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A MESHLESS METHOD for 3D PRINTING PROCESS SIMULATION

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ABSTRACT

3D Printing has been considered a promising manufacturing way as it can produce parts with highly irregular shapes. However, since the printing process uses melting material to generate the part and obtains the final shape after cooling down, the temperature difference causes severe thermal deformation and warpage, especially in 3D metal printing. This decreases the accuracy and quality of printed parts. A prior evaluation by simulation could be helpful for gaining solutions to reduce possible problems. Although, the finite element method is often used to evaluate engineering problems in advance to reduce possible failings; the element meshes generated by auto-meshers are always irregularly distributed, especially for irregular-shaped objects. However, the 3D printing process generates parts in a layer-by-layer way; thus, the analysis model should be able to simulate the layer-by-layer behaviour. Nevertheless, the irregular FEA element meshes cannot match this need. Here, a new meshless method is proposed to match the need. Since the proposed method does not need any element meshes, it has the flexibility to arrange the node's distribution to match the layer-by-layer growing situation, even for parts with highly irregular shapes. Moreover, combined with a layer-by-layer analysis procedure, it can then be used to simulate the 3D printing growing process. With the proposed method and scheme, layer-by-layer analysis models can be automatically generated, based on the input geometry model, and then used to simulate the layer-by-layer growing process. Several simulation cases have been conducted to demonstrate the effectiveness of this proposed method.

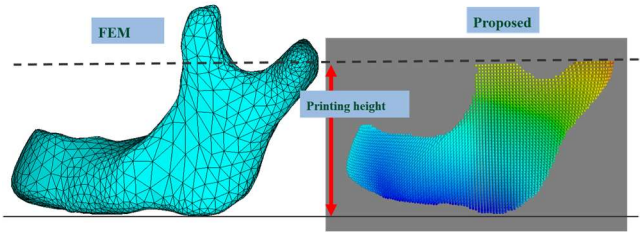

Fig. 1 FEA model cannot but the proposed meshless method can match the vertical growing process

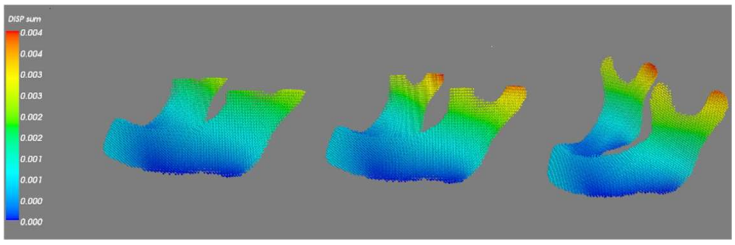

Fig. 2 Layer-by-layer growing simulation results (Displacement distribution)

REFERENCES

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