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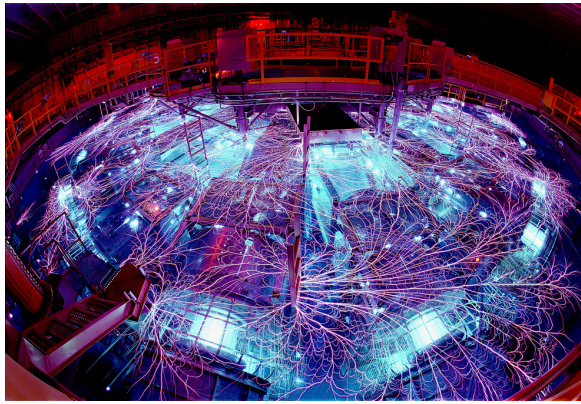
Sandia National Laboratories

SAND2016-4654PE





SPARC ROM Status

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Sandia National Laboratories

5/12/16

U.S. DEPARTMENT OF ENERGY | National Nuclear Security Administration

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Outline

Predictive Runs

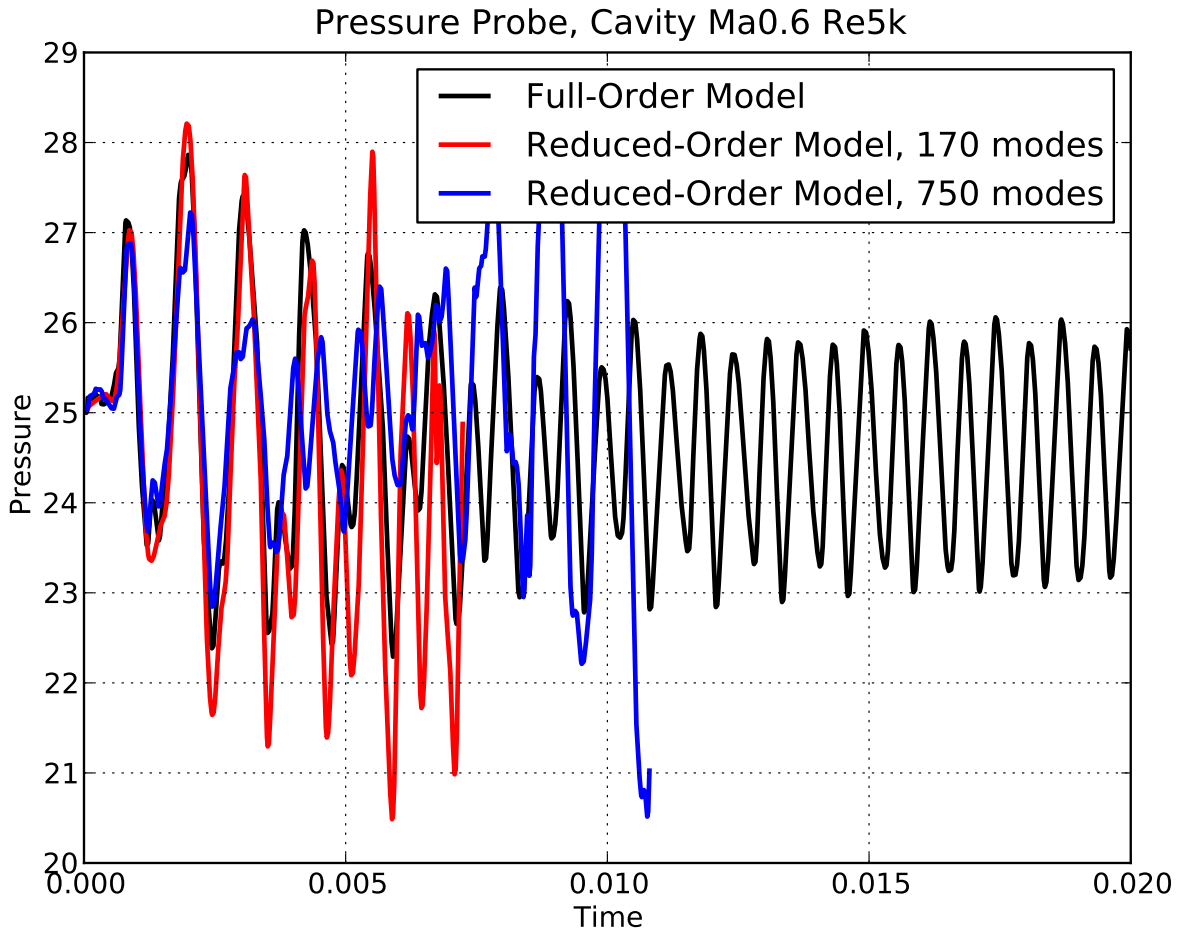
Reproductive Runs

Description of Runs

- Run FOM at Mach 0.575 and 0.625
  - FOM run with time step of 2e-7 (CFL of around 5) for 100,000 steps
  - Output 2000 snapshots per run (one every 50 time steps)
  - Snapshots are from full run, not periodic region
- Compute POD basis using two sets of snapshots
  - Subtract initial flow for Mach 0.6 from both sets
    - Resulting basis tailored for Mach 0.6
  - Snapshots are not non-dimensionalized
- Run ROM at Mach 0.6
  - ROM run with same time step as FOM (2e-7) for 100,000 steps
  - ROM run from beginning of simulation, not periodic region

Comparison of Pressure Traces

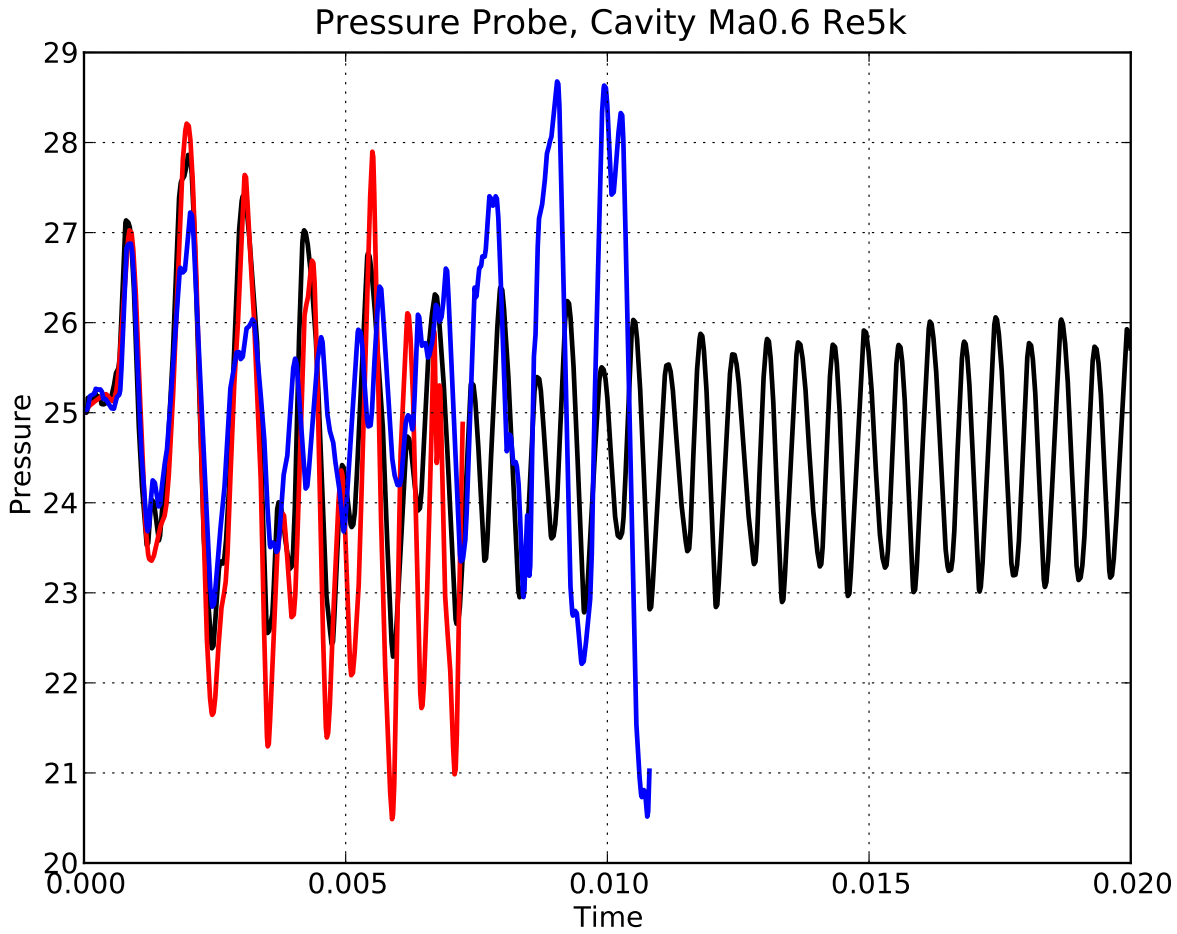
Pressure measured at a point midway up the downstream cavity wall:



- Both ROM runs went NAN

Comparison of Pressure Traces

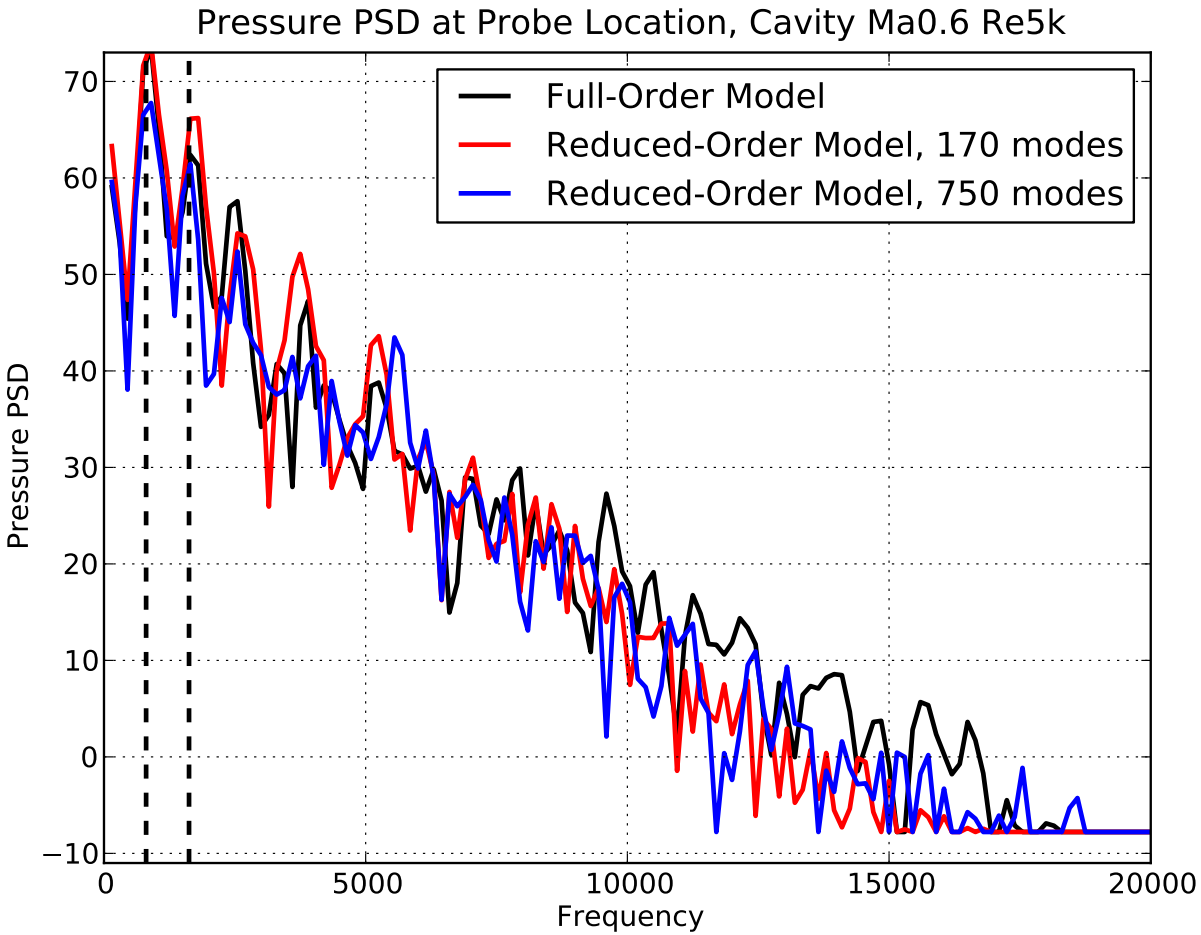
Pressure measured at a point midway up the downstream cavity wall:



- Both ROM runs went NAN

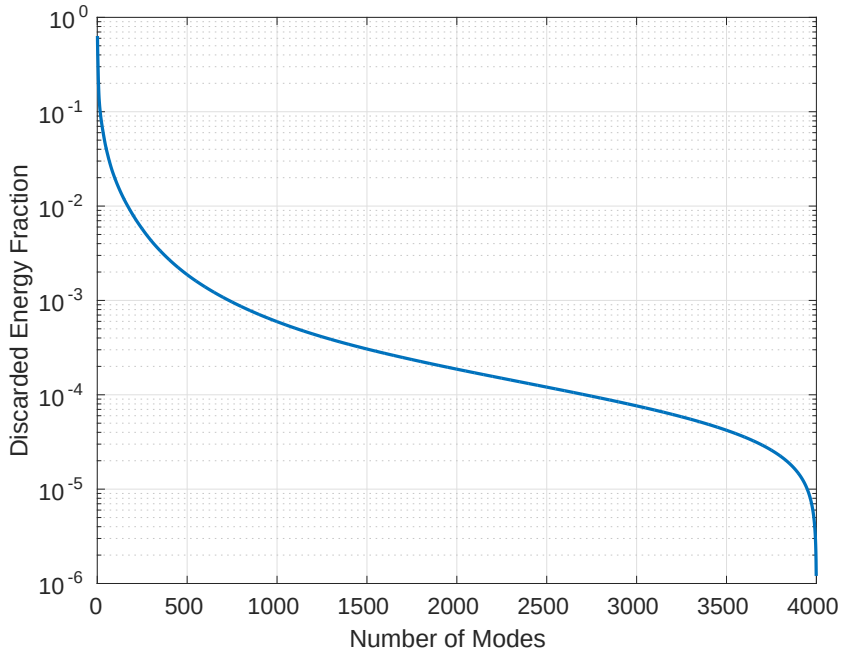
Power Spectral Density

Power Spectral Density of the Pressure signal:



- Dashed lines indicate frequencies estimated from pressure trace

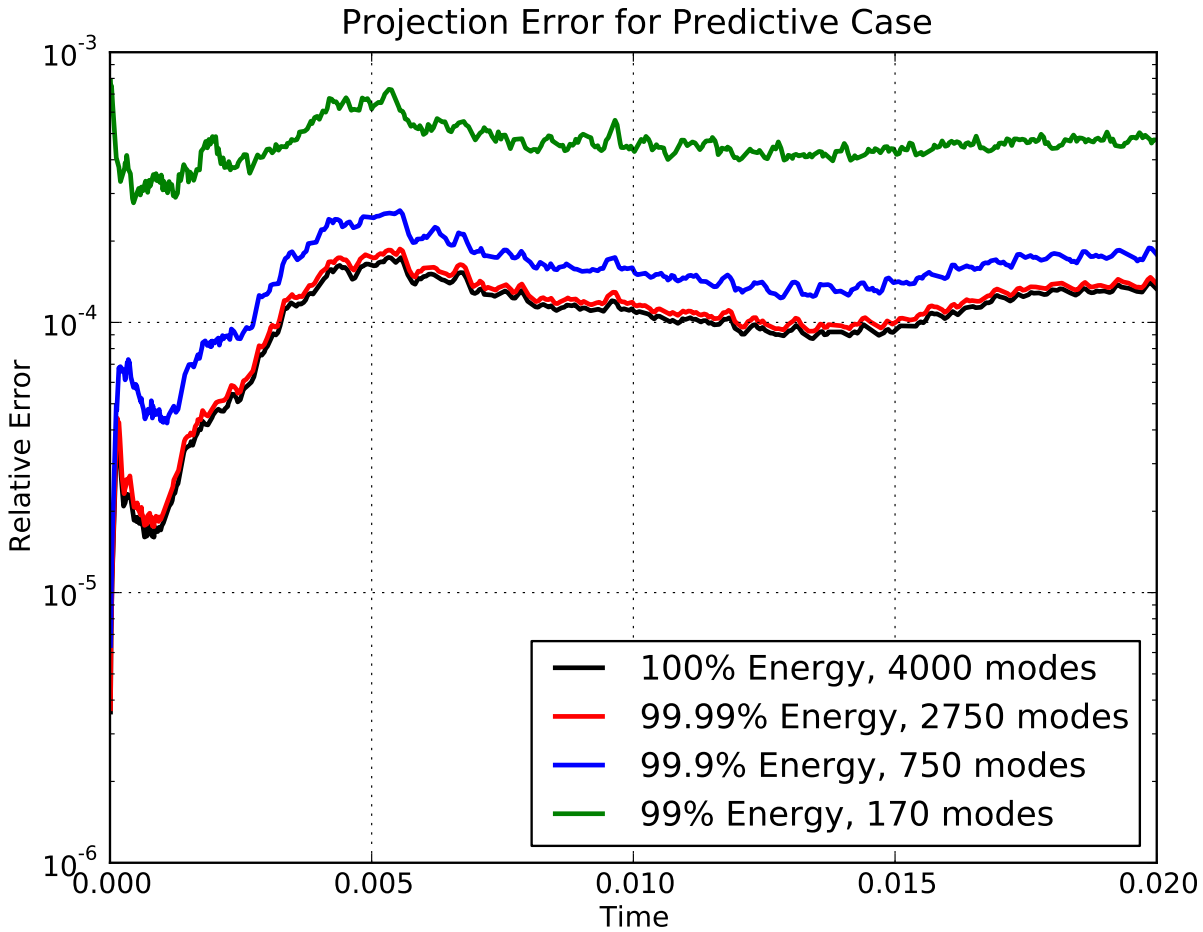
Energy Fractions, 2x2000 Snapshots



Modes	Percent Energy
3950	99.999%
2712	99.99%
733	99.9%
170	99%

Projection Error

2-Norm of difference between snapshots and flow reconstructed from projection onto the POD modes



Discussion

- These runs were not meeting the relative tolerance criteria, they were running for 10 iterations per time step and moving on
- Predictive runs on hold until issues with reproductive runs are resolved

Unclassified - Not Approved for Public Release - Do Not Distribute

Outline

Predictive Runs

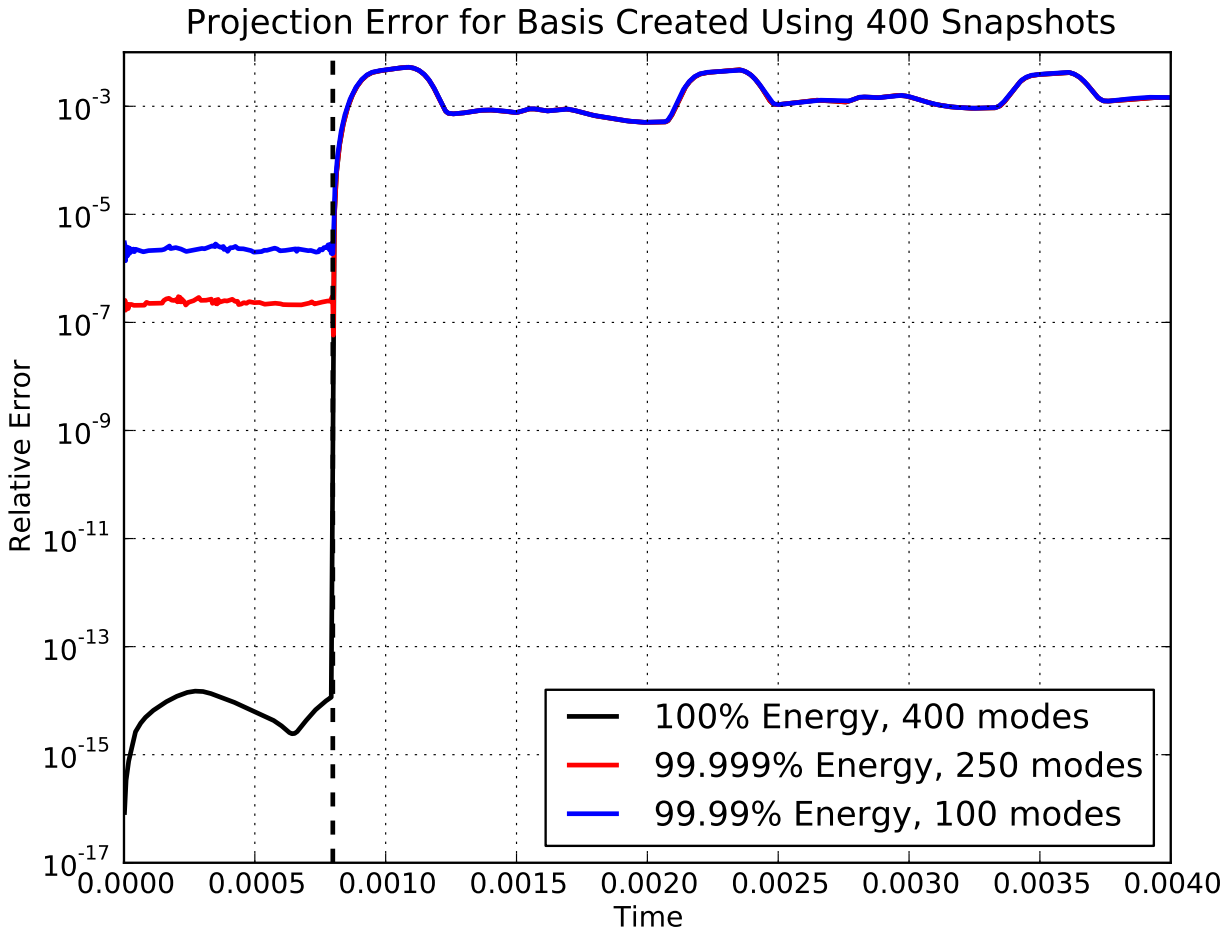
Reproductive Runs

Description of Runs

- FOM initially run with time step of 2e-7 (CFL of around 5) for 100,000 steps
- FOM restarted from t=0.15
  - Output snapshot every time step
  - Changed time step to 2e-6
    - Done to speed up ROM calculations, by reducing basis size
  - Ran FOM for 400 steps
  - Ran FOM for 800 steps
  - Ran FOM for 2000 steps
- Compute POD basis using all snapshots
  - Subtract initial snapshot
  - Snapshots are not non-dimensionalized
- Currently changing convergence criteria
  - Fixed bug, original results did not meet 1e-3 relative tolerance

Projection Error

2-Norm of difference between snapshots and flow reconstructed from projection onto the POD modes



- Dashed line indicates extent of data used to create POD basis

Projection Error

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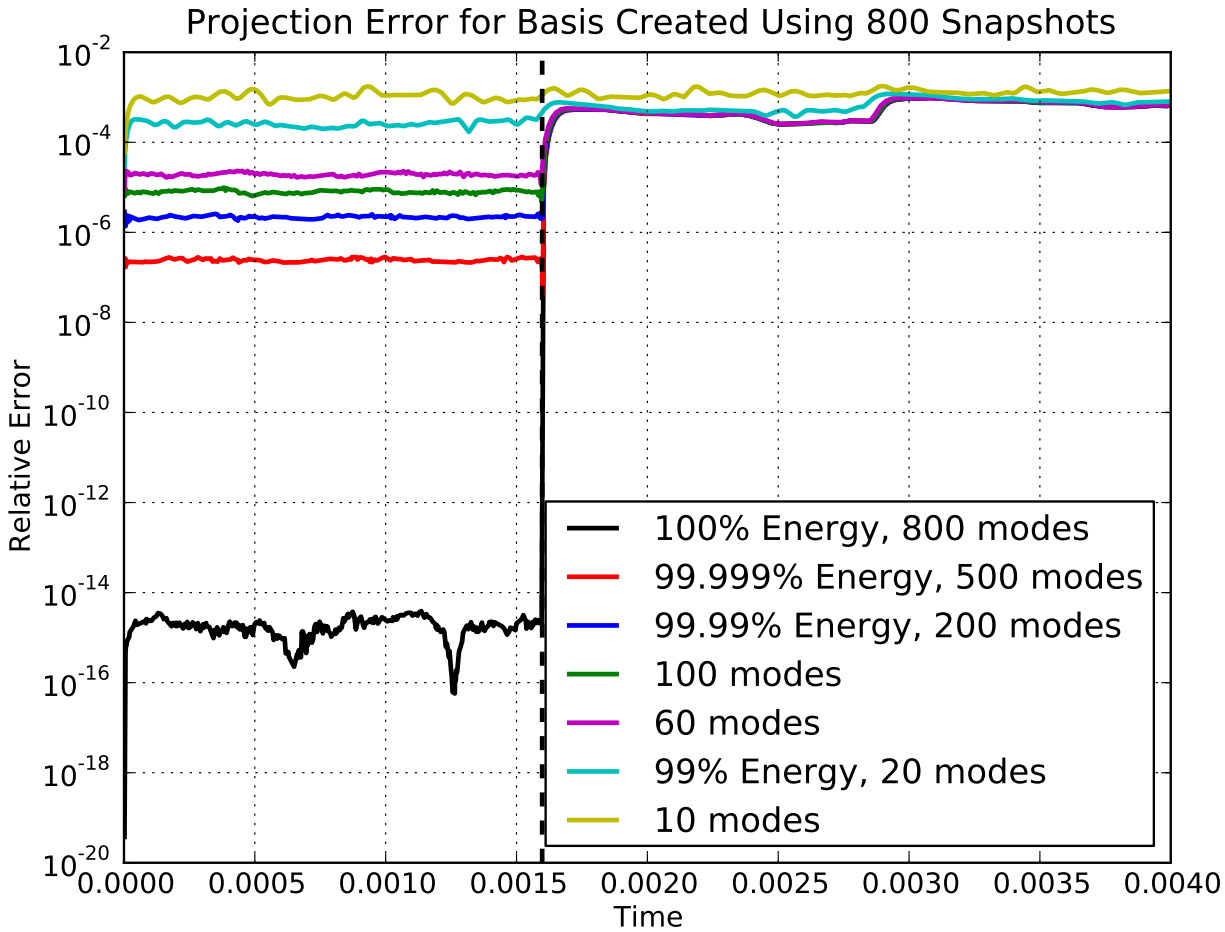

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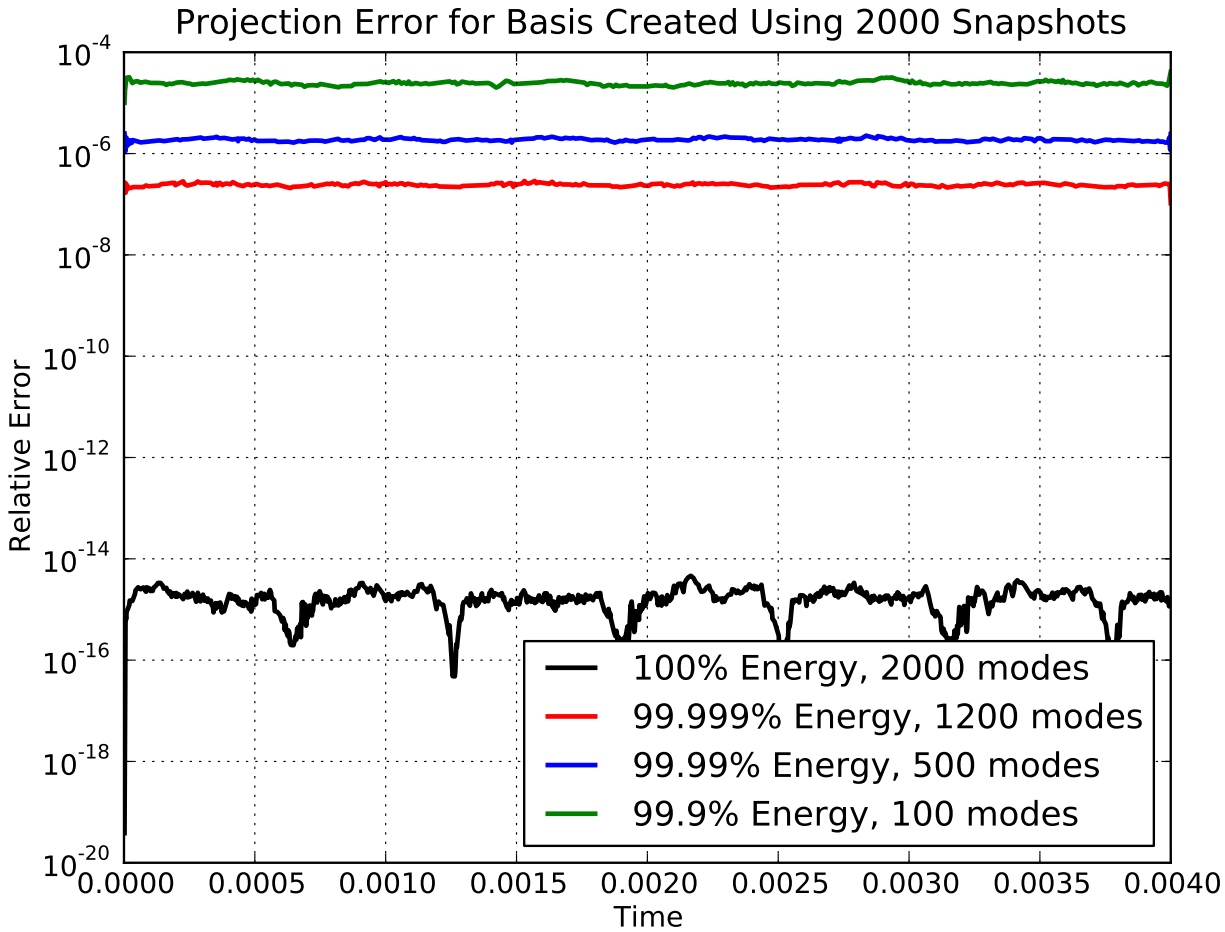

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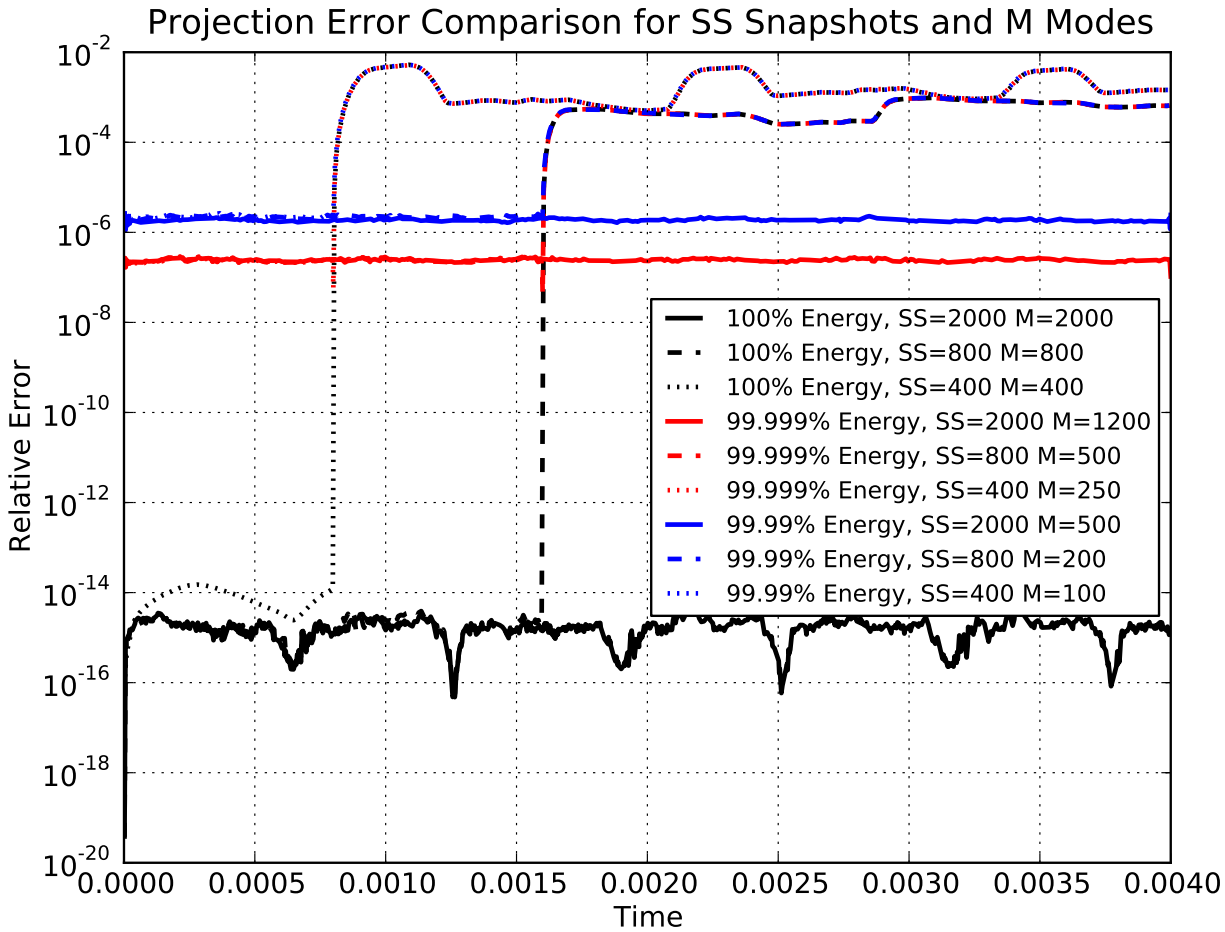
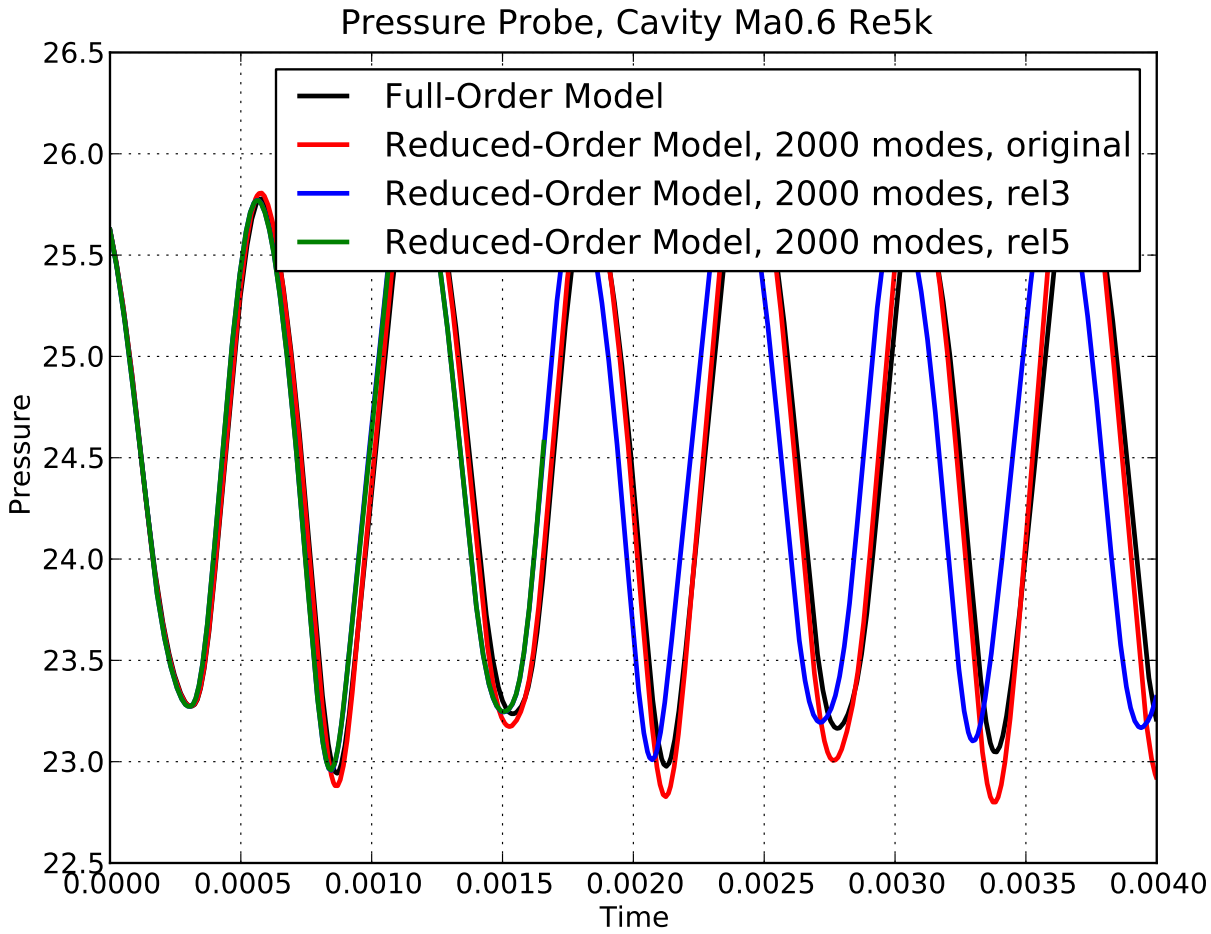


Comparison of Pressure Traces, 2000 Snapshots

Pressure measured at a point midway up the downstream cavity wall:



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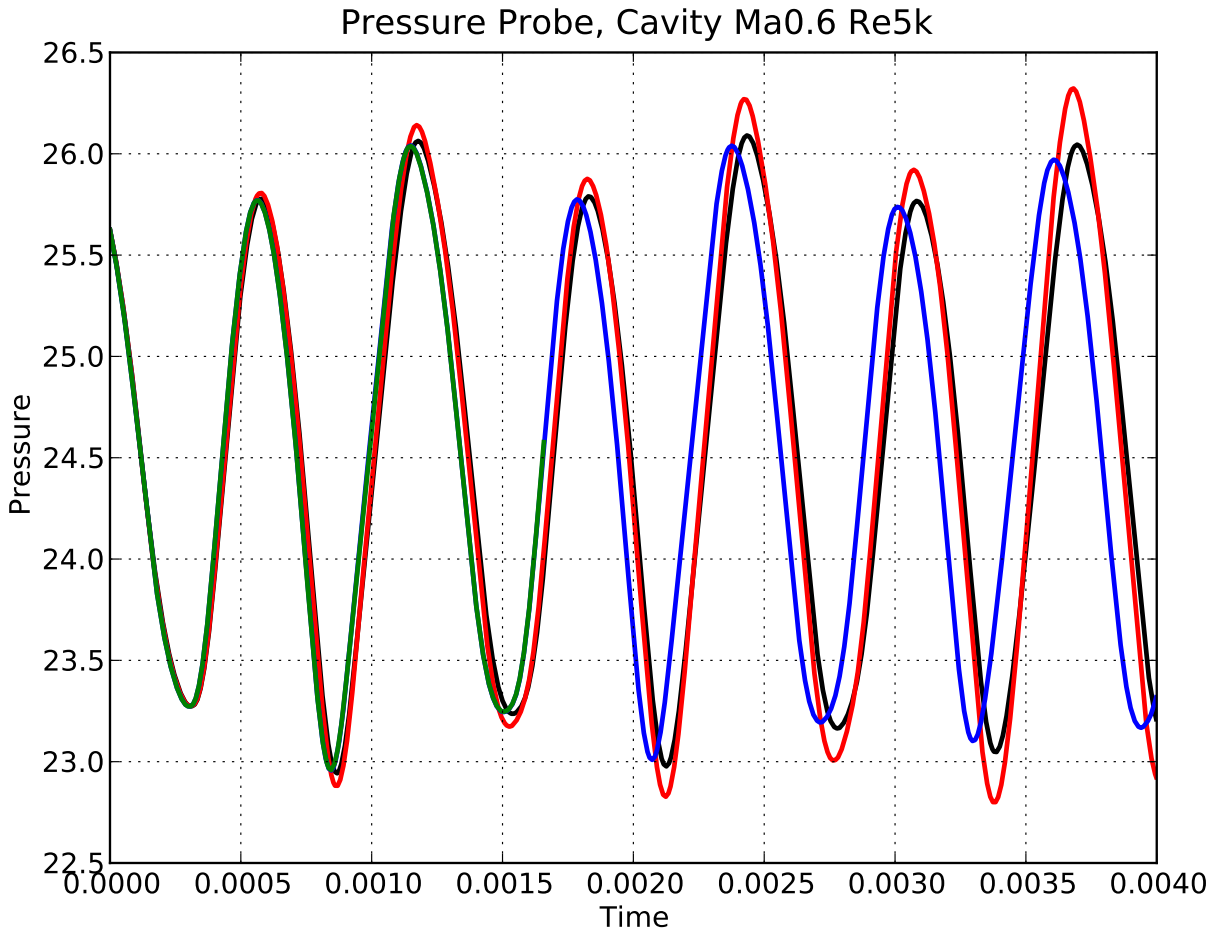


Discussion

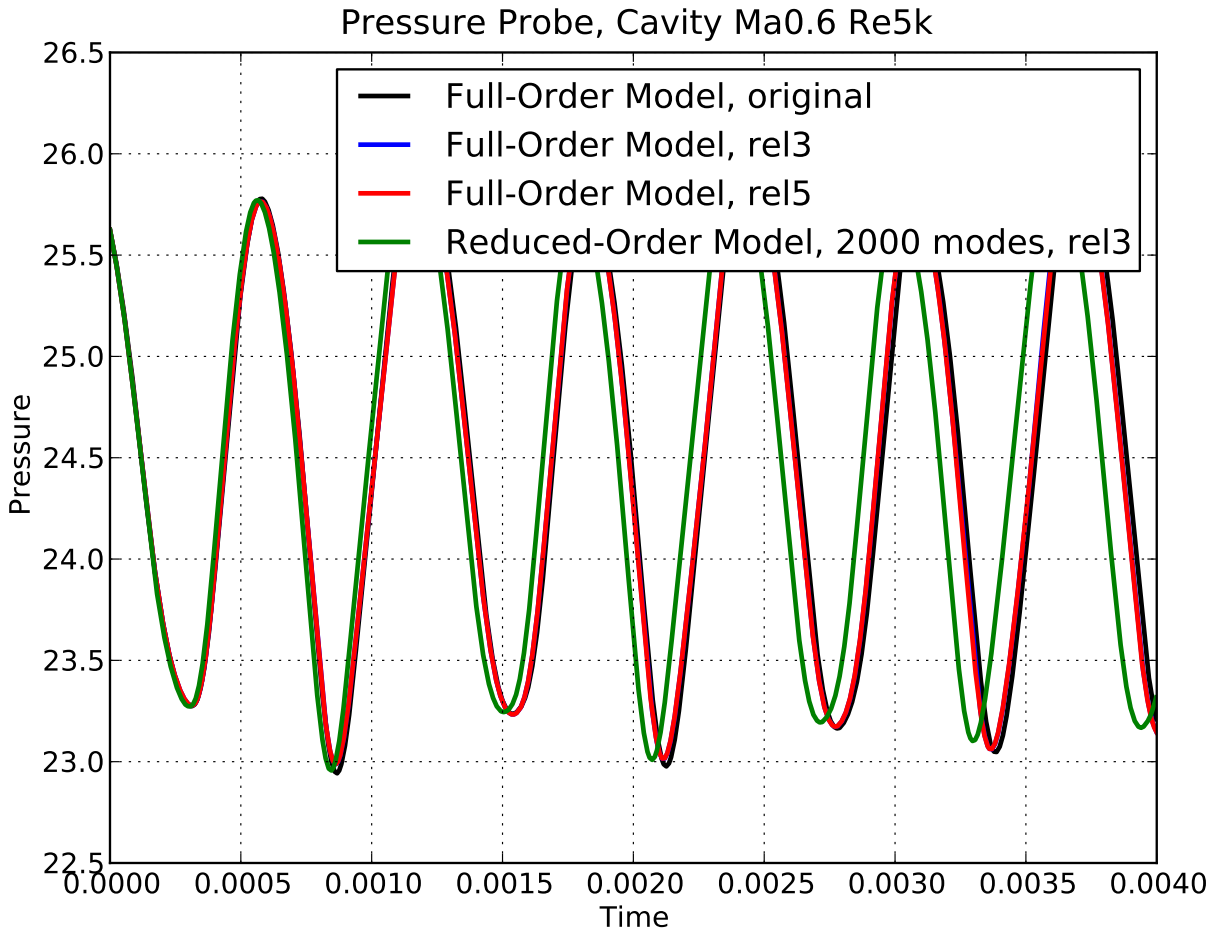
- Run with relative tolerance of 1e-5 is still going
- Original run matched frequency, but grew in amplitude
- New runs do not seem to grow in amplitude, but there is a shift in frequency that grows in time

Things to try:

- Check convergence of FOM run - next slide
- Post-Processing: Plot projected FOM solution on pressure plot and actual ROM error on projection error plot
- Run Galerkin ROM - TODO, next?
- Vary time step for both FOM and ROM - TODO?
- Non-Dimensionalize snapshots before creating basis - TODO?
- Normalize snapshots before creating basis - TODO?

Full-Order Model with Different Relative Tolerances

Pressure measured at a point midway up the downstream cavity wall:



Full-Order Model with Different Relative Tolerances

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