3D Printers

RAA Meeting
Jan 9, 2017

Terry Fisher

About Me

- Retired – software/hardware designer
- Pilot – Cessna 182T C-GYKF, G1000
- Building a Rotorway Exec 162F
- Mentor ECI FIRST Robotics Team
- Have too many hobbies
- May have too many toys...

Types of 3D Printers

- 3D Printing is a rapidly changing Technology
  - Stereolithography (SLA) 1983
    - Photosensitive liquid
    - UV-laser beam to harden liquid
    - X-Y table moves laser to generate a layer
    - Platform lowers
    - Fluid flows over model
    - UV-laser “draws” next layer

Types of 3D Printers

- Fused Deposition Modeling (FDM)
  - Most common “hobby” printers
  - Feed media through heated nozzle
  - Nozzle moves in X-Y as media feeds
  - Forms layer, either bed or nozzle moves
  - Next layer is added
  - Can have multiple print heads to do different colours/materials
  - Basically a computer controlled hot-glue gun

Types of 3D Printers

- Selective Laser Sintering (SLS)
  - Similar to SLA except uses a powder instead of liquid
  - Laser is high-power (dangerous)
  - Can generate models out of stainless steel, aluminum, titanium, and cobolt chrome
  - Models are very strong and durable
  - Alternative to machining
  - Too expensive for most people
  - There are 3D printing services available

Types of 3D Printers

- Electron Beam Melting (EBM)
  - Uses an electron beam under high vacuum
  - Melts powder at up to 1000°C
  - Can print pure titanium, Inconel718, Inconel625 to fabricate aerospace parts and medical implants.
  - Very slow, very expensive

Types of 3D Printers

- Laminated Object Manufacturing (LOM)
  - Uses a roll of adhesive-coated paper/plastic/etc
  - Layer is fed, fused to previous by heat
  - A computer controlled laser or knife cuts the outline of the part
  - Very fast, inexpensive
  - Can do large parts (solid)
  - can be full colour

FDM Printers

- Can now be purchased as a kit for <$350 including shipping
- Options include:
  - Heated bed
  - Enclosure
  - Multiple nozzles
  - Auto leveling
  - WiFi connectivity
  - Support for various media

Benefits

- Inexpensive
- Filament
  - comes in many colours & is widely available
  - $35-50 /kg
- Software is fairly easy to use
  - generates “support” for overhangs
  - infill of hollow areas
- Parts can be VERY accurate, strong and durable!

The Downside

- Printer has to be set up carefully
- There is a learning curve
  - Parts lift from the bed while printing
  - Parts stick to the bed after
- Overhangs can be problematic
  - 2nd print head with support material helps
  - Thin overhangs are especiallydifficult

ABS Filament

- Extremely durable
- Many colours including glow in the dark
- Glass Transition temperature 105°C
- Prints at ~230°C
- High coefficient of thermal expansion (CTE)
  - Parts warp as printed unless heated
- A heated bed is desirable for adhesion
  - PET, PEI, or Kapton tape will release when the bed cools
- Does generate fumes while printing

PLA Filament

- Harder than ABS
- TG between 60-65°C / prints at 180°C
  - Will deform in hot sun
- Biodegradable. Derived from
  - Corn Starch in Canada/US
  - Tapioca in Asia
  - Sugarcane in the rest of the world
- Many colours including glow in the dark
- Doesn't warp like ABS

PVA & HIPS

- Used as support material as for PLA and ABS
  - HIPS dissolves in Limonene
  - PLA dissolves in water

Many others

- Nylon
- Wood, copper, bronze filled
- Polyester,
- Polycarbonate
- Conductive PLA and ABS
- Carbon fiber
- Alloy 910, and more keep coming

Process

- Design the part in CAD
  - FreeCAD, OpenSCAD ,Tinkercad (autodesk online)
  - SolidWORKS, AutoCAD, etc.
- Save part as STL
- Load into slicer software
  - Generates gcode
- Print

Questions?