Abstract Submittal Form

Joint Army-Navy-NASA-Air Force (JANNAF)
61st JPM / 42nd SMBS / 38th PEDCS / 29th RNTS / 27th SEPS
Joint Subcommittee Meeting
19 – 22 May 2014

JPM Abstract Due Date: Monday, February 3, 2014

Title: Development, Verification and Validation of Parallel, Scalable Volume of Fluid CFD Program for Propulsion Applications

Submitted to: ☒ **JPM** ☐ SMBS* ☐ PEDCS* ☐ RNTS* ☐ SEPS*

Mission Area : ☐ 1 ☐ 2 ☒ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

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Sponsoring organization if SBIR-funded:

Primary Author (this author will receive all correspondence regarding participation in this program)

Name: Jeff West

Organization: NASA/MSFC

Address: Bldg 4203 Rm 3433

City: MSFC	State: AL	ZIP Code: 35812
Phone: 256 544-6309	Fax:	Email: jeffrey.s.west@nasa.gov

2nd Author

Name: H. Q. Yang

Organization: NASA/MSFC

Address: Bldg 4203 Rm 3432

City: MSFC	State: AL	ZIP Code: 35812
Phone: 256 544-8978	Fax:	Email: hong.q.yang@nasa.gov

3rd Author

Name:

Organization:

Address:

City:	State:	ZIP Code:
Phone:	Fax:	Email:

4th Author

Name:

Organization:

Address:

City:	State:	ZIP Code:
Phone:	Fax:	Email:

Approval

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Unclassified Abstract (250 – 300 words; do not include figures or tables)

There are many instances involving liquid/gas interfaces and their dynamics in the design of liquid engine powered rockets such as the Space Launch System (SLS). Some examples of these applications are: Propellant tank draining and slosh, subcritical condition injector analysis for gas generators, preburners and thrust chambers, water deluge mitigation for launch induced environments and even solid rocket motor liquid slag dynamics.

Commercially available CFD programs simulating gas/liquid interfaces using the Volume of Fluid approach are currently limited in their parallel scalability. In 2010 for instance, an internal NASA/MSFC review of three commercial tools revealed that parallel scalability was seriously compromised at 8 cpus and no additional speedup was possible after 32 cpus. Other non-interface CFD applications at the time were demonstrating useful parallel scalability up to 4,096 processors or more.

Based on this review, NASA/MSFC initiated an effort to implement a Volume of Fluid implementation within the unstructured mesh, pressure-based algorithm CFD program, Loci-STREAM. After verification was achieved by comparing results to the commercial CFD program CFD-Ace+, and validation by direct comparison with data, Loci-STREAM-VoF is now the production CFD tool for propellant slosh force and slosh damping rate simulations at NASA/MSFC. On these applications, good parallel scalability has been demonstrated for problems sizes of tens of millions of cells and thousands of cpu cores.

Ongoing efforts are focused on the application of Loci-STREAM-VoF to predict the transient flow patterns of water on the SLS Mobile Launch Platform in order to support the phasing of water for launch environment mitigation so that vehicle determinantal effects are not realized.

➢ By submitting an abstract, you agree to both complete a final paper for publication and to attend the meeting to present this information.

➢ Submit abstracts electronically; submittal instructions are found in the call for papers.

➢ Direct questions to Shelley Cohen, by phone at 410.992.7302 x 215, or email to scohen@cpiac.jhu.edu.