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3D DESIGN SOFTWARE

Learning how to design in 3D is essential to creating custom 3D printable models. The broad capabilities of the printer will push you to design increasingly complex objects. Once you begin to experiment, you'll discover the unique advantages that different 3D design programs offer for different applications.

We recommend starting with easy solid modeling programs before branching out to digital sculpting or parametric modeling as you become more comfortable. No single program is right for everyone, and it may take a few tries before you find one that you're comfortable with.

There are a lot of 3D design programs available, all with different strengths and weaknesses. When looking at 3D modeling programs, you'll find that all of them fall into three major categories; **solid modeling**, **digital sculpting**, or **polygon modeling**. The projects in this guidebook focus mainly on free programs.

TERMINOLOGY

Solid Modeling: Define and construct solid objects with real world dimensions

Digital Sculpting: Simulate clay sculpting. Push and pull surfaces to create detail and texture

Polygon Modeling: Define outer surfaces like edges and corners to create intricate models

Parametric Modeling: A feature in 3D design programs, use dynamic variables for object parameters so that entire designs can be easily altered or scaled

Mesh: The collection of vertices, edges, and faces that make up the surface of a 3D model

Watertight: A continuous outer surface with no holes in it, necessary for successful 3D printing

Perspective View: Objects further away appear smaller than objects closer to the viewpoint

Orthographic View: Fixes the point of view to a single perspective, where similarly sized objects appear the same size regardless of their distance from the viewpoint

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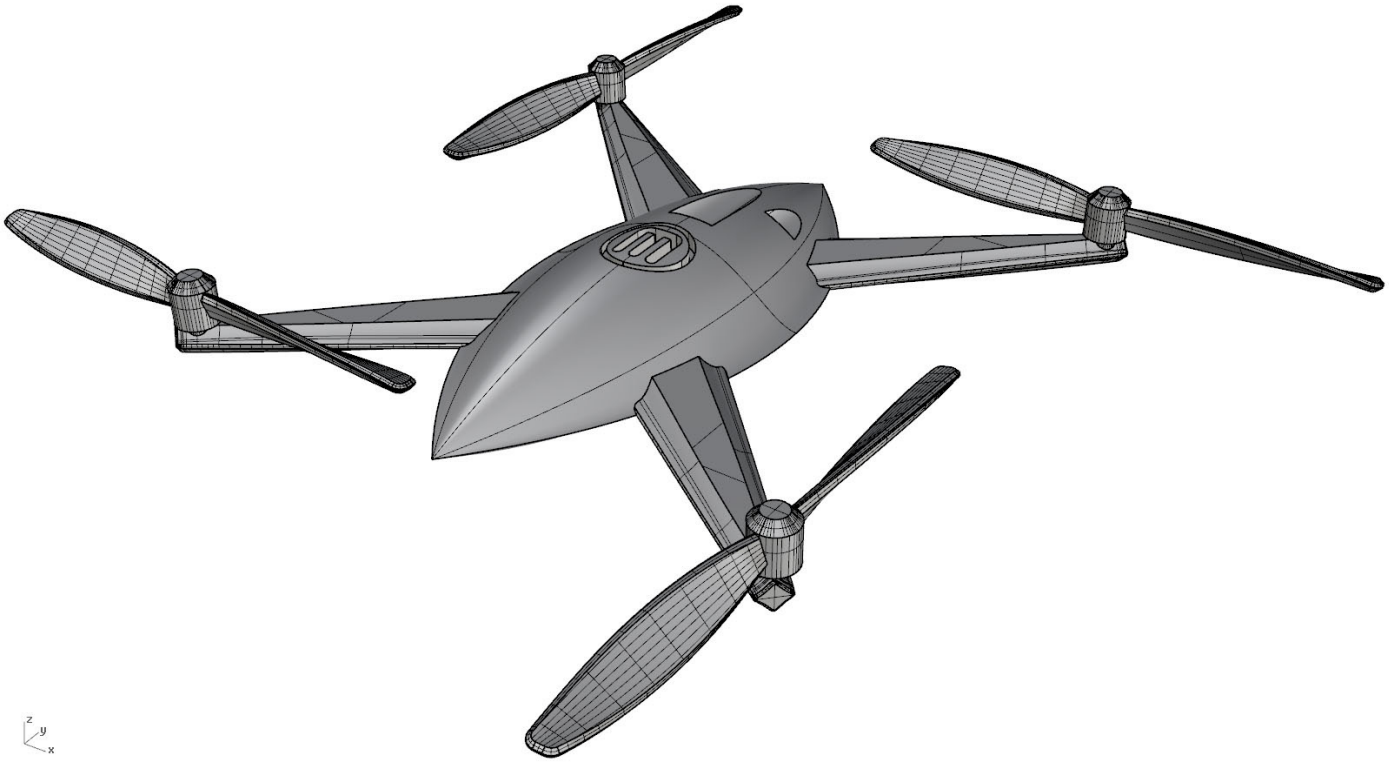
SOLID MODELING



QUADCOPTER DRONE: *Created in Rhinoceros*

Solid modeling programs work well for creating models with real-world dimensions and are used to make functional parts. In some of the advanced programs you can form complex assemblies of objects and run simulations.

Industries: Engineering, industrial design, architecture
Free software: Autodesk Tinkercad™, Autodesk® Fusion 360™, Onshape® and more
Paid software: SolidWorks®, Autodesk Inventor®, Rhinoceros

STRENGTHS

- Creating mechanical structures with dimensions
- Building assemblies
- Simulating real-world conditions
- Access to material property libraries

WEAKNESSES

- Poor organic shape creation
- Difficult to create detailed surface textures and patterns

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DIGITAL SCULPTING

ROSE: *Created in Sculptris*

Digital sculpting simulates the process of sculpting with physical clay. Users can push and pull digital clay to create organic, highly detailed and textured models.

Industries: Film, video games, art
Free software: Sculptris™, SculptGL
Paid software: ZBrush®, Mudbox®, 3D-Coat

STRENGTHS

- Highly detailed models
- Organic shapes
- Digital painting

WEAKNESSES

- Creating functional parts is difficult
- Often requires additional hardware like a drawing tablet
- Difficult to design for manufacturing

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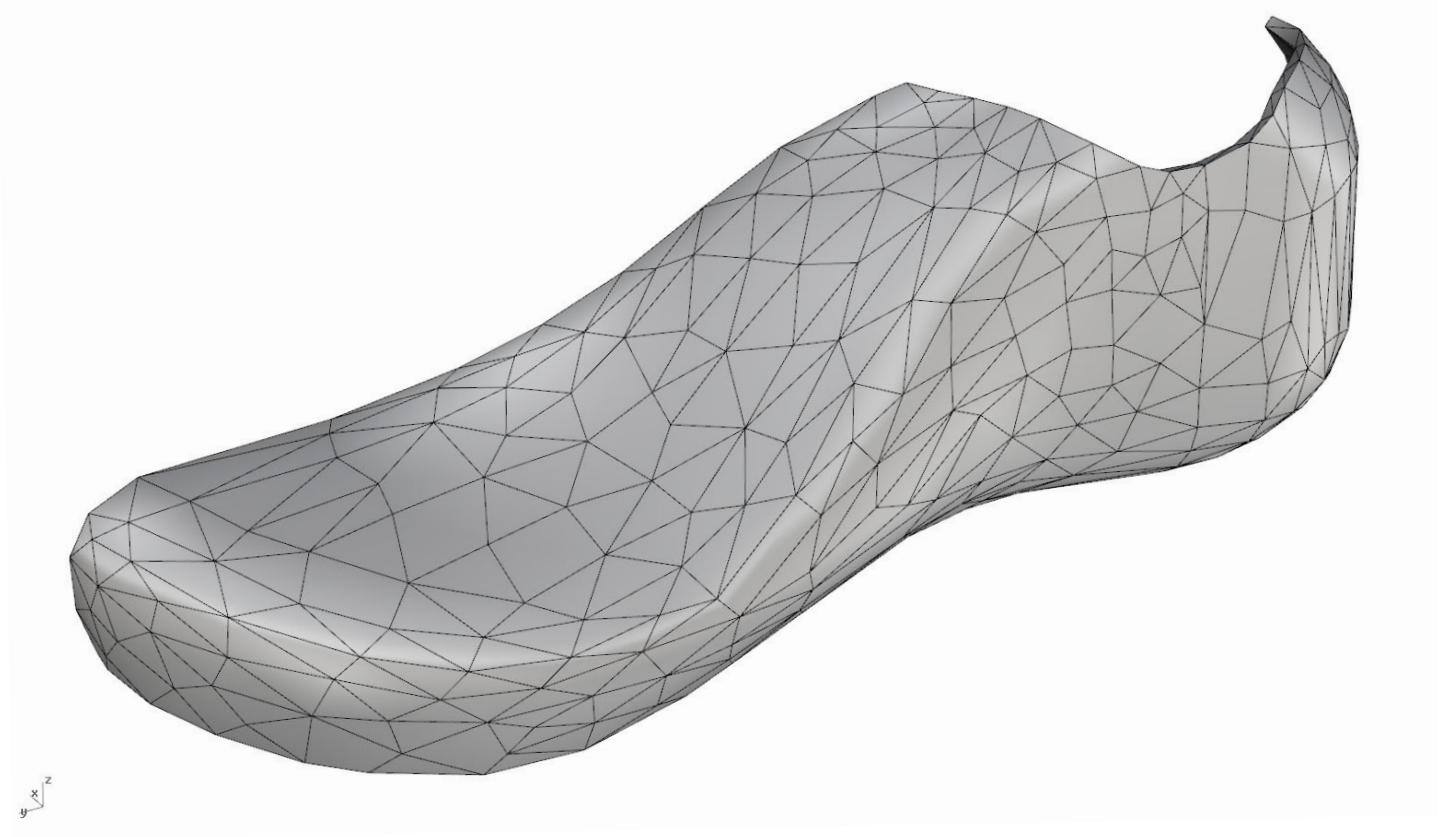
POLYGON MODELING



RUNNING SHOE: *Created in Blender*

Polygon modeling gives users direct control of the mesh, faces, vertices, or edges of a model. This allows for the creation of highly detailed and intricate 3D models. These models can be organic or inorganic.

Industries: Animation, visualization, film, video games
Free software: Blender®, Wings 3D
Paid software: Maya®, 3DS Max®, Cinema 4D®

STRENGTHS

- Highly detailed, intricate models
- Direct control of the mesh

WEAKNESSES

- Steep learning curve
- Models aren't always watertight

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3D MODELING APPLICATIONS

If you're just getting started, here are some recommended free 3D Design program options to try out.

BR

BLENDER®

Difficulty: Advanced

Type: Polygon Modeling, Digital Sculpting

Platform: Mac, Windows, Linux

Price: Free

Supports modeling, rigging, animation, simulation and even video editing and game creation.

AF

AUTODESK® FUSION 360™

Difficulty: Intermediate

Type: Solid Modeling

Platform: Mac, Windows

Price: Free/$

Powerful software for creating and analyzing complex geometries and assemblies.

AM

AUTODESK® MESHMIXER

Difficulty: Intermediate

Type: Polygon Modeling, Digital Sculpting

Platform: Mac, Windows

Price: Free

Manipulate meshed objects in preparation for 3D printing. Create custom supports, fix mesh errors, and add detail.

MO

MORPHI®

Difficulty: Easy

Type: Solid Modeling

Platform: Mac, iOS, Windows

Price: Free/$

Create 3D designs on mobile devices with this simple and intuitive program.

ON

ONSHAPE®

Difficulty: Advanced

Type: Solid Modeling

Platform: Online

Price: Free/$

Browser-based software for creating and analyzing complex geometries and assemblies.

OS

OPENSCAD

Difficulty: Intermediate

Type: Solid Modeling

Platform: Mac, Windows, Linux

Price: Free

Use code to define object dimensions and dynamic variables for easy resizing and alteration.

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SC

SCULPTRIS™

Difficulty: Easy

Type: Digital Sculpting

Platform: Mac, Windows

Price: Free

Push and pull object surfaces. Great for organic, high-detail models. Use SculptGL for a browser-based version.

SK

SKETCHUP®

Difficulty: Easy

Type: Solid Modeling

Platform: Mac, Windows, Online

Price: Free/$

Draw objects with dimensions. Good for accurate, geometric forms, especially architectural models.

TC

TINKERCAD™

Difficulty: Easy

Type: Solid Modeling

Platform: Online

Price: Free

Design in-browser by combining and resizing simple shapes and holes.

MC

MINECRAFT®

Difficulty: Easy

Type: Solid Modeling

Platform: Mac, Windows

Price: $

Though not a traditional 3D modeling program, Minecraft helps to teach core 3D modeling skills.

STUDENT PRIVACY

The projects in Section 2 of this book involve student usage of many 3D design programs. For any program that requires user information and/or account creation, be sure to consult the Terms associated with each program before beginning the project. Students under 13 years of age often are restricted from creating accounts or entering personal information in these programs without explicit consent from their parent/guardian. Here are some suggestions to keep your students' information safe:

DO'S

- Create a generic MakerBot account for students under 13 to use
- Use only school computer and equipment for students under 13

DON'TS

- Allow or require students under 13 to create their own MakerBot account
- Require students under 13 to use their own laptop or mobile devices