Development of an FDM 3D printer capable of additive manufacturing on arbitrary curved surfaces

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Abstract

This study aims to develop a Fused Deposition Modeling (FDM) 3D printer capable of additive manufacturing on curved surfaces. It is well known that conventional FDM 3D printers produce additive models on flat surfaces, but the device developed herein makes it possible to produce models on arbitrary curved surfaces. To achieve this goal, a small displacement sensor is attached to the head of the 3D printer to measure the shape of the curved surface. Based on the recorded data, the movement of the head is controlled using Python to perform additive manufacturing along the curved surface. In addition, a numerical model is constructed to enable 3D finite element analysis of FDM under additive manufacturing conditions. A highly accurate death-birth technique is used to reproduce the additive manufacturing process. This method can accurately simulate the change in temperature and residual stress with time that occurs in the model under different additive manufacturing conditions. As a result, it becomes possible to determine the optimal additive manufacturing conditions, such as filament temperature and head speed, of a curved surface compatible 3D printer, enabling efficient operation. Our work expands the applications of FDM 3D printers by modifying the printer itself.In addition, by modeling the additive manufacturing process, it compensates for the currently limited data on optimal printing conditions for curved surface additive manufacturing. This plays a critical role in promoting the use of this 3D printer.

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