Mathematical Surfaces and 3D Printing

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ABSTRACT

In studying multivariable calculus, one of the most difficult aspects is Visualizing 3D surfaces that one works with. With the accessibility of a 3D printer, these theoretical models can be converted into physical models, creating both a visual and physical understanding that the conventional approaches lack. We present some of these models and describe some of the benefits of such models.

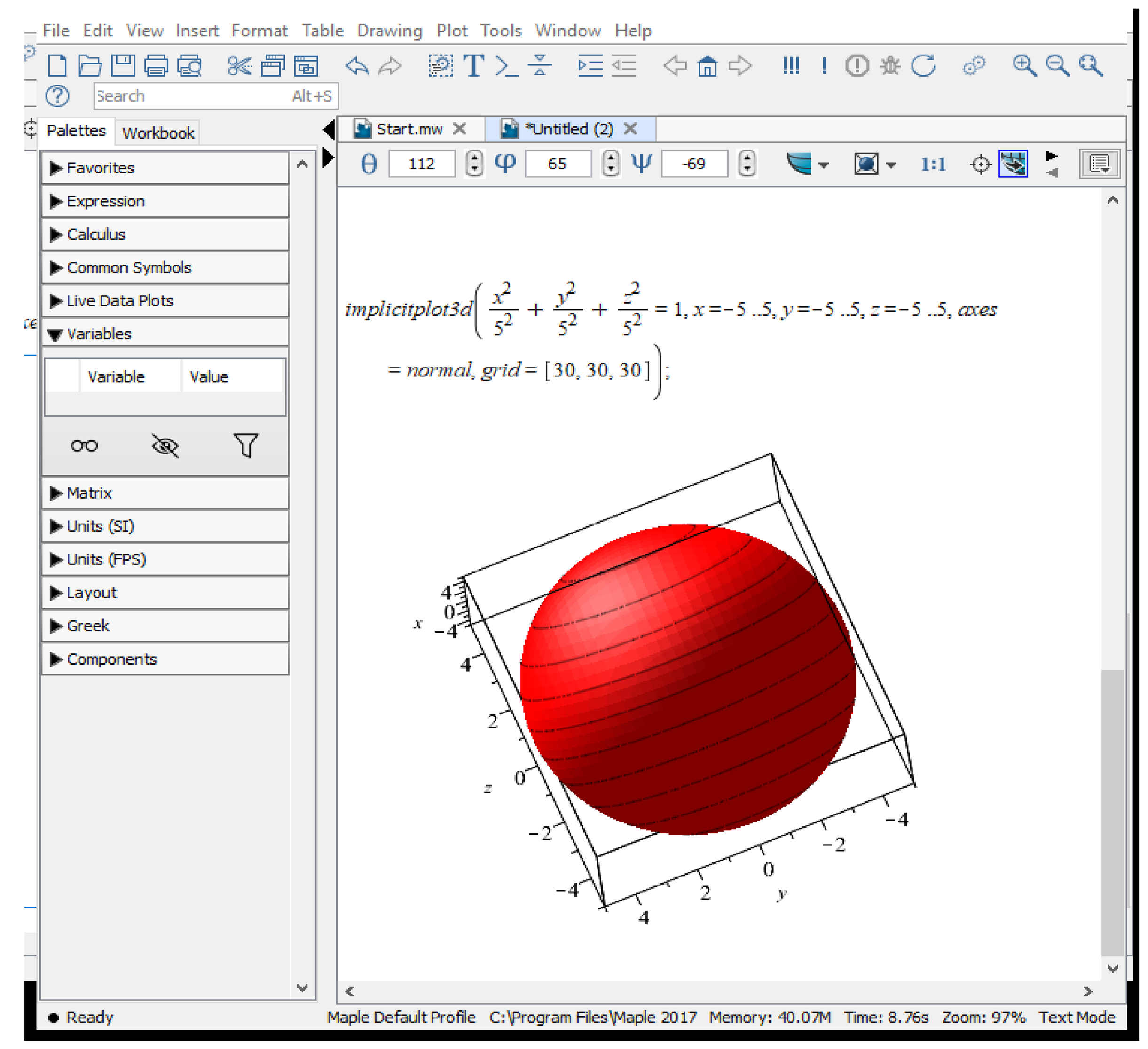
3D PRINTING

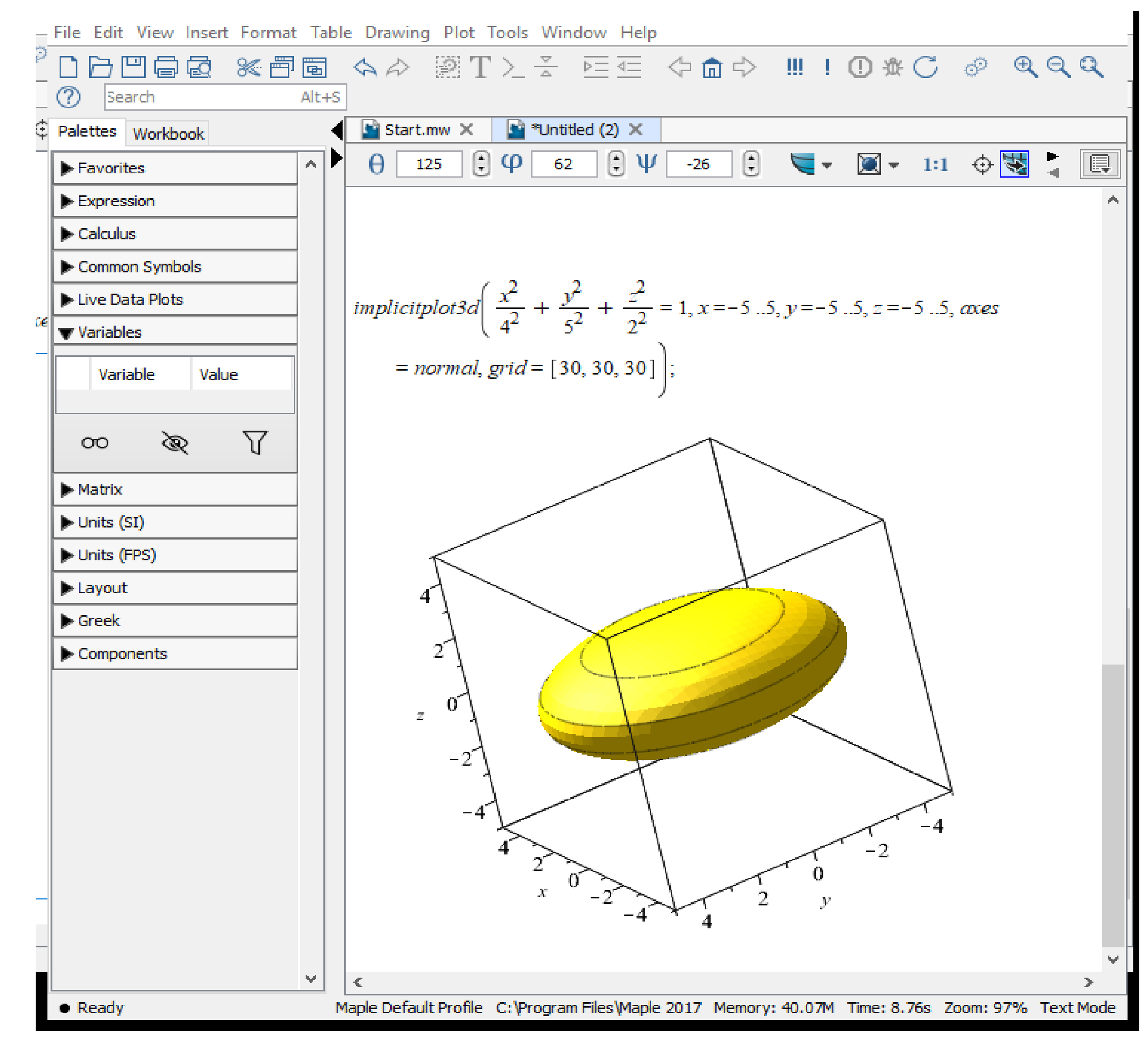
- A CAD drawing is converted to a Standard Tessellation Language (STL).
- STL file is copied to a computer that controls the 3D printer.
- Polymers, binders, and other consumables are loaded into the printer.
- 3D object is built from 0.1mm thick layers.

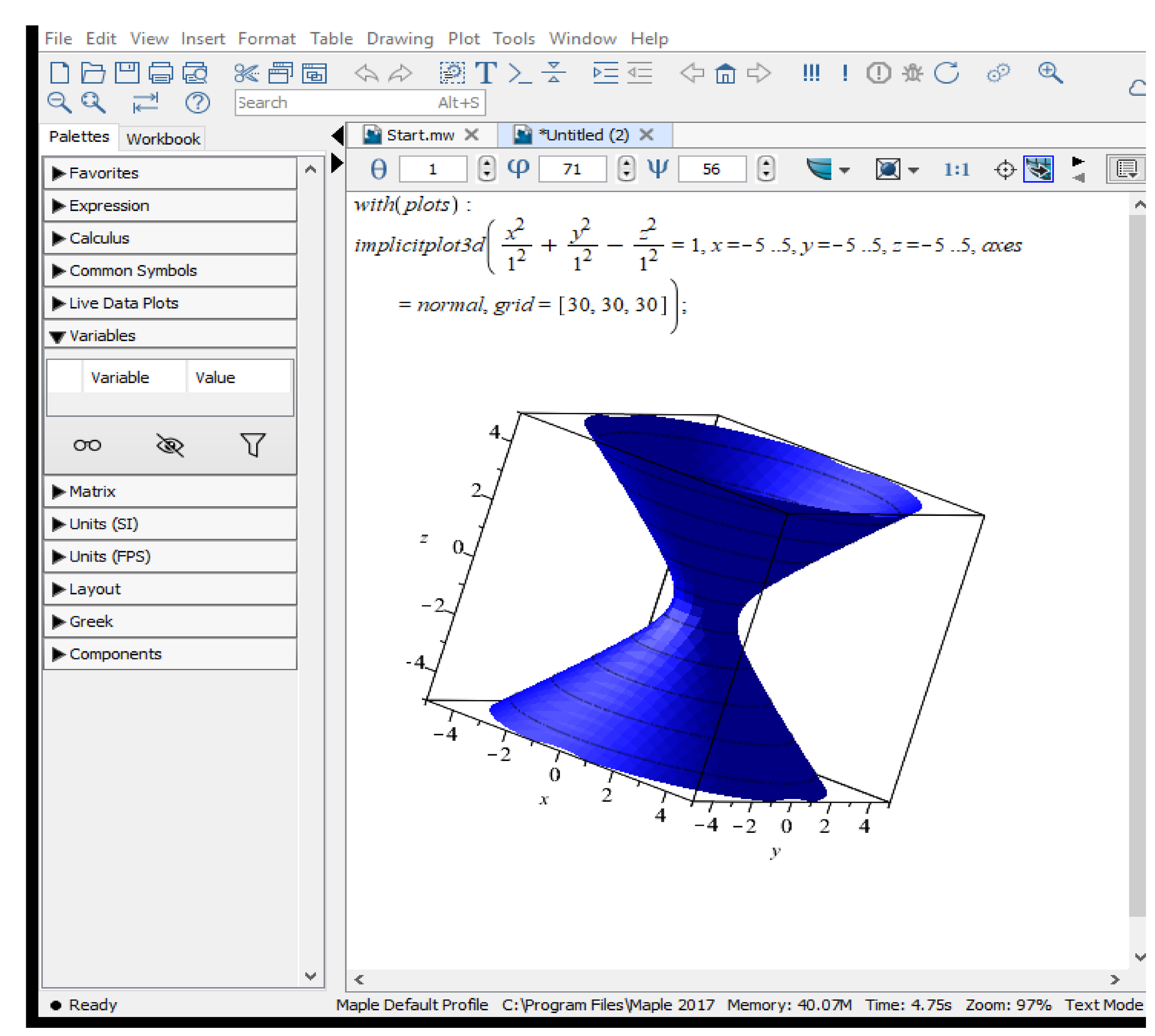
RESULTS

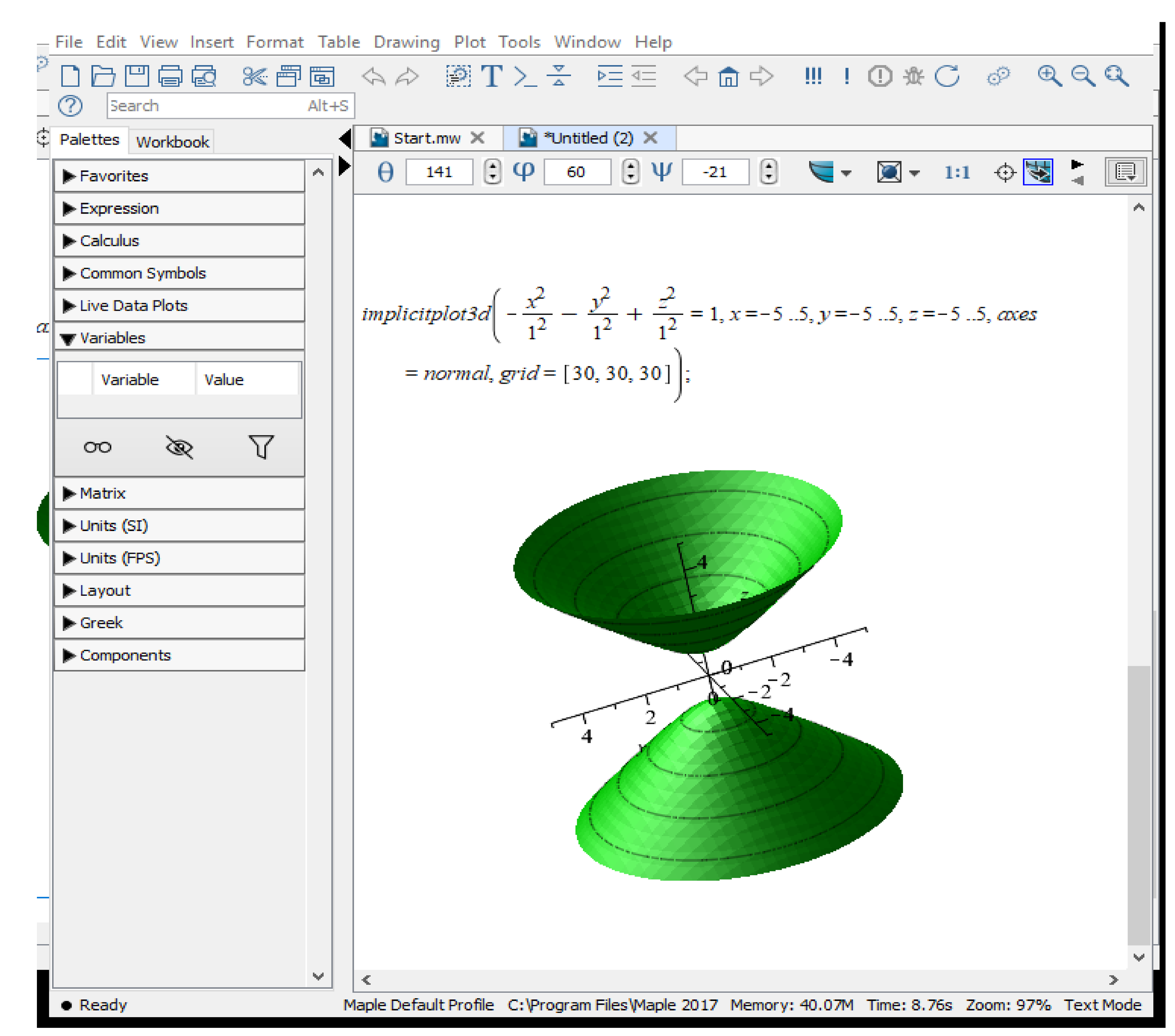
When visualizing the mathematical process behind 3D models, software can be used to show how altering the signs within an equation can manipulate the outcome of that 3D shape.

SOFTWARE









Sphere: $\frac{x^2}{1^2}+\frac{y^2}{1^2}+\frac{z^2}{1^2}=1$

Ellipsoid: $\frac{x^2}{4^2}+\frac{y^2}{5^2}+\frac{z^2}{2^2}=1$

Hyperboloid of one sheet: $\frac{x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=1$; $\frac{x^2}{a^2}-\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$; $\frac{-x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$

Hyperboloid of Two Sheets: $\frac{-x^2}{a^2}-\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$; $\frac{-x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=1$; $\frac{x^2}{a^2}-\frac{y^2}{b^2}-\frac{z^2}{c^2}=1$