A Design For An Object To Be 3D Printed Should Be A Transformable Parametric Program

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Abstract

It has been common practice that a 3D model for additive manufacture of a part is created primarily by specifying its dimensioned shape. However, most CAD systems internally represent even a graphically-drawn design as a program that, when executed, will generate a 3D surface mesh. That mesh is later sliced to create machine-specific G code that will control the machining of the part.

In contrast, parametric modeling is an approach to 3D CAD that attempts to include not just the physical shapes, but also information about design intent, features, and constraints. Instead of this additional information being unstructured annotations on the design, we suggest making them explicit parameters and attributes in the structured, hierarchical, and composable program that encodes the design. Working directly on that representation (as opposed to meshes or G code), surprisingly conventional optimizing compiler technology, and even AI methods like GPT (Generative Pre-trained Transformers), can implement a wide range of high-level machine-specific transformations of the design to adjust for machine constraints, tolerances, etc. In sum, the hard work of DFM (design for manufacturability) can be largely automated.

This talk will discuss the key concepts and will show a few examples of DFM using parametric modeling in the **`OpenSCAD`** language to create useful parts and devices using consumer-level 3D printers.

Biography of Presenter

Since 1999, Henry (Hank) Dietz has been a Professor, and James F. Hardymon Chair in Networking, in the Department of Electrical and Computer Engineering at the University of Kentucky. His computer engineering research generally involves making the hardware and software aspects of a system work better together to improve performance and gain new abilities, with an emphasis on leveraging commodity technologies and facilitating widespread use of the new methods. For example, some of his work enabling cluster supercomputing has been recognized by Gordon Bell and Computerworld Smithsonian awards. His research is primarily disseminated via **`Aggregate.Org`**.