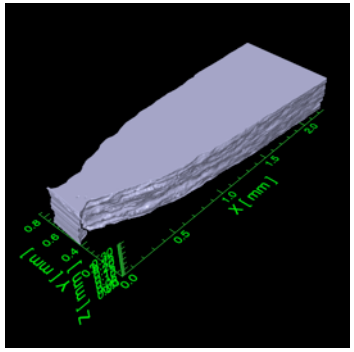
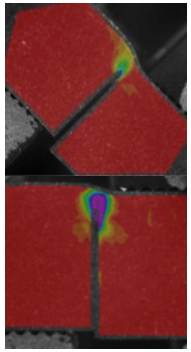
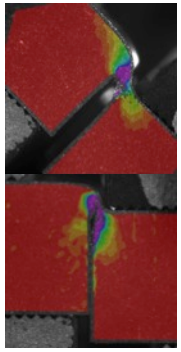
SAND2014-0333P

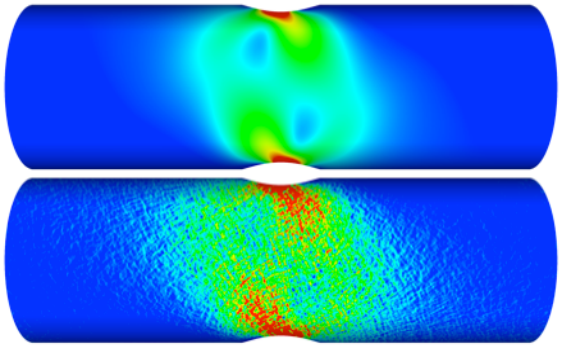
Exceptional service in the national interest

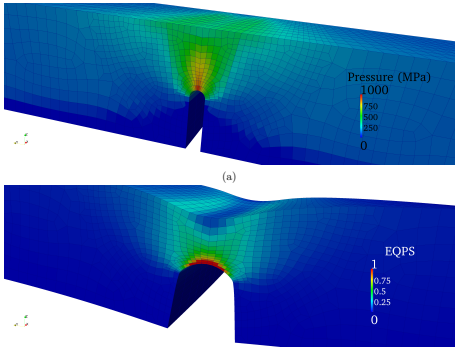
Sandia National Laboratories











Task 3: FY 14 Work Emphasis

PPM Summit 1/17/14

Team: J. Emery, J. Bishop, B. Boyce, R. Field, J. Foulk, S. Kramer, J. Madison, M. Grigoriu (Cornell)

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

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. 2011-XXXXP

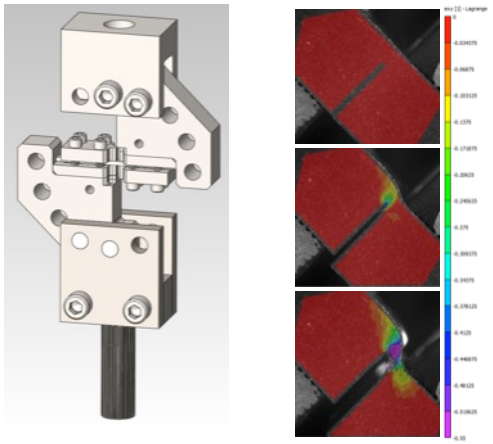
Overall goals

- Further develop weld modeling capabilities
  - Explicit modeling of weld porosity
  - Further developments for SROM-based surrogate modeling
- Demonstrate closer connections with Task 2
  - Computational modeling efforts to bridge length scales and exercise BCC crystal plasticity
  - Direct numerical simulation of Ta / Ta10W welds
- Align with PPM's focus on Ta / Ta10W alloys welds through experimental exploration and direct numerical simulation

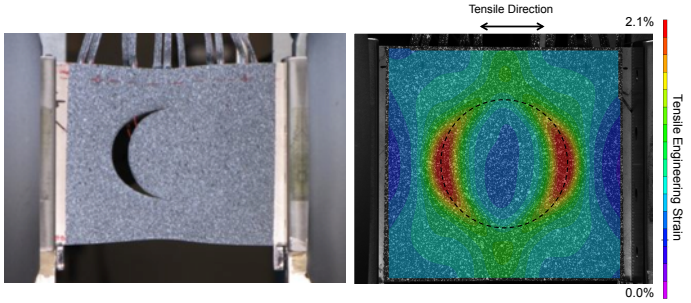
Experimental efforts

- Ta / Ta10W weld tests
  - Explore the failure mode(s) in tension
  - Explore extents of ductility
  - Response to multi-axial loading (stretch goal)
- Explore rate effects at RT and elevated temps for 304L VAR (WSEAT collaboration with Helena Jin, a friend of PPM)
- Multi-axial loading scenarios & complex geometries for 304L laser welds (leverages Sharlotte's WSEAT project objectives)
- Complete serial-sectioning and 3-D reconstruction of Ta
- Perform 3-D X-ray tomography of A304L VAR laser welds
  - Characterization of porosity to support modeling efforts

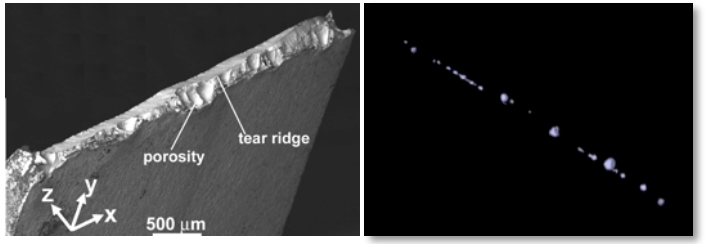
mixed shear/tension



complex geometry / multi-axial loading



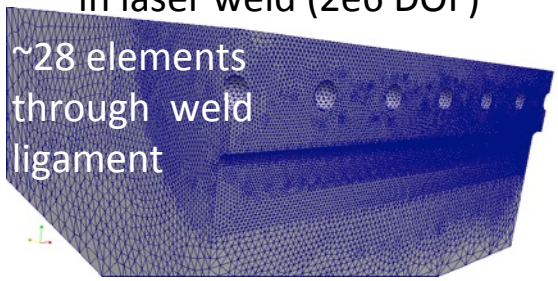
tomographic reconstruction of voids



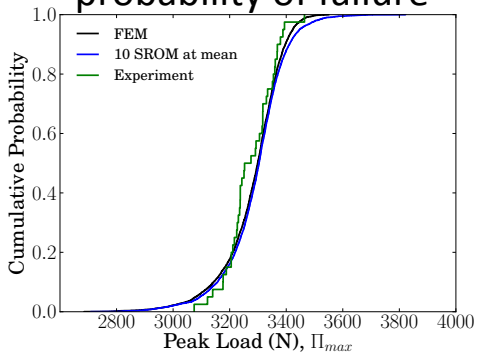
Computational efforts

- Stochastic modeling of uncertain size/spatial distributions of weld porosity
- Explore / extend SROM-based surrogate modeling for
  - Complex loading scenarios
  - Spatial variability
  - Predicting field quantities
  - Consider higher fidelity physics (rate/ temperature effects)
- Explore uncertainty due to fine scale heterogeneity through direct numerical simulation (DNS)
  - Plasticity of A304L
  - BCC plasticity of Ta / Ta10W

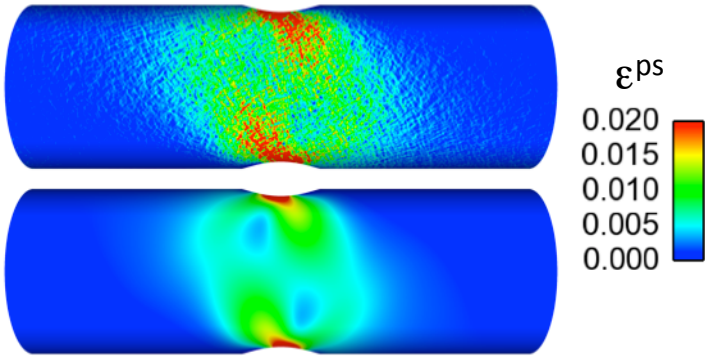
finite element model of porosity in laser weld (2e6 DOF)



probability of failure



DNS vs homogenous case



Anticipated journal publications

Sandia National Laboratories

- Exploring uncertainty due to fine scale heterogeneity through direct numerical simulation
- Predicting laser weld reliability with stochastic reduced-order models
- Porosity metrics in A304L laser welds
- Porosity effects on mechanical response of A304L laser welds
- 3-D DIC of deformation / failure in circular laser welds

Thoughts / Discussion?

- Do you see obvious “low hanging fruit” for Task 3 to make connections with Tasks 1, 2, or 4?
- What important aspects of “macroscale” work are we missing?
- How can Task 3 help PPM make direct connections with mission-area work?
- Are there relationships / collaborations we should pursue with other R&D staff? (do you know someone we should be talking with? no such thing as too many friends of PPM!)