

Understanding of Additive Manufacturing with the Combination of the Flexible Manufacturing Process

Briley Perkins, Emmanuel Ewuzie, Mauricio Aristizabal, Matt Balcer, Dr. Harry Millwater

Abstract:

Additive Manufacturing is 3D printing which requires a set of repeating steps throughout the process. STL, or Standard Triangle Language, is the most important step in the printing process that allows the model to be "sliced" the fastest and most proficient way, and allows the entire model to be modified at any step of the process. Although the printing process is the same for all the parts, some parts may be printed differently.

Background:

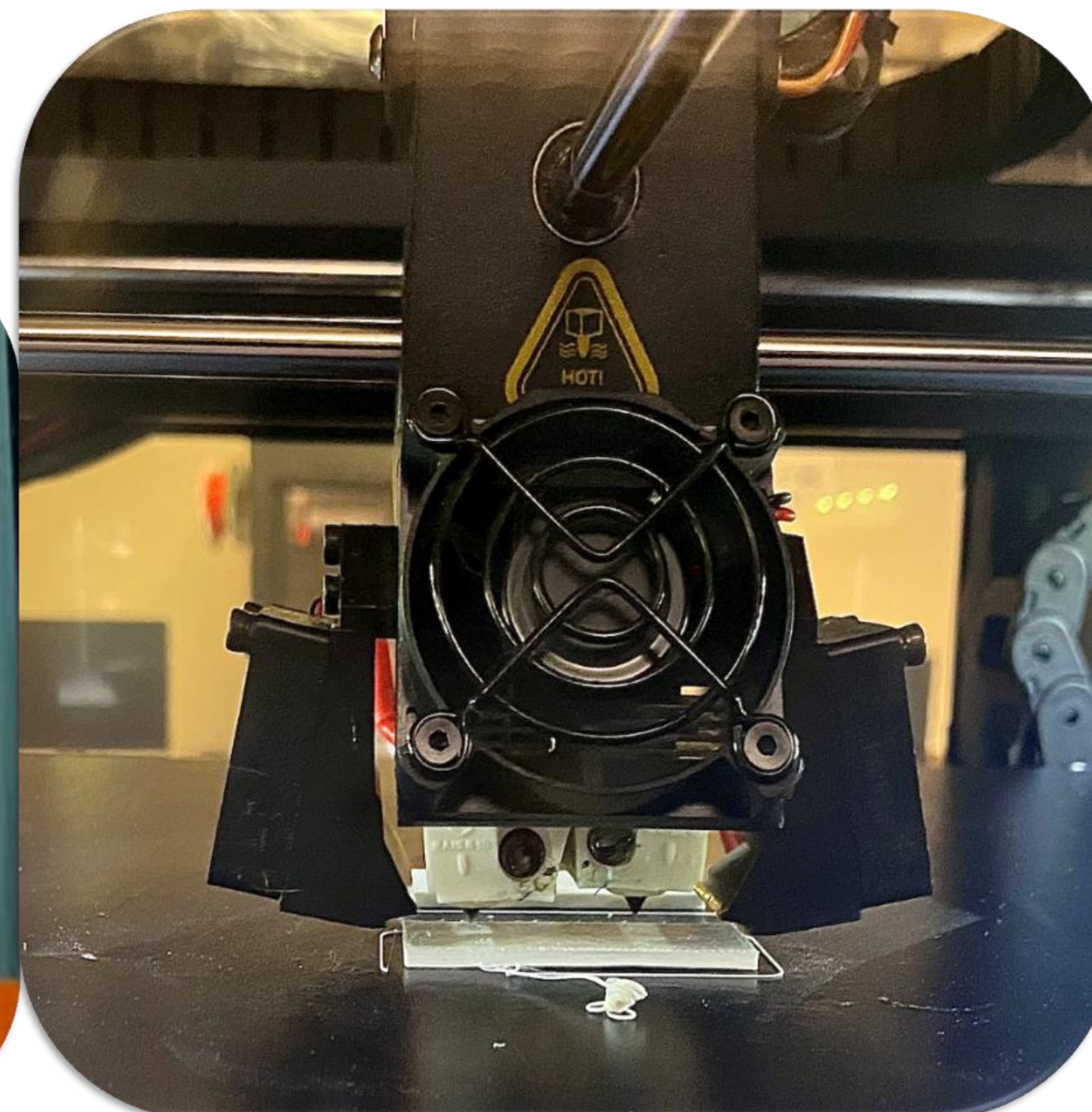
Additive manufacturing offers a range of opportunities to produce complex geometries from existing materials, offer new routes for processing of previously difficult to process materials, allow for the design of new high-performance materials, and finally facilitate hybridization of dissimilar materials. STL, or Standard Triangle Language, was created as a part of stereolithography printing technology for 3D systems' first commercial 3D printers. It is the most common file format for 3D printing.



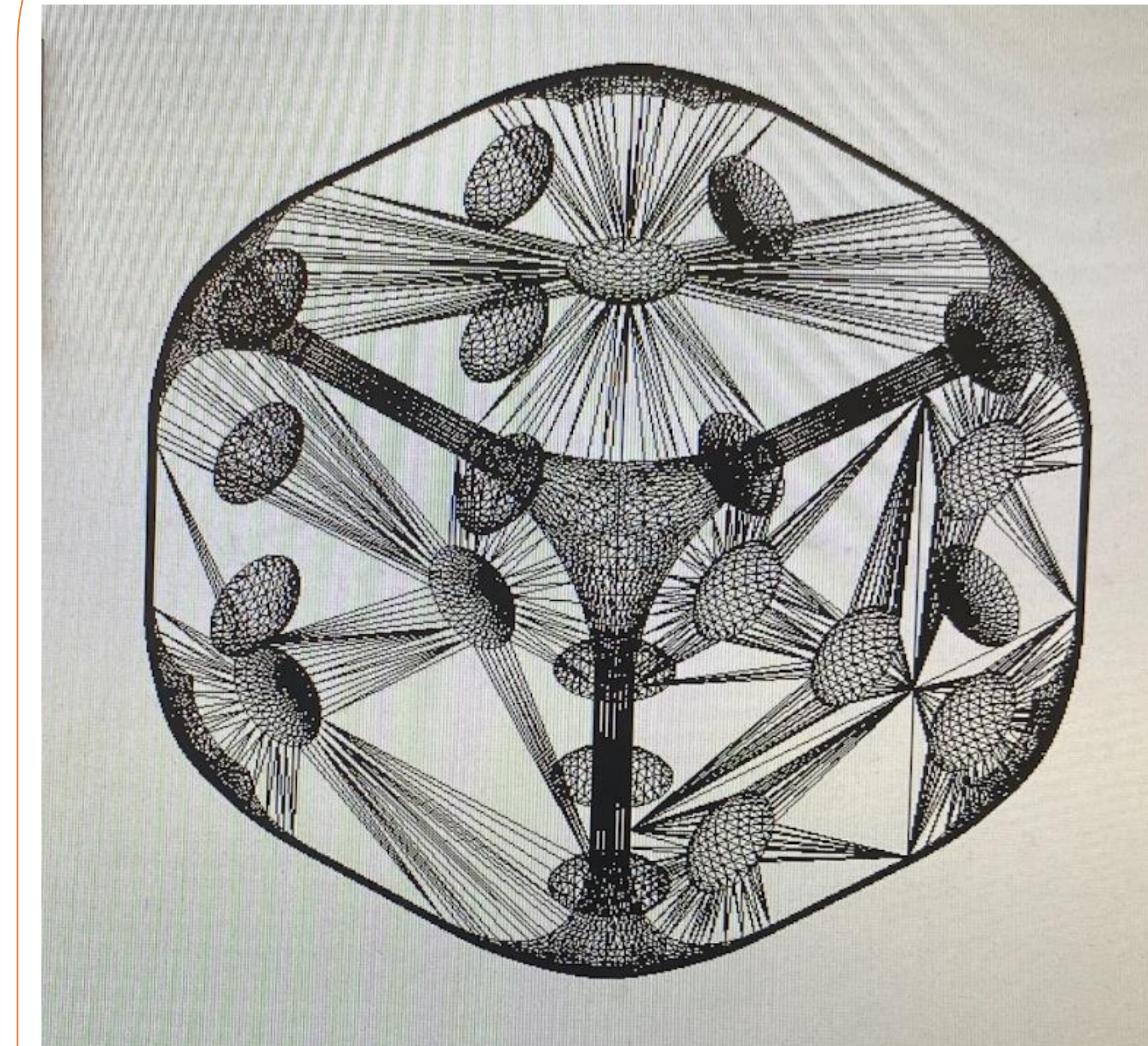
Methodology:

- To begin the process of Additive Manufacturing, a Computer-Aided Design (CAD) software is used to design the desired model.
- Once created, the file is converted to a STL file which converts the model to machine coding.
- Lastly, after the model becomes coded, the piece is printed with either one of the printers: MakerBot Replicator Z18, Raise3D Pro2, or Renishaw AM 400.

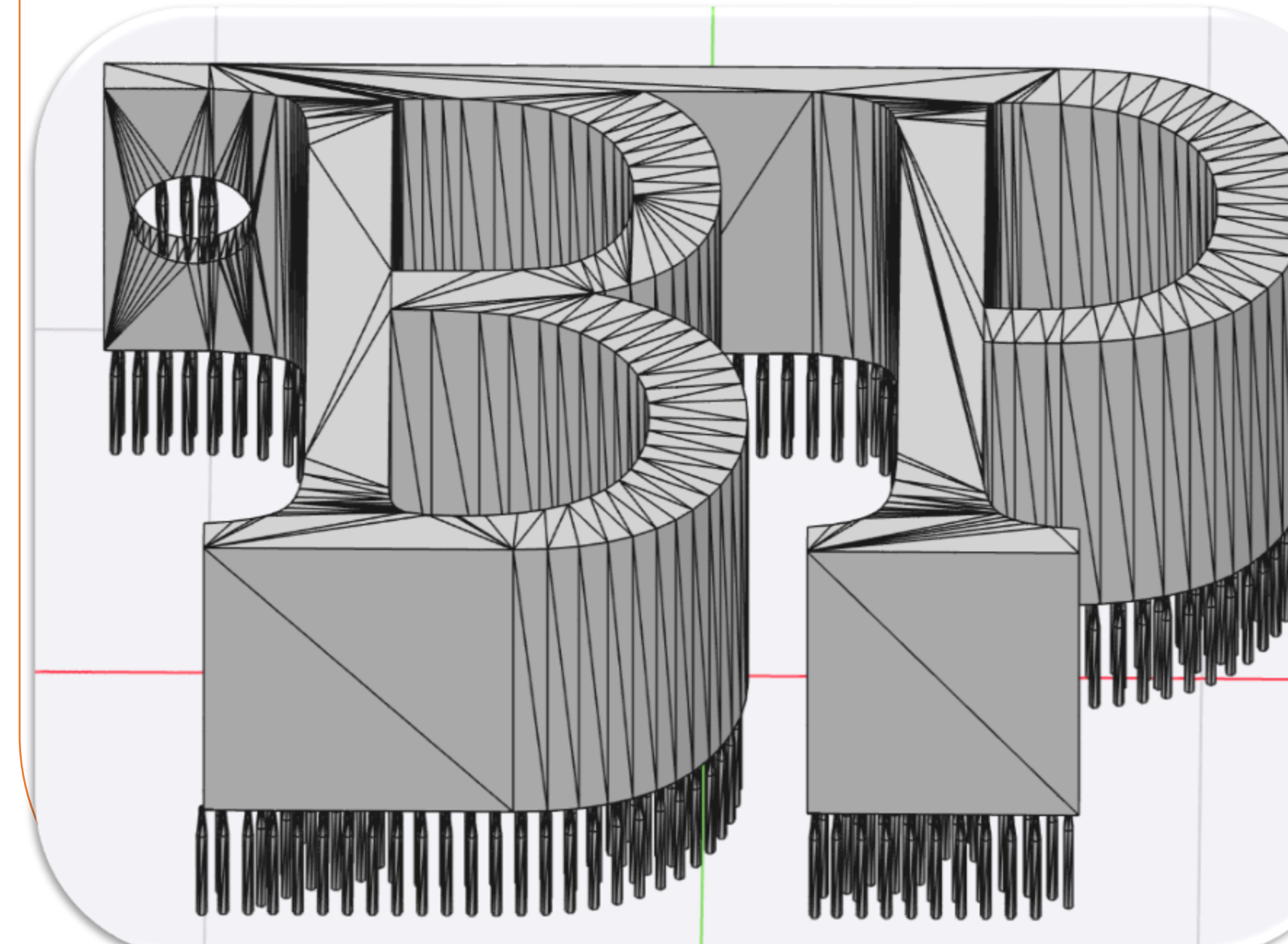
A print occurring in the Renishaw printer(left) and Raise 3D Pro2(right).



Results:



The CAD models successfully converted into STL files. As a result, the entire surface is recreated into triangles which causes a faster way to code the print.



Conclusion:



The process of Additive Manufacturing throughout is straight-forward and flexible. Although the process is straight-forward, the printing process can be sensitive. The support structures that can be used when printing is sometimes faulty, because they are made very thin to be easily taken off of the print. Additionally, the modifications that needed to be changed in a model were easily accessible and do-able making it a very simple manufacturing process.

Results cont'd:

The models that were designed in a CAD software and converted to the STL file, mostly printed successfully. Although, some prints failed, which was due to a printer error or a setting change in the program. In particular, the initials BP was the first successful print of Titanium to occur for the Renishaw printer. A post print process is needed to obtain smooth surfaces, no matter the type of material that is printed.



References:

- [1] Cheng Sun, Yun Wang, Michael D. McMurtrey, Nathan D. Jerred, Frank Liou, Ju Li, Additive manufacturing for energy: A review, *Applied Energy*, Volume 282, Part A, 2021, 116041, ISSN 0306-2619
- [2] "Journal of Nuclear Materials." *Journal of Nuclear Materials | Additive Manufacturing for Nuclear Energy Applications | ScienceDirect.com by Elsevier*
- [3] 3DPrinting.com. "What Is 3D Printing?" *3D Printing*, 31 May 2022
- [4] "What Is Additive Manufacturing: GE Additive." *What Is Additive Manufacturing | GE Additive*
- [5] "STL (File Format)." *Wikipedia*, Wikimedia Foundation, 1 June 2022
- [6] "A Detailed History of 3D Printing." *3D Insider*, 2 Feb. 2018

Acknowledgments:

This research was funded and carried out through National Nuclear Security Administration under Award number DE-NA0003948 and through the CONNECT program.