PSAAP III Intro

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ASC V&V Verification Project Lead

PSAAPIII Personal Intros
19 August 2020

Brief background…

1998 Small Town, U.S.A
senior class: ~ 40 students
town population: < 1500

2003 Texas A&M University
B.S. Nuclear Engineering
B.A. Physics
Pulsed-power Dense Plasma Focus (DPF)
Explosive Flux Compression Generators (FCG)

Brief tour with the Nuclear Navy

Started grad school at TAMU to study
BH solutions in 11D Gauged-Supergravity

FCG

DPF w/
cathode & anode

Brief background…

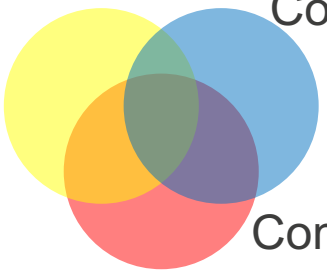
2014
Ph.D. Applied Physics
Rad-hydro code-verification solutions
Group awarded PSAAPII as I finished

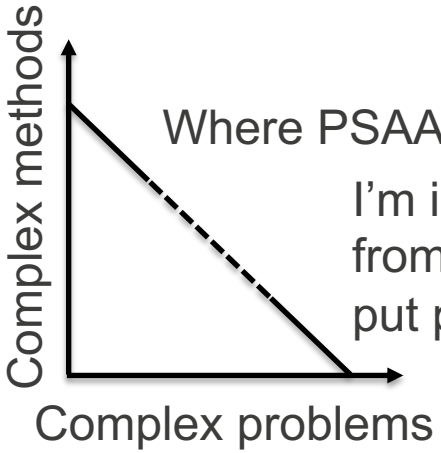
2014 – 2017
LANL Postdoc
XTD-Pri, XTD-SS, XCP-8

2017 – current
XCP-8 Staff Scientist

May 2019 – current
Verification Project Lead
Trying to align verification work with DSW/SS needs

PSAAP problems: critical to our world (jobs!)

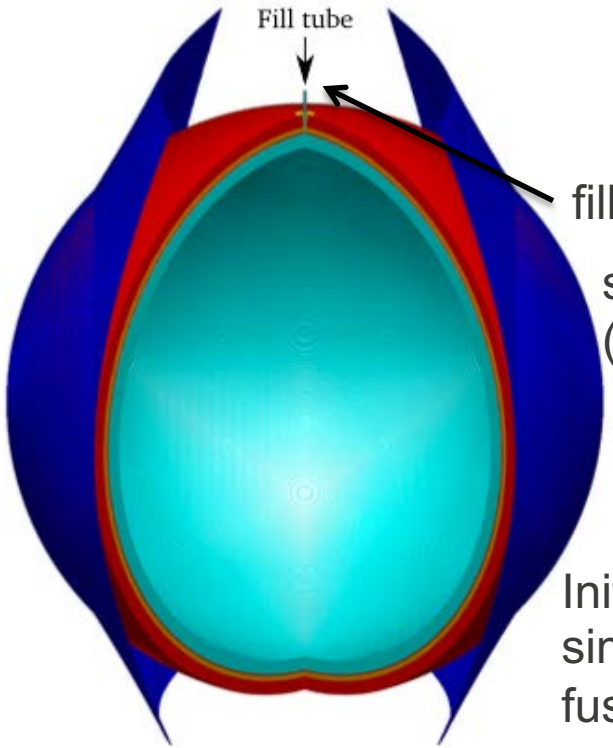




Where PSAAP succeeds!

I'm interested to keep learning from the PSAAP centers and put proven methods to use.

What are we trying to do? … Need to answer the question: “Is my simulation predictive?” Need verification results that matter and that are defensible (not strictly 1D, analytic, …)

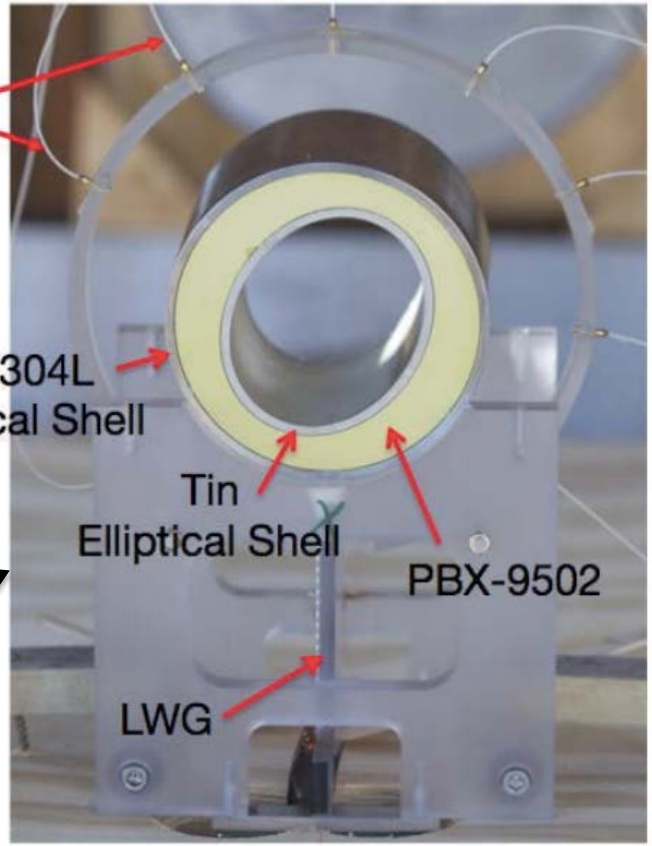


fill tube feature

support tent (blue)

Initial setup for 3D simulation of Omega fusion capsule.

FIG. 6. Initial conditions for the 3D simulation with a quadrant cut out to aid in visualization. Blue: support tent, red: HDC ablator layers, orange: W-doped HDC ablator layer (for the simulation of the full scale design only), yellow: glue spot, turquoise: wetted foam layer, and grey: glass (fill tube).



Exptl. setup of the Cyclops experiment.

VVUQ for non-deterministic, chaotic and complex systems needs to be thought about through a fresh lens.

My thanks to the many centers who will think about this problem.

Thanks for the opportunity to be a part of this, learn from you, and engage with your centers!

Jim Ferguson, XCP-8
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Career Pathways from ASAP Centers to Leadership Roles at NNSA Labs

2020 PSAAP III (Virtual) Kickoff Meeting
19 August 2020

Fady M. Najjar
Design Physicist & Group Leader
Design Physics Division
Weapons & Complex Integration

LLNL-PRES-813565
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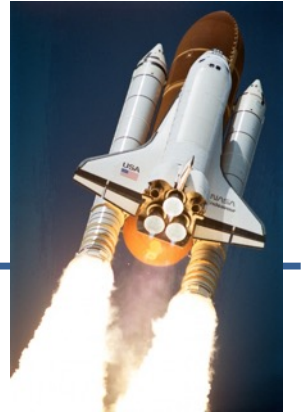
Lawrence Livermore National Laboratory

CSAR Era

Center for Simulation of Advanced Rockets

University of Illinois at Urbana-Champaign

My "Rocket" Journey started at CSAR in the late 1990s and landed me at LLNL, NNSA's Design Physics Lab

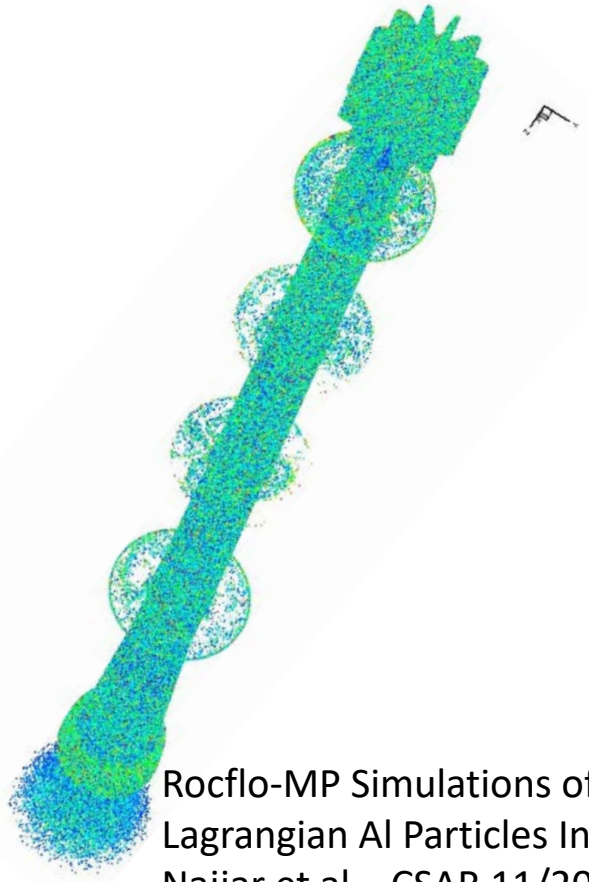


- Joined CSAR in May 1998 as Research Scientist
  - ASC(i)/ASAP Center formed in late 1997
  - Studied Complex Turbulent Multiphase Flow inside the Space Shuttle Solid Rocket Motors (SRMs)
  - Developed Rocflo/Rocflu-MP & Performed Multiphase Simulations for Lagrangian Particles inside SRMs.
  - Worked with S. Balachandar, Jon Freund & Bob Moser

  (Are their names familiar?)

- Thanks to the TST, AST and ASC Leadership team
  - Thanks Dr. Voigt for the wonderful support you have provided for ASAP/PSAAP Programs!
  - Tina Mancuso works tirelessly to ensure thorough notes were taken and is the most gracious person.
  - Dr. Thuc Hoang, Dr. Njema Fraizer, every DOE Lead for ASC: **THANK YOU**!
  - Question always asked at CSAR Review Meetings:

  "What was your AHA Moment?" (D. Watson, LLNL, Circa 1998-2007**)**



Rocflo-MP Simulations of Lagrangian Al Particles Inside RSRM, Najjar et al., CSAR 11/2007

My "Rocket" Journey at CSAR extended for over 9 years

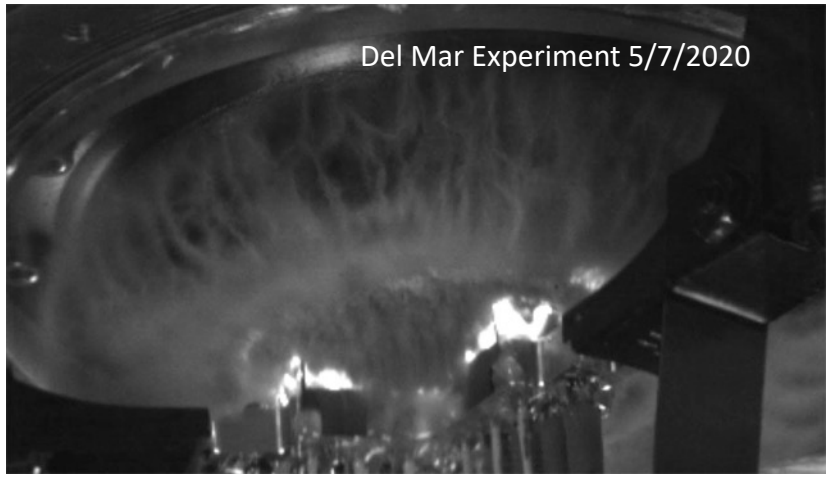
- **Most Memorable ASAP Review**: 9/11/2001!
  - Every 30 minutes, review is paused and Tina gave an update from CNN, NYT, …
  - Review team members were stuck in Champaign, IL, and drove home to CA and NM.

- **Most Memorable Field Trip**: RSRM-V Static Testing Firing at ATK Thiokol, Promontory, UT
  - Amazing 2 minutes
  - Felt ground shaking while standing 2 miles
  - Pre-firing, watch NASA Astronauts mingling with ATK Senior Leadership & attendees
  - Alas, never attended a Space Shuttle Launch at KSC, FL

- **Technical meetings**:
  - Edwards AFB, NASA-Johnson, ATK, Aerojet, JANNAF,
  - International: CNES (France's NASA), Safran SME (France's ATK/Aerojet)

My LLNL journey started in October 2007 joining B-Division, whose focus was on Primary Design Physics

- 2007-2013: Computational Physicist for Hydrodynamic code
  - Developed code for ALE3D & provide user support
  - From a team of 5-10 coders at CSAR, ALE3D had over 20 staff.
  - Synergy and teamwork were staples
  - Collaborated with DoD
  - Access to astounding HPC resources: Purple, Blue Gene/L & Q, Sequoia



- 2013-Present: Design Physicist supporting our country's nuclear safety and security
  - Lead physicist for "hydro"experiments interacting with team of project managers, engineers & analysts
  - Group Leader for 7 DPD designers
  - Tri-lab Collaboration with LANL and MSTS to design and field Gas Gun Experiments
  - Computational Lead for LDRD's project, MERIT (Metal Ejecta: Recollection, Interaction & Transport)
  - Interact & collaborate with PSAAP Grads: LLNL-B. Morgan, J. Horwitz (Stanford), Kyle Mackay (UIUC) & LANL-Y. Mehta (UFL)
  - Did I mention I get to run simulations on SIERRA?
  - **Member of TST Review Team for University of Buffalo**

https://www.llnl.gov/news/work-resumes-support-stockpile-modernization

Waiting to Exa-Scale!

- PSAAP-III is providing you amazing opportunities to learn and grow your career
- You are the EXASCALE "WARRIORS" who will show us to how to use this great resource that NNSA has started building

Do amazing research, Get your degrees,
Then come join us at the DP Labs
So we continue together our EXASCALE Journey on El Capitan!

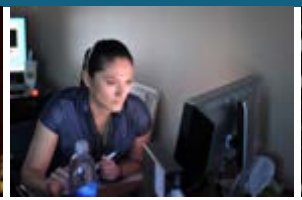
Thanks for Listening!

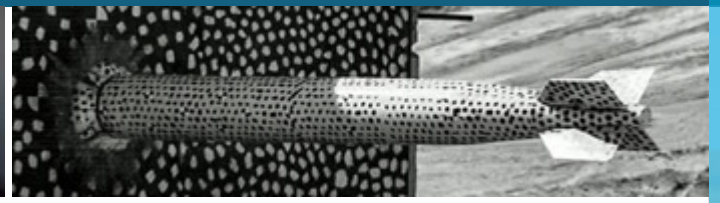
Fady M. Najjar, Ph.D.
Design Physics Division

Email: fady@llnl.gov

Lawrence Livermore National Laboratory

I hope your electives were in the social sciences





Greg Weirs

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My professional trajectory

NC State and U of MN:

- Aerospace Engineering, CFD for reacting compressible flow (combustion, reentry), turbulence, DNS, canonical engineering instabilities, and a focus on numerical methods for these.

University of Chicago ASCI Flash Center:

- Compressible Euler equations! I'm among friends! NOT. Astrophysicists have a different perspective on their problems and solution techniques than aerospace engineers, but more significantly, a different culture and a different value system.

Sandia National Laboratories: V&V and UQ

- Being a V&V "expert" forced me to travel through different (technical) cultures.
- Today: Analyst and V&V and UQ for SPARC, a code for reacting compressible reentry flow, turbulence, DNS/other variants/LES. It is good to be back among friends.

Comments on PSAAP Centers

- Traditionally, universities are optimized to produce single-discipline experts. The PSAAP challenge is to produce researchers that can apply their expertise in a multidisciplinary collaborative environment.
- Integration and V&V/UQ are central to your projects because they require multidisciplinary collaboration for your center's success.
- PSAAP centers impose lab project scale and deliverables on academic environment; a lot of things that work well for you now will not scale.
- The most successful centers I have seen have a culture in which the staff and students own the problem: each knows the deliverables of the center and how their part fits in, and each takes responsibility for trouble-shooting the whole problem.