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   Nov. 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   Nov. 2018 – Oct. 2020

- 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   Sep. 2019 – Dec. 2020

- 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. 2020 – 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   Nov. 2016 – May 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   Sep. 2015 – Aug. 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.