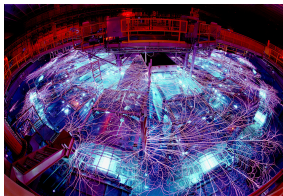


*Exceptional service in the national interest*



SAND2016-6415PE



## SPARC ROM Status

Jeffrey A. Fike  
*Sandia National Laboratories*

6/30/16



Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000. SAND NO. 2016-XXXX

Unlimited Release

# Outline

Cavity Runs

Viscous Pulse Box

# Description of Runs

## Increase Tolerances

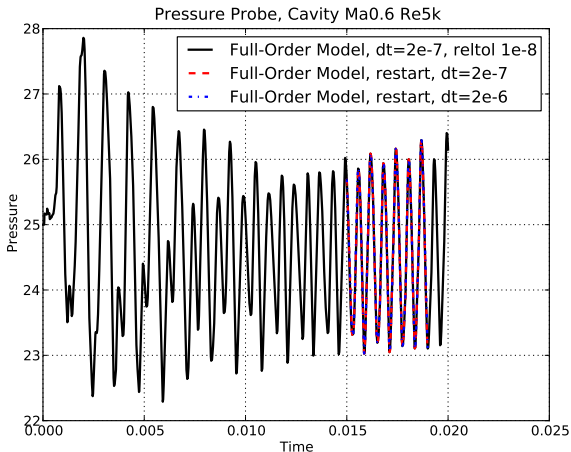
- Run FOM at tighter tolerance
- Restart in periodic region to get snapshots (change  $\Delta t$ )
- Compute POD basis
- Run ROM with tight tolerances

## Try running FOM with relative tolerance of $1e-8$

- Might be too tight of a tolerance
- Several time steps hit 100 iteration limit (i.e. stalls with relative tolerance of  $6e-7$ )
- But proceeding with this run
  - Restart from  $t=0.015s$ , same tolerances and timestep ( $\Delta t=2e-7$ )
  - Restart from  $t=0.015s$ , same tolerances but larger  $\Delta t$  ( $\Delta t=2e-6$ )
  - $\Delta t=2e-6$  produces 2000 snapshots (2000 mode ROM is slow but manageable)

# Comparison of Pressure Traces

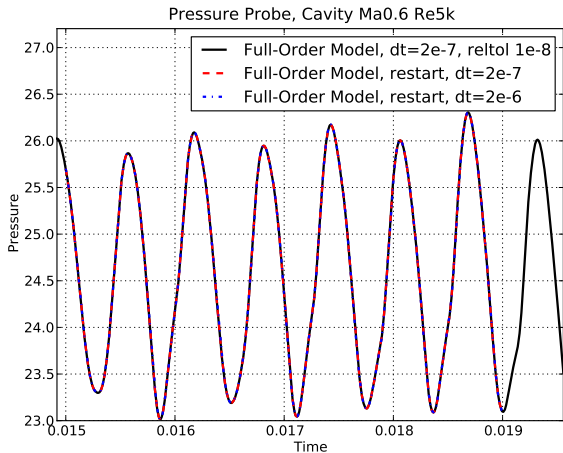
Pressure measured at a point midway up the downstream cavity wall:



- Changing timestep has a small impact, but is probably okay

# Comparison of Pressure Traces

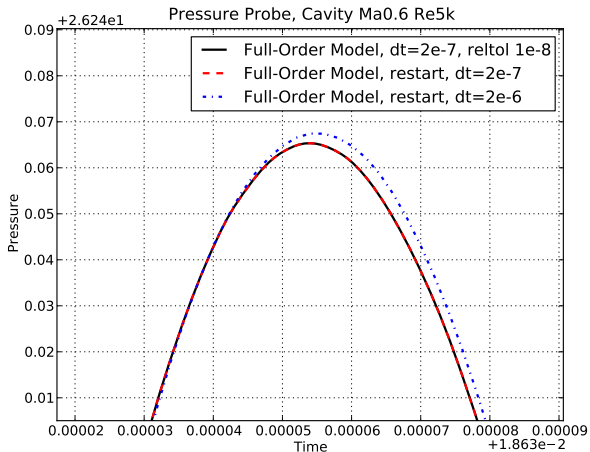
Pressure measured at a point midway up the downstream cavity wall:



- Changing timestep has a small impact, but is probably okay

# Comparison of Pressure Traces

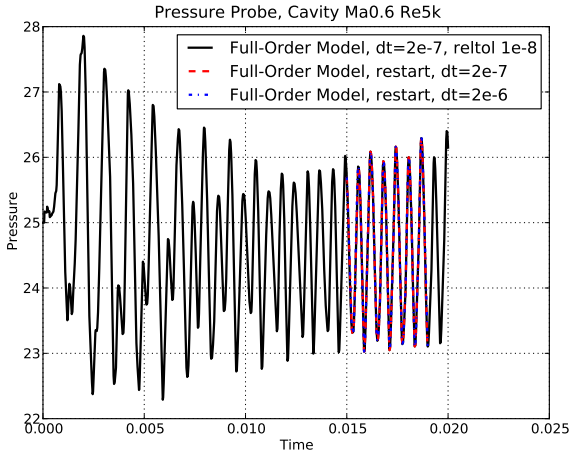
Pressure measured at a point midway up the downstream cavity wall:



- Changing timestep has a small impact, but is probably okay

# Comparison of Pressure Traces

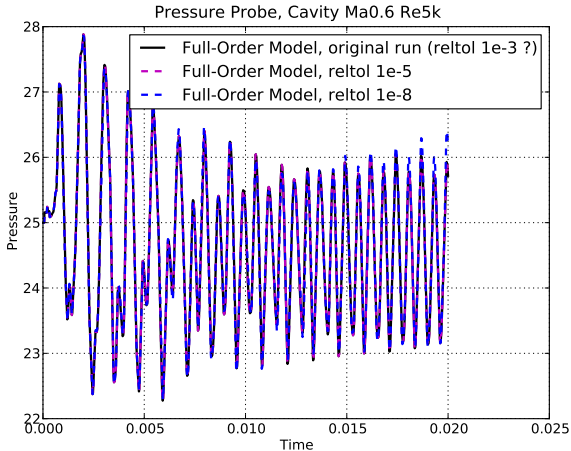
Pressure measured at a point midway up the downstream cavity wall:



- In these runs, pressure is growing after  $t=0.015s$  (not periodic)

# Compare with Older Runs

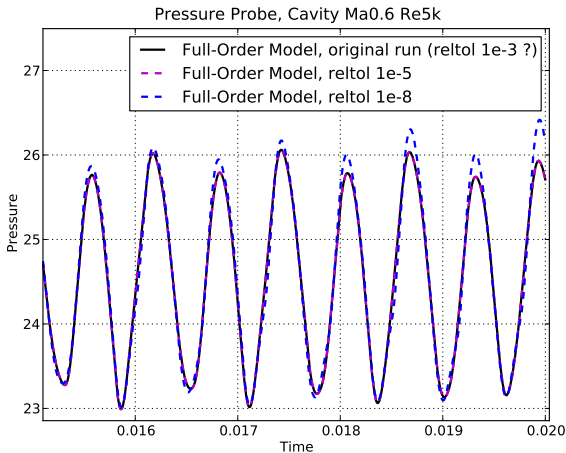
Pressure measured at a point midway up the downstream cavity wall:



- New run has growing pressure, different than older runs

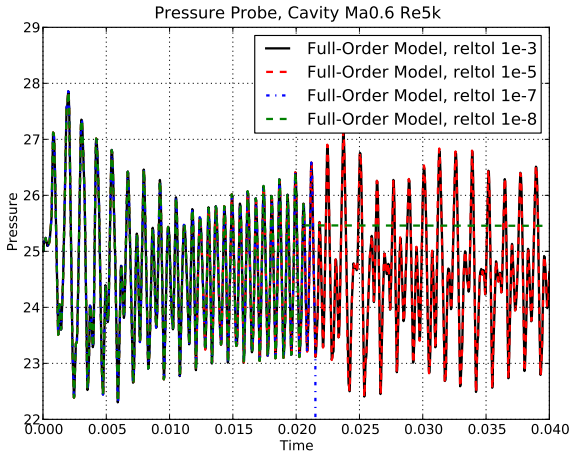
## Compare with Older Runs

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



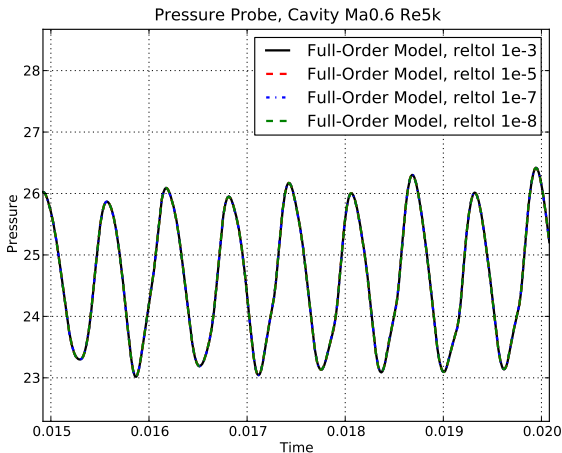
- New run has growing pressure, different than older runs

# Vary Tolerances Consistently, Run 2x Longer



- Same behavior for all tolerances
- Where to choose restart point? Periodic Region?

# Vary Tolerances Consistently, Run 2x Longer



- Same behavior for all tolerances
- Where to choose restart point? Periodic Region?

# Outline

Cavity Runs

Viscous Pulse Box

## Description of Run

Gaussian pressure pulse in a still box, that reflects off walls

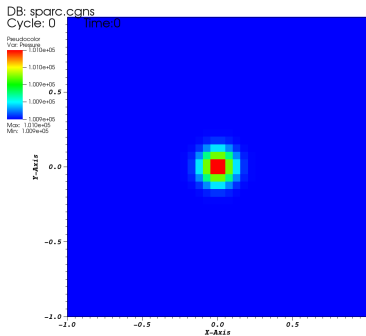
- Density  $\bar{\rho} = 1.1715554$
- Temperature  $\bar{T} = 300$
- Gas Constant  $R = 287.0973$
- Viscosity  $\mu = 2.9e - 4$
- Pulse  $p' = 0.001\gamma\bar{p}e^{-100r}$

Resulting pressure is  $\bar{p} = 100905$

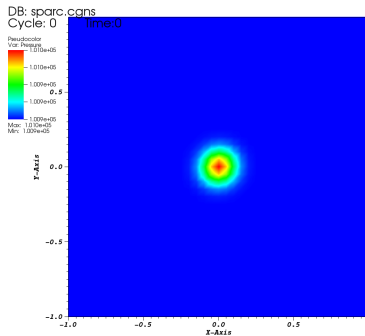
- May need to adjust values to get  $\bar{p} = 101325$

# Cell Center vs. Nodal Output

Cell Center:

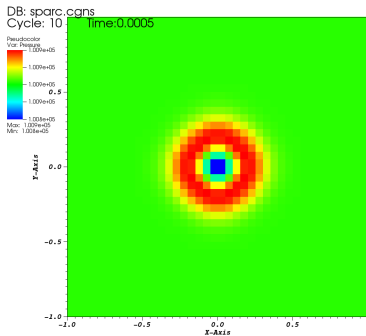


Nodal:

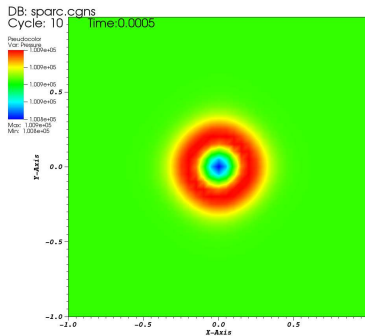


# Cell Center vs. Nodal Output

Cell Center:

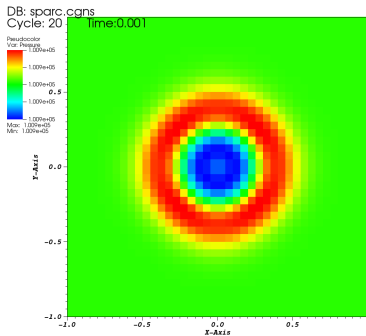


Nodal:

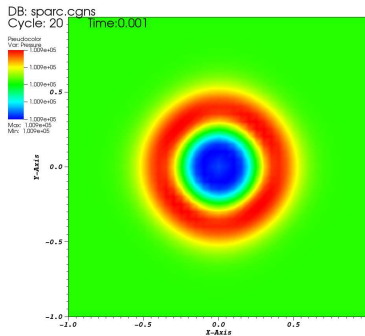


# Cell Center vs. Nodal Output

Cell Center:

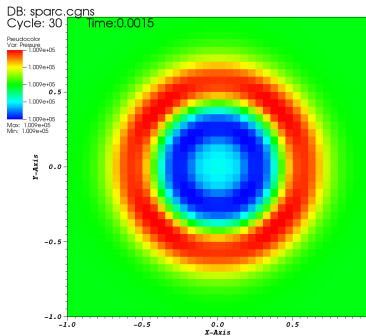


Nodal:

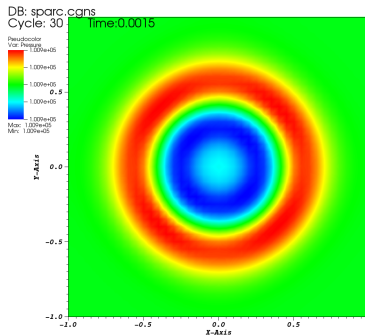


# Cell Center vs. Nodal Output

Cell Center:

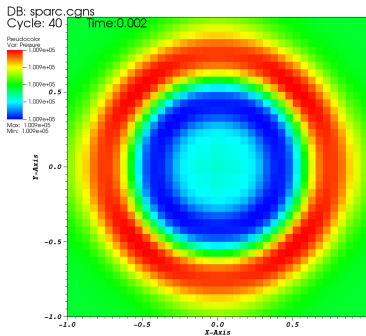


Nodal:

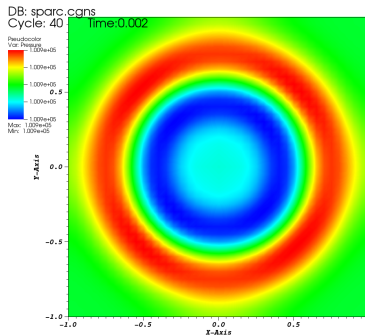


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Cell Center:

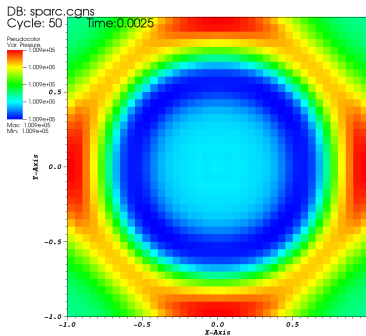


Nodal:

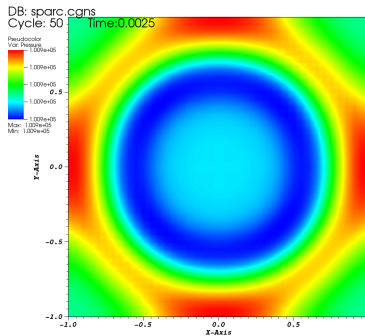


# Cell Center vs. Nodal Output

Cell Center:

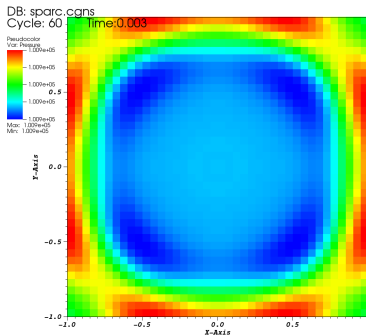


Nodal:

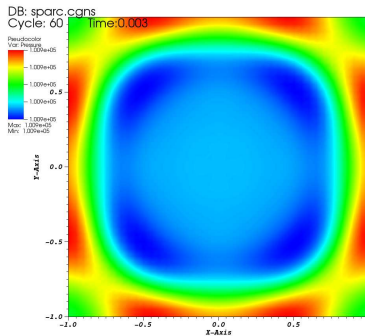


# Cell Center vs. Nodal Output

Cell Center:

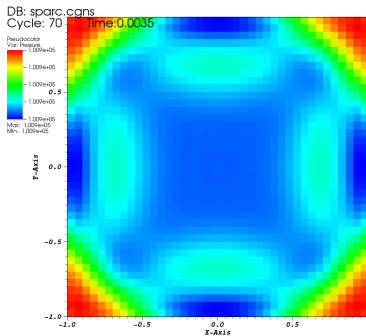


Nodal:

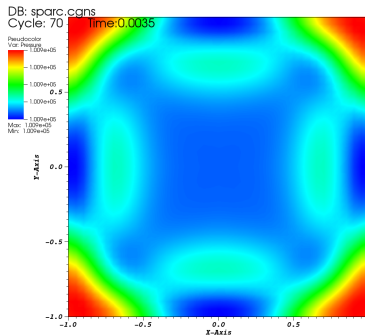


# Cell Center vs. Nodal Output

Cell Center:

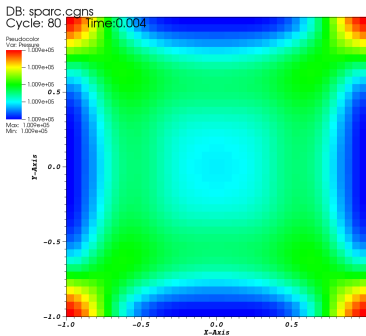


Nodal:

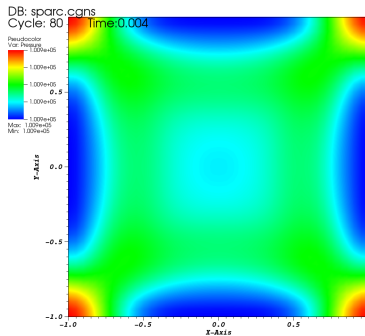


# Cell Center vs. Nodal Output

Cell Center:

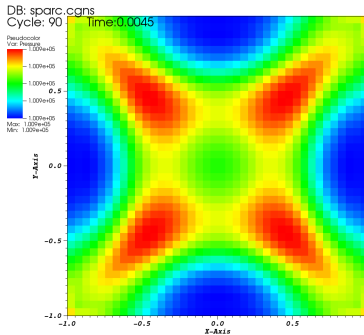


Nodal:

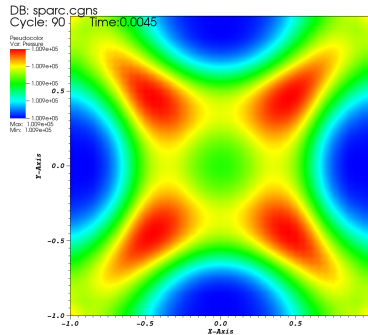


# Cell Center vs. Nodal Output

Cell Center:

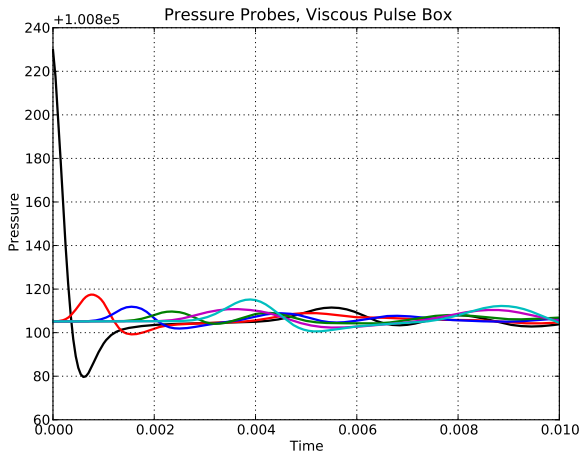


Nodal:



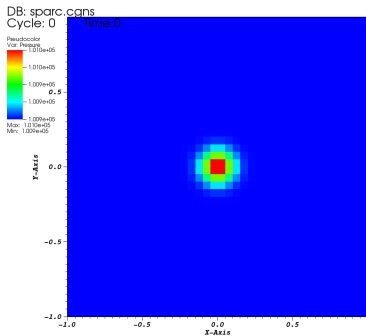
# Pressure Traces

Pressure traces at several locations:

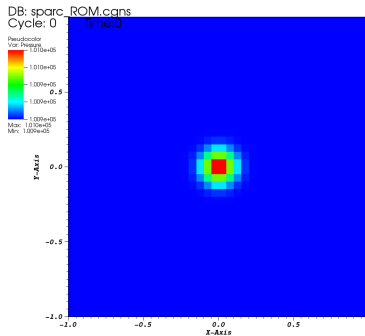


# Reduced-Order Model, 20 Modes, Cell Center Output

## Full-Order Model:

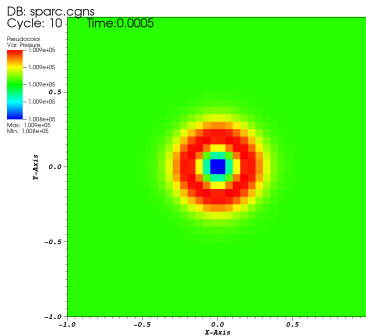


## Reduced-Order Model:

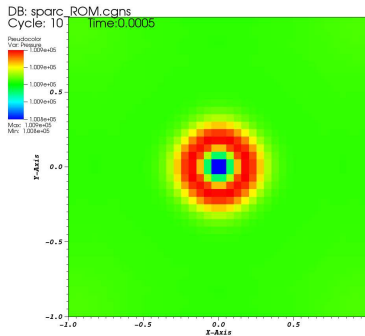


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

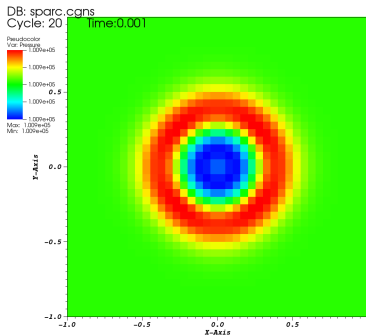


Reduced-Order Model:

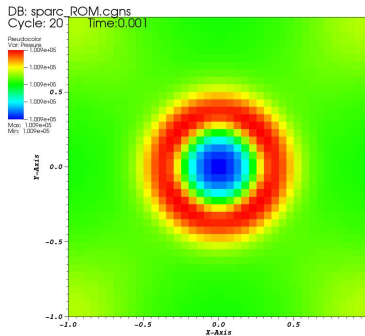


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

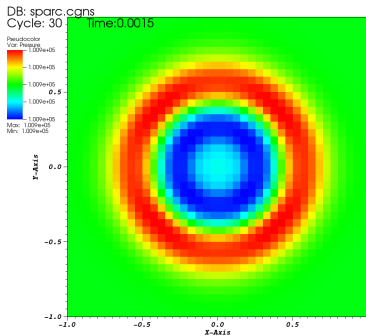


Reduced-Order Model:

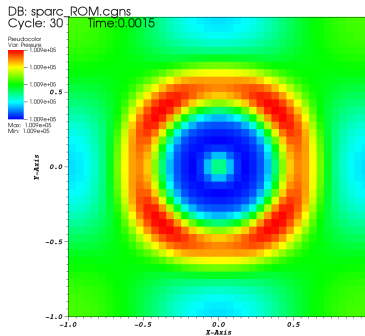


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Full-Order Model:

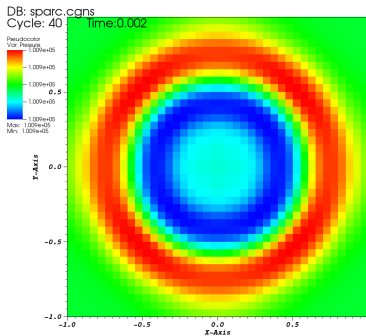


Reduced-Order Model:

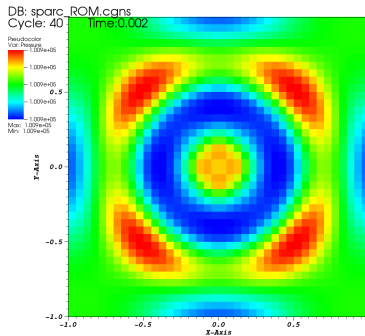


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

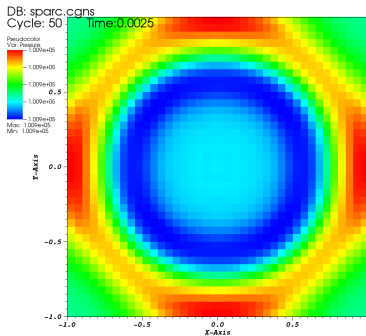


Reduced-Order Model:

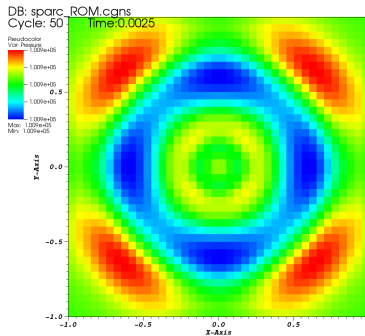


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

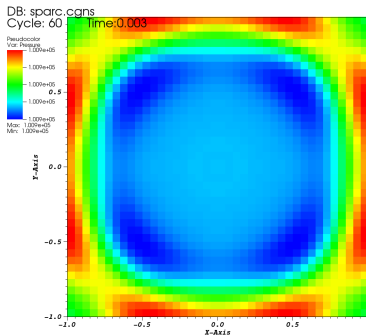


Reduced-Order Model:

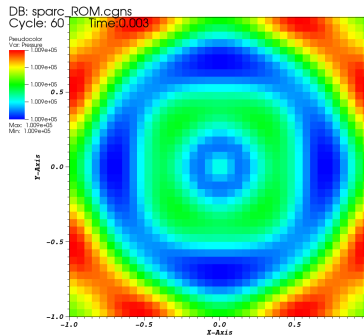


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

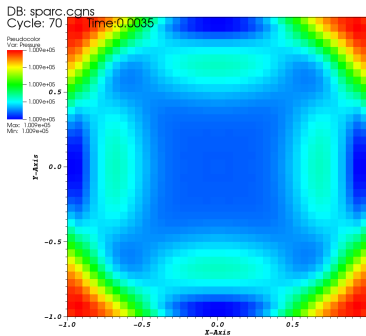


Reduced-Order Model:

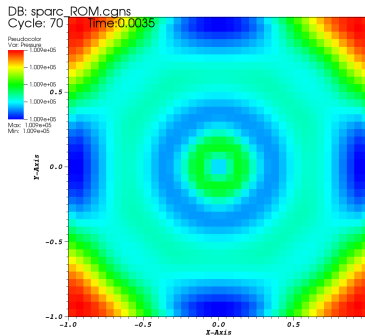


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

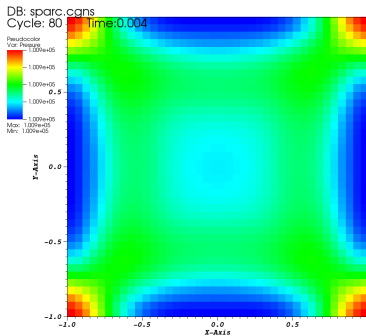


Reduced-Order Model:

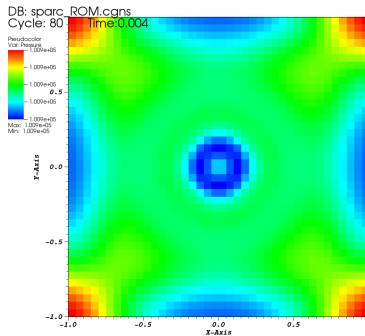


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

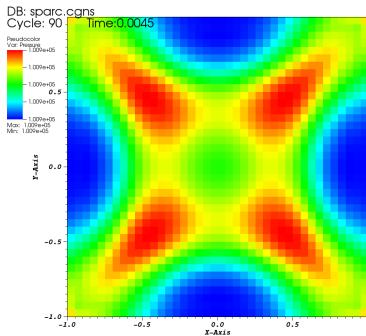


Reduced-Order Model:

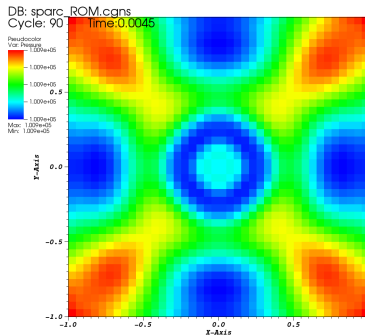


# Reduced-Order Model, 20 Modes, Cell Center Output

Full-Order Model:

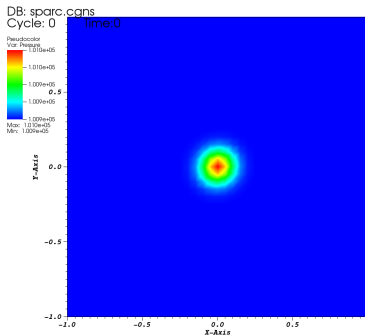


Reduced-Order Model:

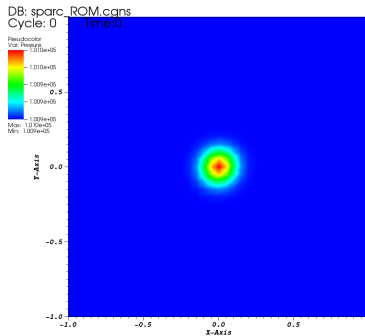


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

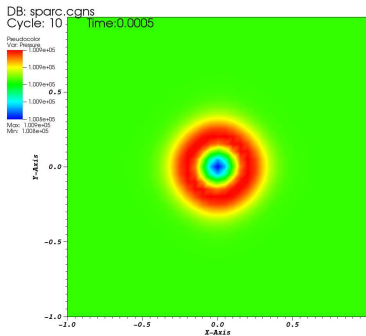


Reduced-Order Model:

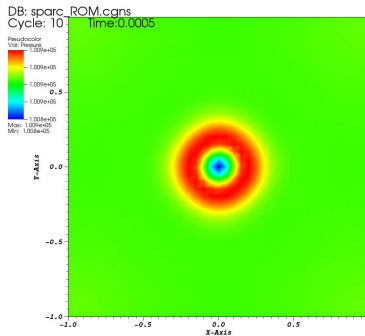


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

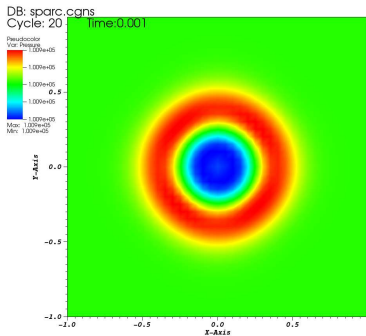


Reduced-Order Model:

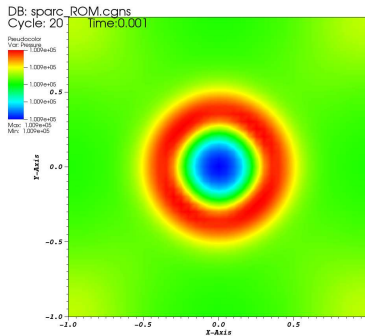


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

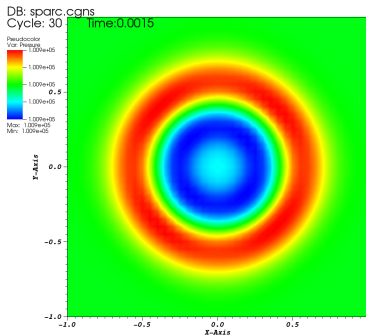


Reduced-Order Model:

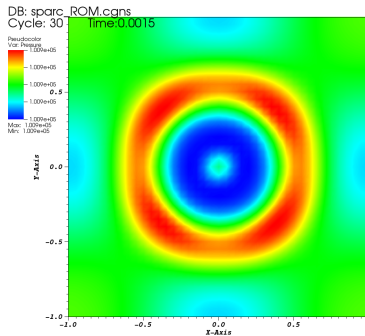


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

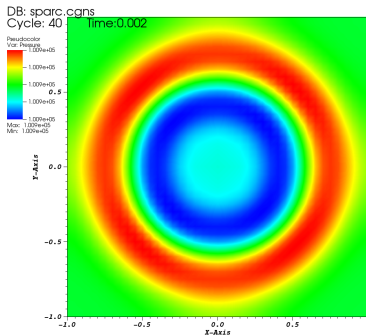


Reduced-Order Model:

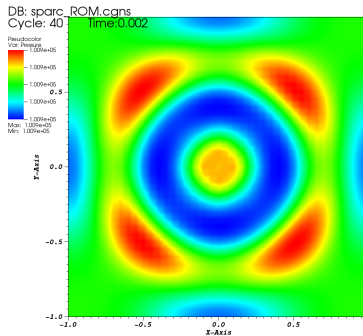


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

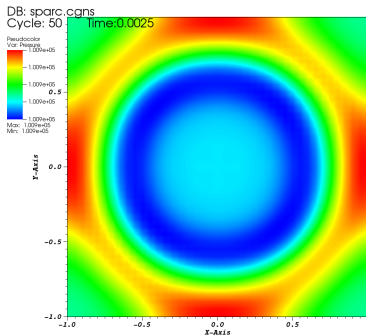


Reduced-Order Model:

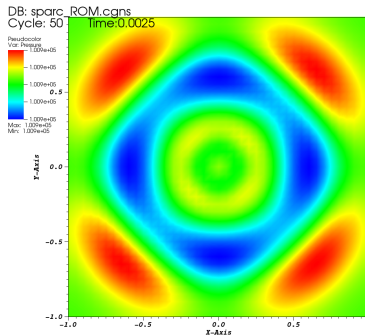


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

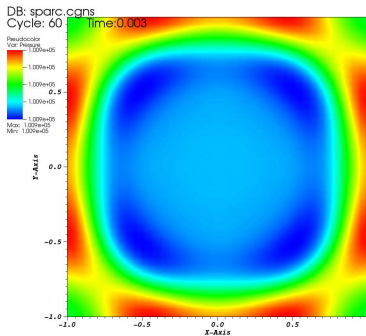


Reduced-Order Model:

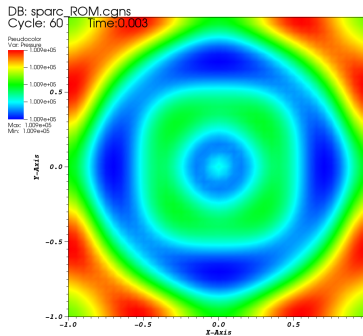


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

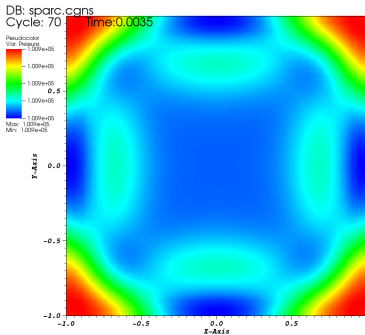


Reduced-Order Model:

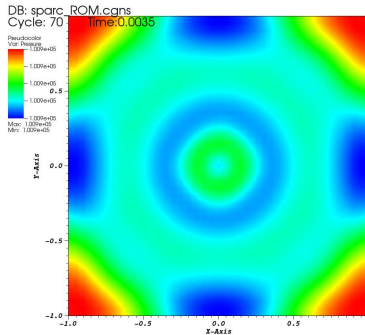


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

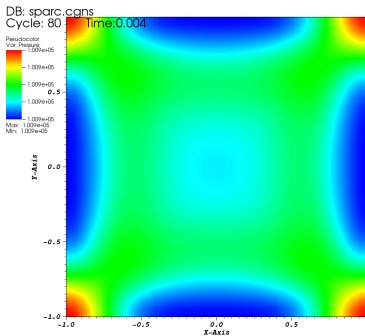


Reduced-Order Model:

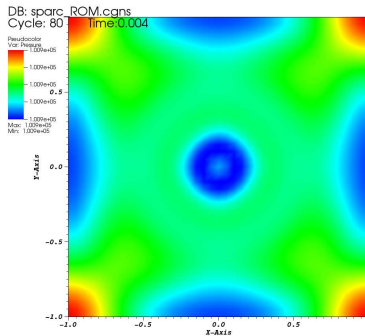


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

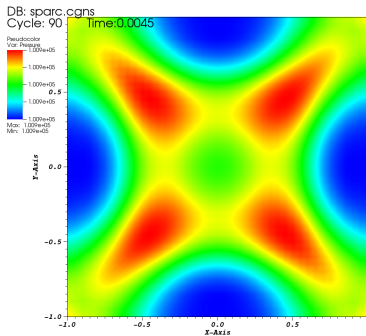


Reduced-Order Model:

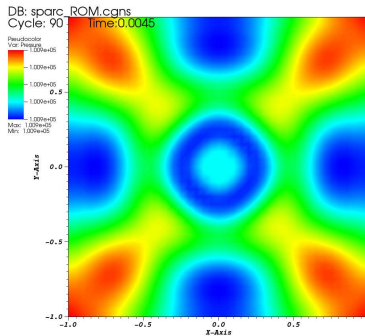


# Reduced-Order Model, 20 Modes, Nodal Output

Full-Order Model:

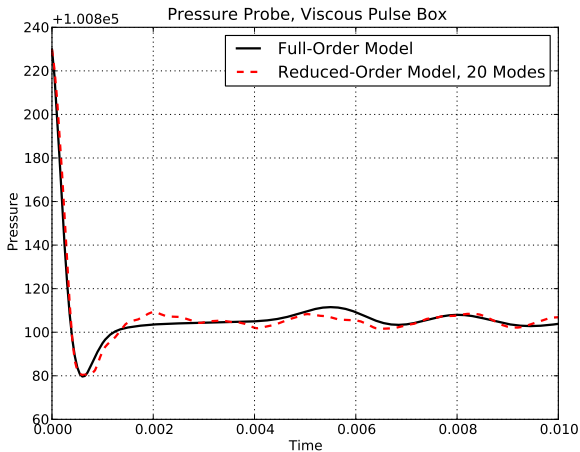


Reduced-Order Model:



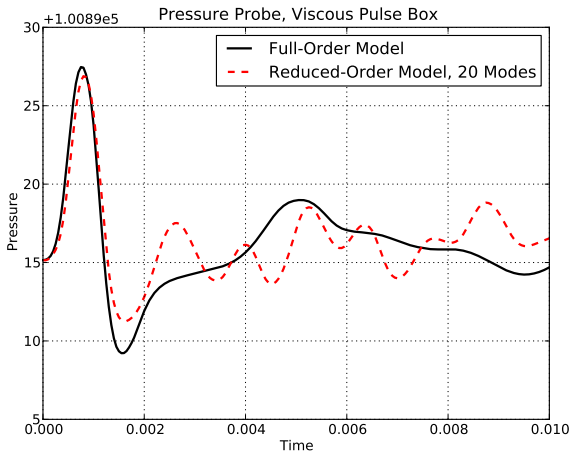
# Comparison of Pressure Traces

## Probe 19



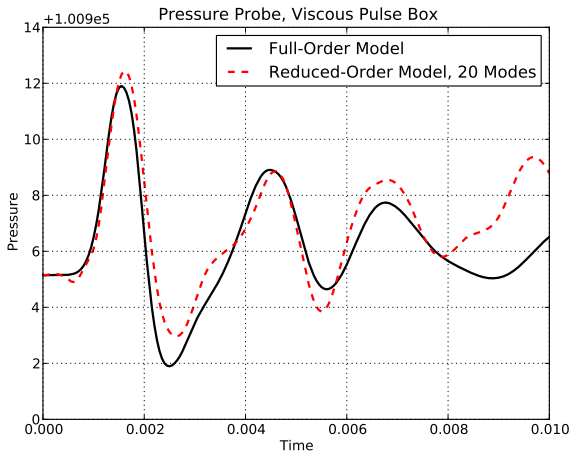
# Comparison of Pressure Traces

## Probe 15



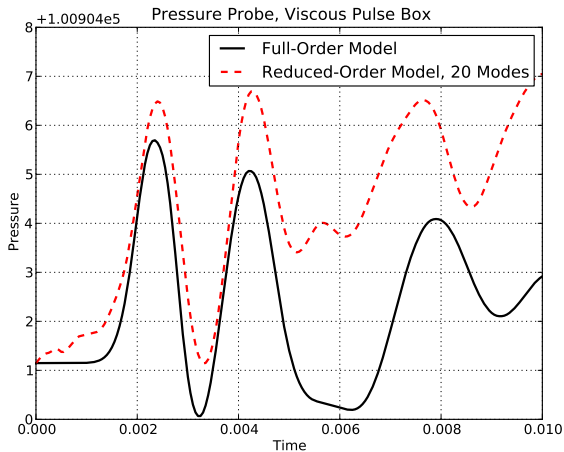
# Comparison of Pressure Traces

## Probe 11



# Comparison of Pressure Traces

## Probe 7



# Comparison of Pressure Traces

## Probe 3

