In-situ Imaging and Data Analytics for Coaxial Monitoring of Laser Powder Bed Fusion Additive Manufacturing

This technology offers an in-situ imaging and data analytic method for the coaxial monitoring of laser powder bed fusion. This system can quickly gather data, process its quality and stability, and automatically generate alarms.

Technology ID

BDP 8711

Category

Hardware/3D Printing
Selection of Available Technologies

Authors

Xu Chen

Learn more

What is the Problem?

Laser powder bed fusion (LPBF) has demonstrated a wide range of competitive advantages over conventional manufacturing methods in terms of customizable parts with intricate internal features, complex external geometries, and a broad range of materials. The process has also shown the potential of producing parts with lighter weights and reduced components. Despite such capabilities and countless emerging applications, limited reliability and reproducibility are hindering broader adoption of this manufacturing technology. LPBF is sensitive to disturbances and input process parameters such as laser powers, laser scan paths, and scan speeds. Unpredictable process variations can result in various part defects, including porosity, balling, high surface roughness, thermal cracking, geometric error, microstructural inhomogeneities, impurities, etc. The same part can come out differently from different machines or even from the same machine on another day. As a result, tremendous human efforts are involved in the loop to inspect the parts to find defects and assure quality after the printing, especially in such industries as medical devices and aviation.

What is the Solution?

This solution is in-situ imaging and data analytics for coaxial monitoring of LPDF. This is an efficient data processing framework for the coaxial process monitoring module with a visual camera. This novel framework can quickly make sense of gathered data during the process to determine the quality and stability and automatically generate alarms. Specifically, this invention eliminates various noises in the raw data, isolates the area that interacts with the power source from the unmolten powder bed, and extracts important features that reflect the evolution of the melting pool, laser-material interaction characteristics, and potential process imperfections in LPBF.

What Differentiates it from Solutions Available Today?

Despite emerging research and development efforts related to these topics, state-of-the-art results are still far from the maturity reached in other manufacturing applications. Most current

LPBF systems do not monitor the laser-material interaction process but only measure simple system statutes (e.g., temperature, pressure, and oxygen level). This solution will increase the consistency of LPBF parts.

Patent Information:

US20220335595A1

References

1. Tianyu Jiang, Mengying Leng, Xu Chen(44979) , https://www.scilit.net/article/358db25875b006bb118c448d5f80e63c, Progress in Additive Manufacturing