Taking Inspiration from Systems Engineering: a Framework for Requirement Flow Down in Lattice Design

RESEARCH TEAM

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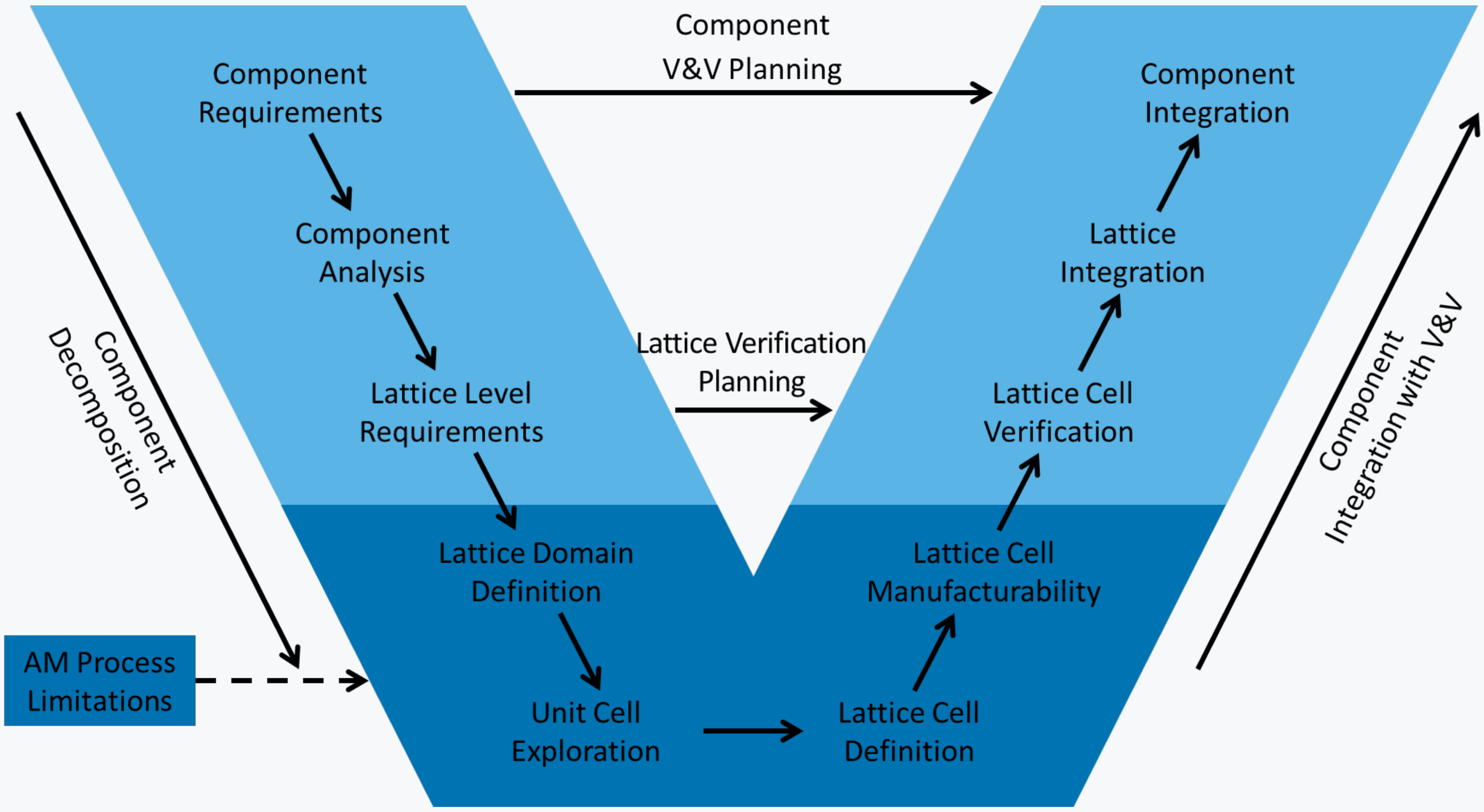
RESEARCH GOAL

The goal of the Lattice Vee Framework (LVF) is to provide a structured process for lattice design that is:

- Easy to understand
- Requirement-driven
- Extensible (with different modeling and optimization techniques)

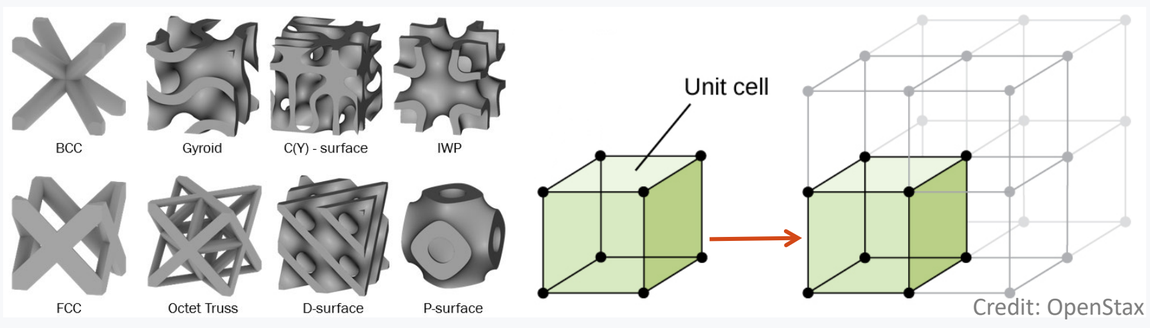
It should incorporate verification and validation and should not limit design freedom.



The Lattice Vee Framework (LVF)

RESEARCH TASK & OVERVIEW

- In the context of additive manufacturing (AM), lattice structures are cellular solids, like a foam, but with highly ordered cells.
- Lattice structures offer reductions in the weight and cost of additively manufactured parts and offer improvements to performance.
- Several decisions must be made in lattice design, including topology selection (shown below), cell size, and relative density.
- Many methods have been proposed to optimally distribute material within a lattice structure; however, these methods exist in a bubble, independent of broader engineering design criteria and processes.



(left) Eight different lattice unit cells, and (right) a visual demonstration of the patterning of a unit cell to fill space

METHODOLOGY

The Lattice Vee Framework was modeled after the System Vee. The System Vee was chosen as a basis because of its focus on hierarchy, requirement flow down, integration, and verification & validation (V&V). The LVF was made more prescriptive to reflect its narrower focus.

FUTURE RESEARCH

- Development and integration of a lattice property database into the framework for data driven decision making
- Development of a demonstration toolchain for the framework
- Case studies applying the framework

CONTACTS & REFERENCES

Fisher, J. W., Simpson, T. W., Miller, S. W. "Application of Systems Engineering to Lattice Structure Design: A Framework for Requirements Flow Down" *2022 International Solid Freeform Fabrication Symposium.* University of Texas at Austin, 2022.

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