XUXIAO LI

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Ph.D. with five years' experience in physics-based modeling and computation

- Expertise in computational fluid dynamics, heat transfer, and material science.
- Experienced with maintaining, extending, and developing large scientific code.
- Collaborated with experimentalists and modelers, coauthored multiple journal articles.

EDUCATION

University of Utah — Salt Lake City, Utah, USA
Ph.D., Mechanical Engineering — Jan. 2021
M.S., Mechanical Engineering — May 2019
Area of Focus: thermal-fluid modeling of metal 3D printing and laser welding.
Relevant Coursework: Numerical Solution of PDE, Finite Elements, Machine Learning.

Tongji University — Shanghai, China
B.S., Aircraft Manufacturing Engineering — June 2015

TECHNICAL SKILLS

Linux	Git	Latex	Fortran	c/c++	Python	SLURM
MATLAB	Comsol	Abaqus	MPI	OpenMP	Tecplot	Profiling

RESEARCH EXPERIENCE

Scientific Code Development — 2016 – Present

- Maintaining a legacy code (in Fortran, over 25000 lines), General Equation Mesh Solver (GEMS), initially developed for turbulent reacting flow computation with unstructured mesh and MPI parallelization.
- Developed and integrated new modules (Level-Set and Ghost Fluid Method, over 10000 lines) into GEMS to enable multi-phase, free-surface flow and fluid-solid interaction computations.
- Designed and conducted simulations of over 15 benchmark fluid dynamics problems for systematic verification of GEMS and the new modules.

Transient Dynamics in Laser Welding — 2018 – Present

- Developed a multi-physics model (based on GEMS) that simulates the laser absorption, melting/solidification, evaporation/condensation, thermal-capillary forces, gas dynamics, and interface instabilities in laser welding processes.
- Synthesized results from simulations and X-ray imaging experiments (from collaborators) to quantify the physical forces and thermal field on the keyhole.
- Provided mechanism explanations on the relationship between process parameters (e.g., laser power and scanning speed) and defect/pore formation.

Powder-gas Interaction in Metal 3D Printing — 2019 – Present

- Implemented a Lagrangian-point forcing scheme and the Discrete Element Method into the laser welding model to simulate the powder motion in metal 3D printing.

- Verified simulation results by fluid mechanics principles and X-ray experiments.
- Identified characteristic modes of powder-gas interaction based on the quantification of the surrounding gas flow and gas-induced forces on powders.
- Quantified the effects of the ambient pressure on the gas flow, powder-gas interaction, and powder behaviors (velocity, forces, temperature, and ejecting angle).

Machine Learning for Laser Absorption in Keyhole Jan. – April 2020

- Extracted laser absorption distribution on keyhole's surface from the laser welding model as the training and validation data sets.
- Applied convolutional neural network algorithms using Tensorflow to predict laser absorption for random keyhole shapes in laser welding.

Cellular Automata Simulation for Grain Nucleation and Growth 2016 – 2018

- Developed a process model that simulates the thermal history and surface evolution in direct energy deposition processes.
- Implemented the Cellular Automata (CA) algorithm to simulate the grain nucleation and growth given the thermal history from the process model. Implemented hybrid MPI and OpenMP parallelization for the CA algorithm.
- Conducted simulations to identify nucleation conditions for tailoring distinct grain morphology, e.g., small equiaxed grains and large columnar grains.

Laser Absorption by Powder Bed 2015 – 2016

- Implemented a rain-dropping algorithm to generate randomly packed beds of powders as in typical laser powder bed fusion processes.
- Implemented the ray-tracing algorithm to model the multiple reflections of a laser beam on the surfaces of powders.

SELECTED PUBLICATIONS (full list: https://xuxiaoli-1993.github.io/publications.html)

1. **Li, X.**, Zhao, C., Sun, T., Tan, W., 2020. Revealing transient powder-gas interaction in laser powder bed fusion process through multi-physics modeling and high-speed synchrotron x-ray imaging. Additive Manufacturing, 35, p.101362.
2. Zhao C., Parab, N.D., **Li, X.**, Fezzaa, K., Tan, W., Rollett, A.D., Sun. T., 2020. Critical instability at moving keyhole tip generates porosity in laser melting. Science, 370(6520), pp.1080-1086.
3. Kouraytem, N., **Li, X.**, Cunningham, R., Zhao, C., Parab, N., Sun, T., Rollett, A.D., Spear, A.D., Tan, W., 2019. Effect of laser-matter interaction on molten pool flow and keyhole dynamics. Physical Review Applied, 11(6), p.064054.
4. Zhao, C., Guo, Q., **Li, X.**, Parab, N., Fezzaa, K., Tan, W., Chen, L., Sun, T., 2019. Bulk-explosion-induced metal spattering during laser processing. Physical Review X, 9(2), p.021052.
5. **Li, X.**, Tan, W., 2018. Numerical investigation of effects of nucleation mechanisms on grain structure in metal additive manufacturing. Computational Material Science, 153, pp.159-169.
6. Herriott, C.F., **Li, X.**, Kouraytem, N., Tari, V., Tan, W., Anglin, B.S., Rollett, A.D., Spear, A.D., 2018. A multi-scale, multi-physics modeling framework to predict spatial variation of properties in additive-manufactured metals. Modelling and Simulation in Materials Science and Engineering, 27, p. 025009.