XUXIAO LI

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PhD with 5 years' experience in physics-based modeling and computation

- Expertise in computational aspects of fluid dynamics, heat transfer, and material science.
- Experienced with the simulation of manufacturing processes, e.g., welding and 3D printing.
- Managed both large legacy codes and commercial software.

EDUCATION

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

Finite Elements	Heat Transfer	Thermodynamics
Computational Fluid Dynamics	Turbulence	Kinetics
Machine Learning	Radiation	Optics

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

RESEARCH EXPERIENCE

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.

GEMS Maintenance — 2016 – Now

- Maintaining a legacy code (in Fortran, over 25000 lines), General Equation Mesh Solver (GEMS), for solving general partial differential equations with unstructured mesh and MPI parallelization.
- Implemented the Level-Set and Ghost Fluid Method (over 10000 lines) into separate modules, and integrated the new modules 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.

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.

Keyhole Dynamics in Laser Welding 2018 – Now

- 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 make estimations on the magnitude of the various driving forces 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 – Now

- Implemented a Lagrangian-point forcing scheme and the Discrete Element Method upon 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.

PUBLICATIONS

Selected Papers complete list at https://xuxiaoli-1993.github.io/publications.html

1. **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.
2. **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.
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.**, 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.
6. **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.