XUXIAO LI

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

- Expertise in computational fluid dynamics (CFD), 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

CFD Code Development — 2016 – Present

- Maintaining a legacy code (in Fortran, over 25000 lines), General Equation Mesh Solver (GEMS), initially developed for CFD computation with finite volume method, unstructured mesh and MPI parallelization.
- Developed 5 new modules (based on the level-set method, over 15000 lines) and integrated them into GEMS to enable multi-phase, free-surface flow and fluid-structure interaction computations.
- Designed and conducted code benchmarking of GEMS and the new modules using over 15 fluid dynamic test problems.

Transient Dynamics in Laser Welding — 2018 – Present

- Developed a multiphysics model that simulates the laser absorption, melting and solidification, molten metal flow, evaporation and condensation, thermal-capillary forces, gas dynamics, and interface evolution in laser welding processes.
- Synthesized results from simulations and X-ray imaging experiments (from collaborators) to quantify the physical forces and thermal field in the molten metal.
- Provided mechanism explanations on the relationship between process parameters (laser power and scanning speed) and pore (defect) 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.

- Validated simulation results by fluid mechanics principles and X-ray experiments.
- Identified characteristic modes of powder-gas interaction by quantifying the gas flow surrounding the powder particles and the forces on particle surfaces.
- Predicted the effects of the ambient pressure on the gas flow (pressure and velocity field), powder-gas interaction, and powder behaviors (trajectory and temperature).

Machine Learning for Laser Absorption by Metal Surface Jan. – April 2020

- Extracted laser absorption distribution on surfaces of molten metal from the laser welding model, as the training and validation data sets.
- Applied convolutional neural network algorithms using Tensorflow to predict the laser absorption distribution for random molten metal surfaces in laser welding.

Grain Structure Modeling for Metal 3D Printing 2016 – 2018

- Developed a process model that simulates the thermal history and surface evolution in metal 3D printing processes.
- Implemented a cellular automata algorithm with a hybrid MPI-OpenMP parallelization (in C/C++) to simulate the grain melting, nucleation, and growth.
- Conducted simulations to identify nucleation conditions to tailor 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 metal 3D printing processes.
- Implemented the ray-tracing algorithm to simulate 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.