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, developing, and optimizing 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 science in metal additive manufacturing and laser keyhole welding.
Relevant Coursework: Numerical Solution of PDE, Thermodynamics, Machine Learning.

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

TECHNICAL SKILLS

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

RESEARCH EXPERIENCE

CFD Code Maintenance — 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.

Keyhole Dynamics in Laser Welding — 2018 – Present

- Developed a multi-physics model (based on GEMS) that simulates the laser absorption, molten pool flow, evaporation/condensation kinetics, thermal-capillary forces, and keyhole evolution in laser welding processes.
- Synthesized results from simulations and X-ray imaging experiments (from collaborators) to quantify the driving forces and thermal field on the keyhole.
- Provided mechanism explanations on the relationship between process parameters, keyhole oscillation, and defect formation.

Powder-gas Interaction in Laser Powder Bed Fusion — 2019 – Present

- Implemented a Lagrangian-point forcing scheme and the Discrete Element Method into the laser welding model to simulate the powder motion in laser powder bed fusion processes.

- Identified characteristic modes of powder-gas interaction based on the quantification of the surrounding gas flow and gas-induced forces on powders.
- Conducted simulations to identify the effects of ambient pressure on the gas flow and statistics of spattered powder, e.g., ejecting angle, temperature, and velocity.

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.

Cellular Automata Simulation for Grain Nucleation and Growth 2016 – 2018

- Developed a thermal model (based on GEMS) that simulates the heat transfer and temperature field in direct energy deposition (DED) processes.
- Implemented the Cellular Automata (CA) algorithm to simulate the grain nucleation and growth given the temperature field from the thermal model. Parallelized the CA algorithm with hybrid OpenMP and MPI.
- Conducted simulations to identify nucleation conditions for tailoring distinct grain morphology in DED processes.

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.
- Conducted parametric studies on the effects of powder size, powder bed thickness, and powder material on the laser absorption distribution within the powder bed.

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, in press.
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.