Layered Tetrahedral Modeling of the L-PBF Process

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ABSTRACT

Process modelling of the laser powder bed fusion process for additive manufacturing to determine part distortions and residual stresses has matured with many commercial offerings now available [1]. These up-front tools allow engineers to not only design for these issues, but also determine optimal orientations and support strategies to mitigate these problems. While they have shown good correlation to experimental measurements, these test artifacts tend to be very simple geometries [2].

ANSYS's engagements with customers, however, reveals that the components to be printed are anything but simple. The parts tend to fall into one or more of these categories: (1) organic (such as those produced by topology optimization), (2) thin-walled, (3) many small features (such as cooling holes), and/or (4) lattice structures.

The majority of process modelling software rely on voxel (or Cartesian) meshes that can only approximate the geometry. Coupled with their small features, the required element size makes the simulation costly as well as inaccurate.

ANSYS has recently introduced a layered tetrahedral meshing approach that alleviates these issues, producing accurate results in a reasonable simulation time.

REFERENCES

[1] P. Keane, "3D Printing Simulation, Part 1: Where Are We Now?", *https://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/17591/3D-Printing-Simulation-Part-1-Where-Are-We-Now.aspx*, (2018).

[2] S. Afazov et. al., "Distortion prediction and compensation in selective laser melting", *Additive Manufacturing*, Vol. **17**, pp. 15-22, (2017)