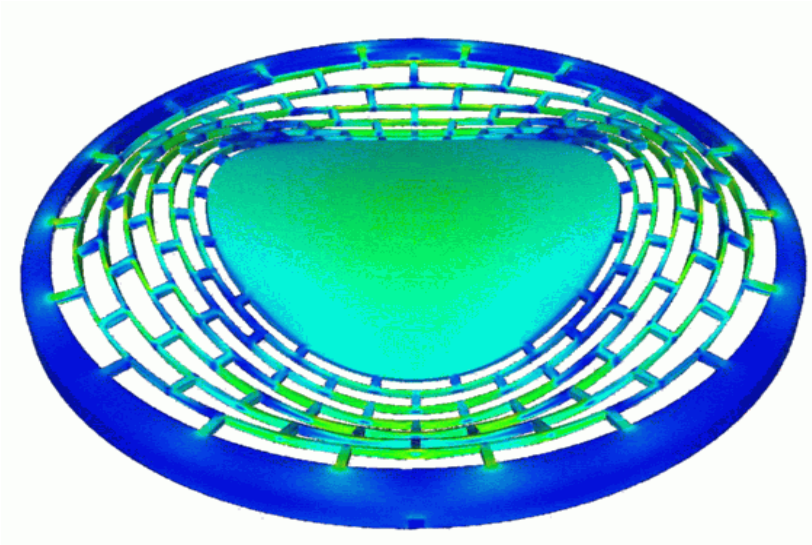
Salinas Eigensolver Capabilities

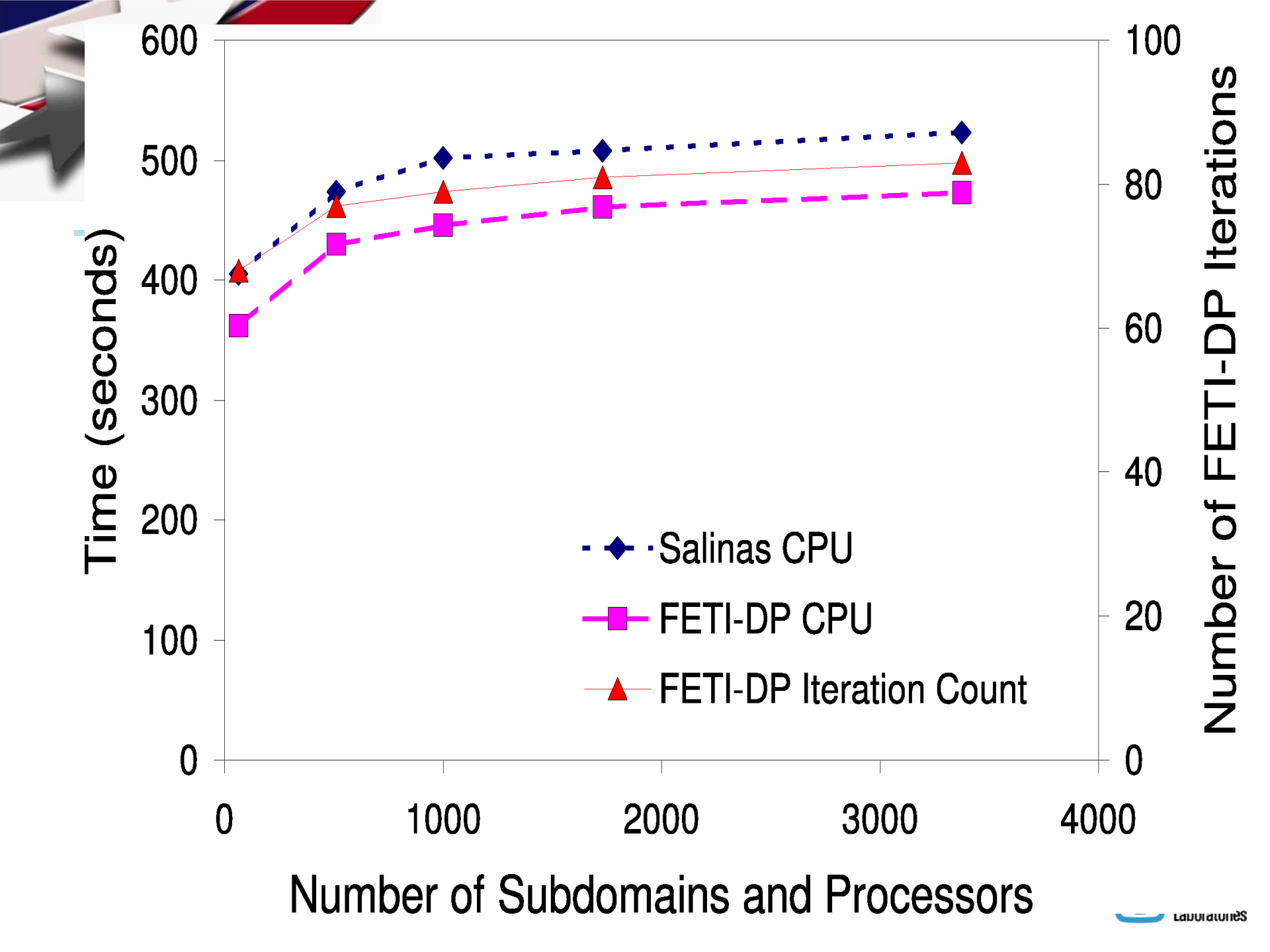
- Very robust capability.
- Very large systems with good scalability.
  - Solid meshes with 100M equations have been addressed.
  - Good support for constrained systems including RBE3 type and tied surface systems.
- Full structural dynamics type problems.
- Some quadratic eigenvalue capabilities. More under development.

Scalability

- Scalability depends on the element types and topography
- Evaluations with representative models
- Full wall clock response is reported

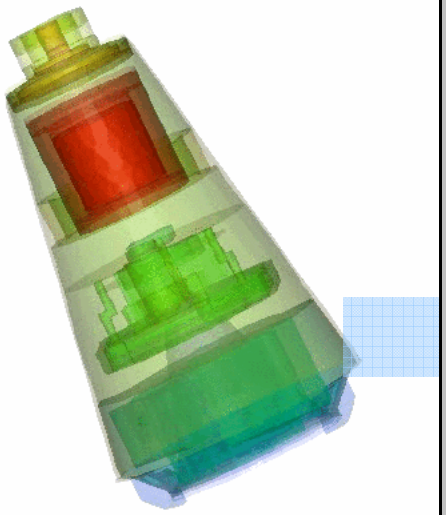





600
500
400
300
200
100
0
Time (seconds)
100
80
60
40
20
0
Number of FETI-DP Iterations
0
1000
2000
3000
4000
Number of Subdomains and Processors
Salinas CPU
FETI-DP CPU
FETI-DP Iteration Count

500k dof Electronics Package

Contains tet10 and tria6 elements



Mode	*Nastran*	*Salinas*
base plate	434.3 Hz	437.0 Hz
1st Bending	627.4 Hz	629.1 Hz
2nd Bending	657.2 Hz	659.2 Hz
Torsion	793.6 Hz	793.2 Hz

Nastran required 5 days on Sun compute server. Salinas required 30 minutes, using 128 processors

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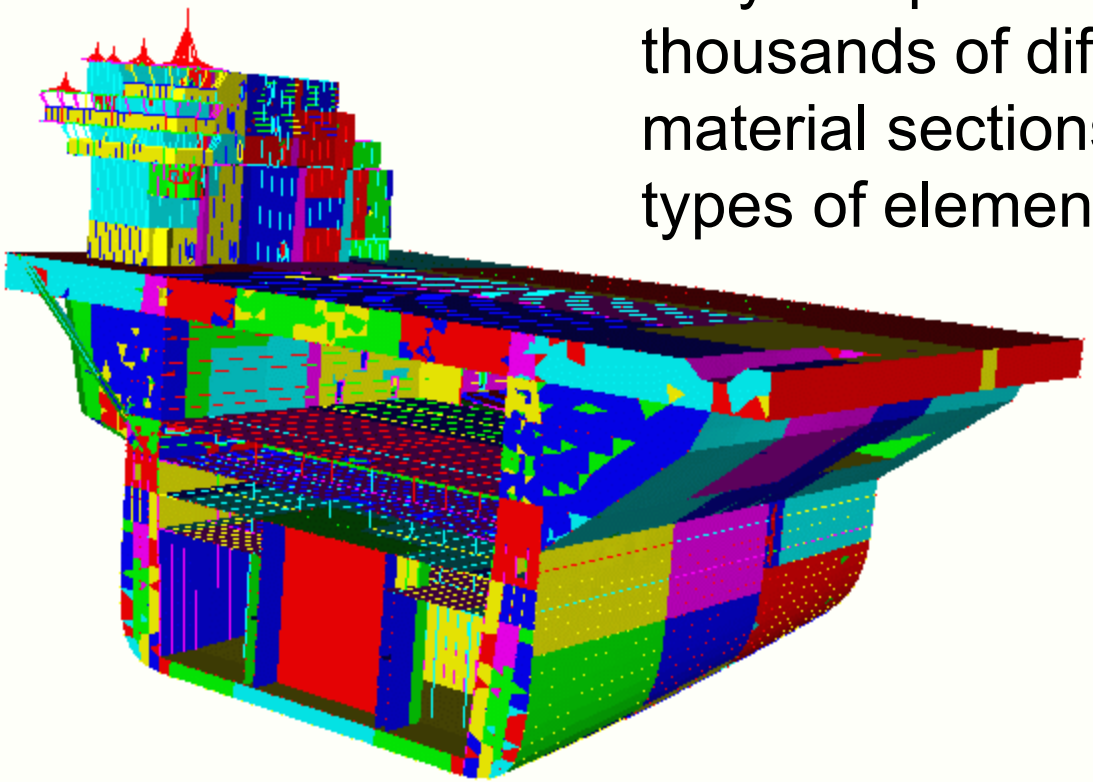
NGSS/NNS - Carrier Models



Very complex models with thousands of different material sections, and many types of elements

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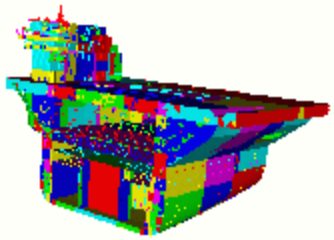
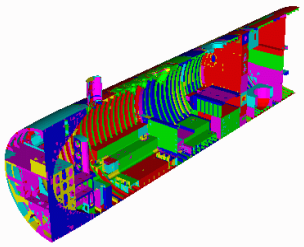
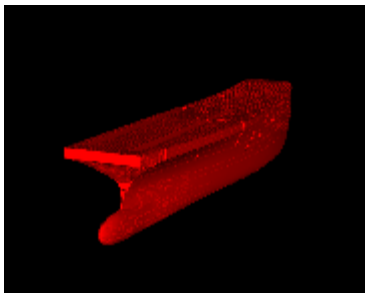
Applications



Sections of the Carrier



Seawolf



CVN76 - carrier

310,000 elements
170,000 nodes
4,700 material blocks

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How the Software Works

- Legacy with ARPACK eigensolver. This is a Lanczos type method.
- Domain Decomposition approach is used for both eigen and linear solver.
- Various linear solvers are inserted using polymorphism.
- Shift/Invert is used for floating structures.

$$(K - \sigma M)$$

σ is a large negative value. Our solvers stay SPD.

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ARPACK wrapper

- Issues with split MPI communicators
- A number of un-addressed issues in parpack.
- Deflation of previously computed modes (as in rigid body modes or restarted modes).
- Restart capability.

Software Status

- Eigensolver software is not designed as a library, but it would not be difficult to combine it as such.
- Software is very well tested.
- Further work and collaboration in the areas of quadratic eigenvalue problems.