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Full multi-axis motion control of a tool tip for metal 3D printing

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Directed energy deposition (DED), an ASTM (American Society for Testing and Material) process classification of metal 3D printing or additive manufacturing (AM) process has enabled to build full density metallic tools and parts using metal powders precisely delivered and controlled for deposition with no powder bed. Recently, DED processes, equipped with more than 3-axis tool mechanism and no additional machining process, turned out to be able to deposit overhang / undercut features directly on a part in multiple directions. Two additional axes of rotating and tilting added to the working table where the part is located need to be controlled using an advanced process management skill that can control multi-axis tool paths along the part. As the previous approach for a simple multi-axis slicing algorithm can only provide a stepwise motion control separately for each of the tool and the part, an integrated 5-axis motion control is needed for the continuous interaction between the tool and the part. A critical barrier to the approach is possible interference between the tool and the part. This study first provides a diagnose algorithm detecting singular part features requiring multi-axis motion control during the build. Second, build tool paths on each 3D build layer after the new slicing method avoiding any possible interference between the tool and the part is generated with a subsidiary visual simulation. The method has been implemented on two example STL models to be built using a DED process.

Biography

Haeseong Jee has completed his PhD at Massachusetts Institute of Technology, USA and Post-doctoral studies from National Institute of Standards and Technology USA. He is a Professor in Department of Mechanical and System Design Eng. at Hong Ik University, South Korea. He has published more than 40 journal papers in reputed journals and has served as a Chief Vice President of Korea Society of Mechanical Engineering. His major research interests include CAD, GD&T, and design rules for additive manufacturing.

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