XUXIAO LI

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EDUCATION

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

University of Utah — Salt Lake City, Utah
M.S./Mechanical Engineering — May 2019
Ph.D./Mechanical Engineering, Advisor: Prof. Wenda Tan — Expected Dec. 2020

RELEVANT COURSEWORK

Optics	Heat Transfer	Thermodynamics
Computational Fluid Dynamics	Turbulence	Kinetics
Machine Learning	Radiation	Numerical Solutions of PDEs

RESEARCH EXPERIENCE

Laser Absorption by Powderbed 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, powderbed thickness and powder material on the laser absorption distribution within the powderbed.

GEMS Maintenance 2016 – Now

- Self-learned a poor-documented legacy code (in Fortran, over 25000 lines), General Equation Mesh Solver (GEMS), for solving general conservative PDE's with unstructured mesh and MPI parallelization.
- Implemented the Level-Set and Ghost Fluid Method (over 10000 lines) into separate modules. Integrated the new modules into GEMS to enable multi-phase flow and fluid-solid interaction computations.
- Documented the methodology systematically. Designed and conducted benchmark CFD simulations for the verification of GEMS and new modules.

Cellular Automata Simulation for Grain Nucleation and Growth 2016 – 2018

- Developed a thermal model (based on GEMS) that simulates the heat conduction and temperature field in direct laser deposition processes.
- Implemented the Cellular Automata (CA) algorithm to simulate the grain nucleation and growth with the temperature output from the thermal model. Parallelized the CA algorithm with hybrid OpenMP and MPI.
- Conducted numerical experiments on the effects of nucleation conditions on the grain size, shape and texture in the builds of direct laser deposition processes. Validated the

simulation results with analytical models and EBSD experiments in literature.

Keyhole Dynamics in Laser Welding 2018 – Now

- Developed a multiphysics model (based on GEMS) that simulates the laser absorption, molten pool flow, evaporation/condensation kinetics, surface tension, and keyhole evolution in laser welding process.
- Extracted and analyzed principal quantities of interest from simulations.
- Synthesized results from simulations and X-ray imaging experiments (from collaborators) and provided explanations for the keyhole geometries and oscillations under varying processing conditions.

Powder-gas Interaction in Laser Powderbed Fusion 2019 – Now

- Implemented a Lagrangian-point forcing scheme and the Discrete Element method to track particle motion driven by fluid-induced and collision force.
- Incorporate particle tracking with the laser welding model to simulate the powder motion in laser powderbed fusion processes.
- Quantified from simulations the surrounding gas flow and gas-induced forces on powders, and identified characteristic modes of powder-gas interaction.

PUBLICATION

- **Li, X.**, Tan, W., 2016. Numerical investigation of laser absorption by metal powder bed in selective laser sintering processes. Solid Freeform Fabrication Symposium 2016, Austin, TX.
- **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.
- 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.
- 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.
- **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.
- **Li, X.**, Tan, W., 2020. Numerical modeling of powder-gas interaction Relative to laser powder bed fusion process. Journal of Manufacturing Science and Engineering, pp. 1-26.

TECHNICAL SKILLS

- *Computer Pragmatics*: Linux, Vim, Git, Latex
- *Programming Language*: Fortran, c/c++, Python, MATLAB
- *Commercial Software*: Comsol, Abaqus
- *High Performance Computing*: MPI, OpenMP, Intel Profiling Tools and Debugger