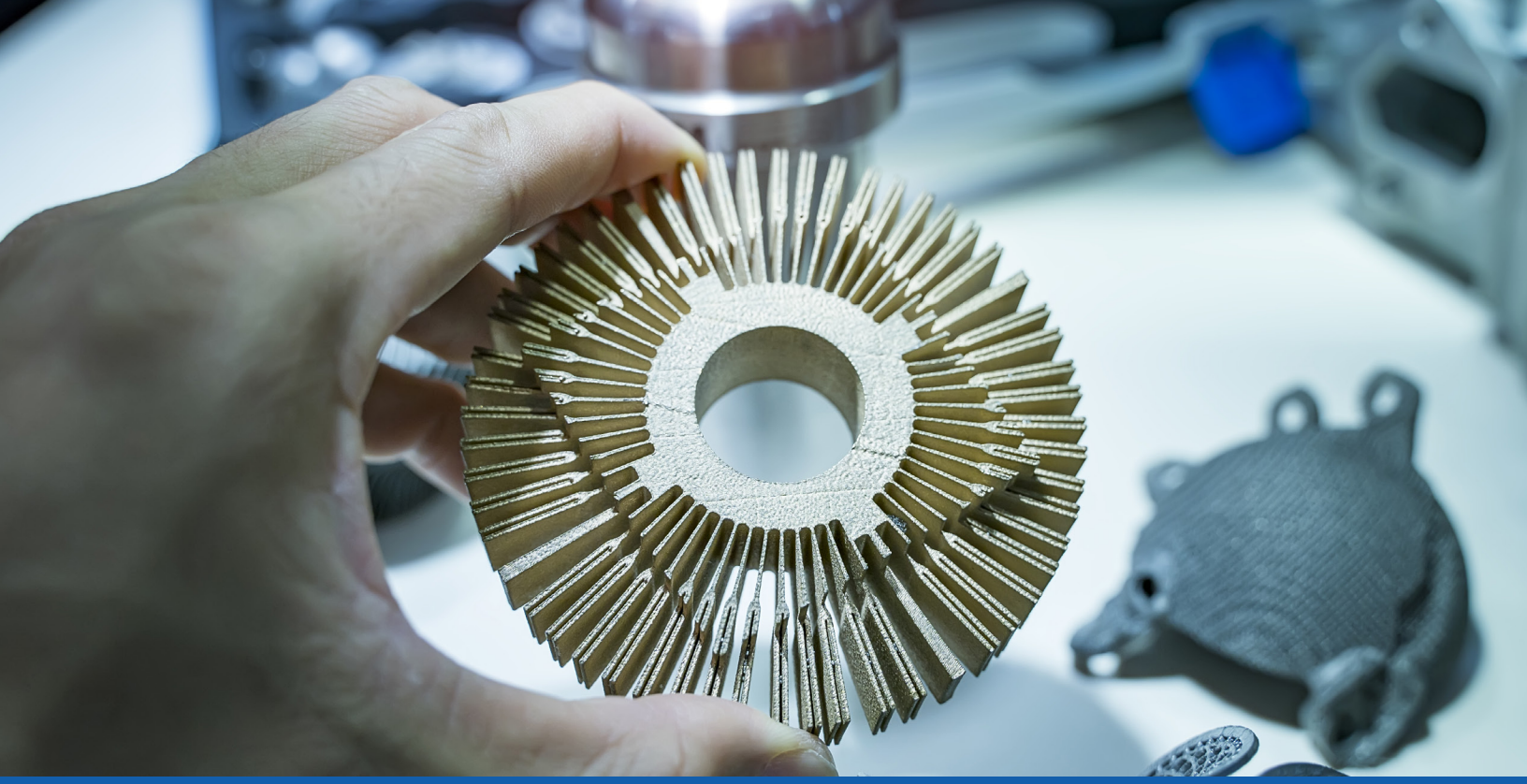


Accelerating a Startup in Industry-Scale Metal Printing

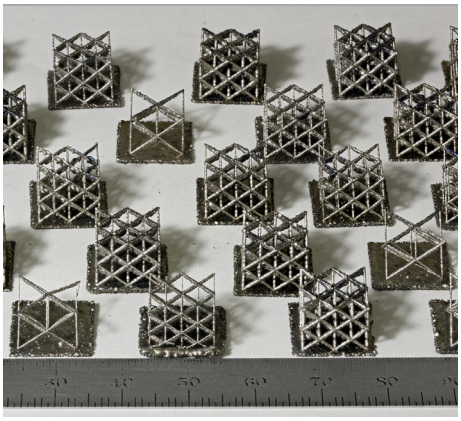
Livermore identified process conditions to speed a new company's lab-to-market timeline

A Promising Technology

Metal Additive Manufacturing (Metal AM) technologies such as Laser Powder Bed Fusion (LPBF) produce precise, lightweight parts required for aircraft, heat exchangers, next-generation automobiles, and other products. A challenge for LPBF is that the printed parts must have high quality – with nearly full density – to meet stringent mechanical property specifications.

Seurat Technologies, a California-based startup, licensed a Livermore-invented metal AM technology in 2015 with the intention of developing and commercializing a high-speed, high-resolution 3D printer to produce metal parts at industrial scale. Since then, Seurat has developed the lasers, optics, and equipment needed to bring the technology to market. Unlike existing LPBF systems, Seurat's lasers melt relatively large areas of metal powder simultaneously, significantly increasing the speed of the LPBF process. Seurat's technology provides precise laser control to finely tune local temperatures, minimizing defects and residual stresses in manufactured parts. However, bridging the gap between promising invention and market-ready product required Seurat to demonstrate that its technology could reliably print high-quality, high-density parts.

For a startup, finding a fast path to market readiness is critical. Conducting trial-and-error experiments to identify specific conditions that minimize printing defects is a time-consuming and expensive process. In contrast, simulations using high performance computing (HPC) capabilities efficiently predict the likelihood of defects and the density of printed parts under a range of manufacturing conditions.



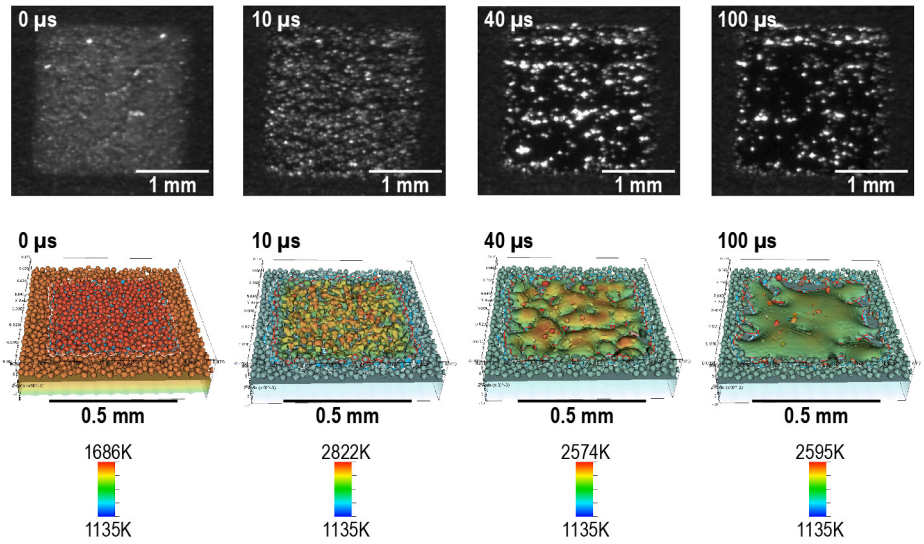
Metal parts made by additive manufacturing can be used in a number of industry applications as long as the material density meets that of traditionally-manufactured metal parts.

Seurat was selected to participate in the DOE-funded High Performance Computing for Manufacturing (HPC4Mfg) Program and apply Livermore's world-class computing resources and expertise to optimize Seurat's metal printing technology. For a startup with limited funding, the HPC4Mfg Program presented a path to speed Seurat's launch into the metal AM market by demonstrating reliability and reducing investor risk.

Closing the Commercialization Gap

Livermore's researchers set out to determine how defects (pores) formed during laser melting of metal powders. Although common in traditional LPBF processes, liquid spatter—leading to large, irregular pores and defects—was determined not to be an issue for Seurat's technology. This finding removed one potential barrier to process improvement.

Still, simulations of the startup's metal printing technology revealed pit formation and areas that would not melt completely, compromising final metal density. Using Livermore's HPC resources, the team simulated situations in which density might increase. The team reviewed its results and found an unconventional solution for LPBF systems: changing some powder characteristics such as size and spatial distribution yielded high density with few defects and complete powder melting.



High-speed imaging of Seurat's process compared to simulation results indicated the simulation faithfully reproduced process timescales and physics.

High-speed imaging of Seurat's process in action revealed that predictions made by Livermore's simulations matched experimental results. Evaluation of the final material's properties, such as density, confirmed the accuracy of the simulation across a range of process conditions. By using simulations to narrow the field of process improvements that could achieve reliable, high-density parts, Seurat could refine the process by running selective experiments, saving time and resources.

Preparing for Launch

In addition to advancing a startup for the benefit of the manufacturing industry and the U.S. economy, efforts in this HPC4Mfg project may ultimately reduce energy use across the metal manufacturing industry. Seurat's laser architecture and melting process have been shown to be inherently efficient. More broadly, metal AM saves energy compared to traditional metal manufacturing, as less waste is produced and less feedstock energy is consumed. Additive manufacturing also reduces storage needs by enabling a digital inventory and rapid parts manufacturing as needed.

Following the HPC4Mfg collaborative effort, Seurat's assets can be devoted to commercialization rather than resource-intensive experimentation. The startup continues to fine tune its business offering for its upcoming product launch.

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