Student Projects and Undergraduate Research

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3D PRINTING:
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“We see it as more of a lifestyle”

– Alyssa Reichental, 3D Systems
History

- Additive manufacturing — 1984
- Commercial systems
- Maker movement ~ late 2000s
- Reprap — 2007
- Makerbot and many others
Our story

- Thing-o-matic #006696 — January 2012
- club project
- four-day build
- installed in dept. computer lab
- 24/7 student access
Classroom use
Wheel for mousetrap car

suspension built-in
scalable design
hub fits round stock
Pan/tilt mount

hobby servos
arduino control
2-axis movement
Quadcopter frame

4 arms

1 hub
Other examples

• Knots (geometry)
• Script for GNUplot → 3d surface
• Summer camp G2CS
Research use
Stray light into CCD
low light imaging disrupted by scatter from prior optics
CCD camera
baffle
standard PVC pipe
aligned mounting holes
Rubidium vapor cell

variable B-field
stable mount
Vapor cell holder
  two-piece design
  easy assembly
  solenoid guides
  1/4-20 mounting holes
cell holder installed
Cell holder

center vapor cell in a magnetic shield
Need: fiber polarizer

each paddle is a wave plate ($\lambda/4$, $\lambda/2$, $\lambda/4$)
thorlabs: FPC560 $211.20
Fiber polarizer

3-paddle design

2 person-hours +
4 printer-hours +
$4.50 of ABS plastic

custom wavelengths
Other examples

• Push-on fiber holder
• Optical table adapters (1/4-20 @ 1” centers)
• AOM mounting bracket
• Quickpost:
Design... Export STL Slicer G-code "Print" and print
Programmatic design
- code → compile

Ideal for:
- specified geometry
- algorithmic design
- patterns

OpenSCAD
Tinkercad

- Fluid 3D design
- click & drag
- Ideal for:
  - rapid prototyping
  - fast revisions
  - sharing
Demo
Design… and print

STL

G-code

Slicer

“Print”
Demo
Lessons learned
We bought our kit in January 2012, by September 2012 Makerbot shifted to closed source development and effectively orphaned their prior products.
Printer support

establish a list of expert users

culture of helping each other

communicate about what breaks (yes, it will break)
Next steps...
Outreach

• 2014–2015 faculty development grant

• Prusa i3 (build from kit)

• Share with 7-8th graders during Fall semester

• iPad apps for design
“I could make that!”
Thank you:

• Jeff Mintz
  • *Physics minor* — assembly and testing

• Noah Holte,
  • *Physics major* — cell holder, fiber paddles,

• Hunter Dassonville
  • *Physics major* — cell heater structure

• NSF, Research Corp, Murdock Charitable Trust, Pacific U.
Outtakes
Sculplexity: Sculptures of Complexity using 3D printing

D. S. Reiss, J. J. Price and T. S. Evans

Department of Physics, Imperial College London - London, SW7 2AZ, UK

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Blender

- Advanced 3D design
- 3D raytracing
- Ideal for:
  - existing users
Sketchup Make

- click & drag
- large 3D library
- free*

* Pro version is also available at an EDU discount