

Fabrication Facilities, Capabilities, and Accessibility in the College of Engineering

Roger Hilten, Assistant Professor of Practice – Design and Innovation
Lab Director

Fall 2020



UNIVERSITY OF
GEORGIA



DRIFTMIER ENGINEERING CENTER



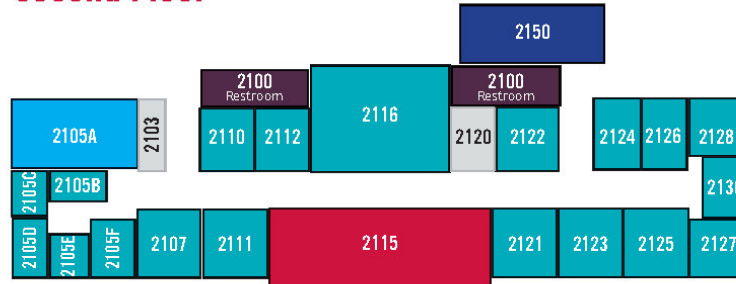
College of Engineering
UNIVERSITY OF GEORGIA



UNIVERSITY OF GEORGIA

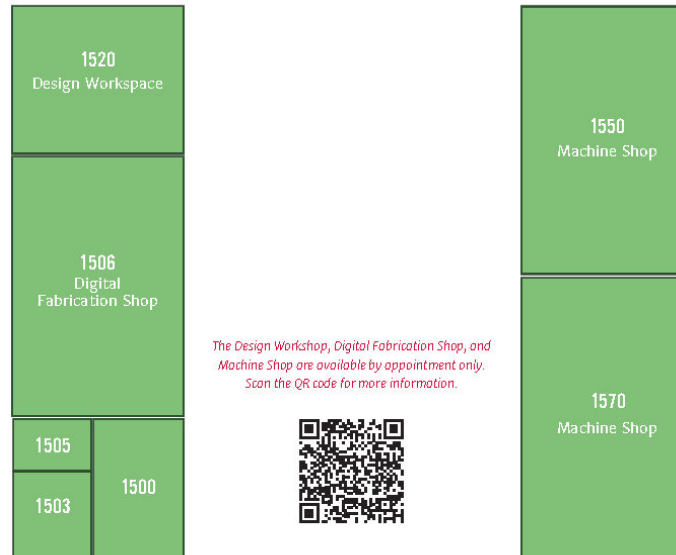
DRIFTMIER ENGINEERING CENTER

Second Floor



Student Fabrication Center and Machine Shop

Located behind first floor of main building



■ Instructional Labs
 ■ Faculty/Graduate Student Offices
 ■ Work Rooms/Storage
 ■ Open Computer Lab
 ■ Experiential Labs



College of Engineering
UNIVERSITY OF GEORGIA



engineering.uga.edu

Manufacturing Capabilities

- **Additive manufacturing**

- FDM – Fused Deposition Modeling
- SLA – Stereolithography (vat polymerization)
- SLS – Selective Laser Sintering
DMLS - Direct Metal Laser Sintering

- **Machining (Subtractive)**

- Milling
- Lathing
- Cutting
- Routing
- Planing
- Surface finishing

- **Molding**

- Injection molding
- Casting (soon)

- **Forming**

- Vacuum forming
- Bending (sheet metal, tube)
- Pressing

- **Joining**

- MIG
- TIG
- stick
- Soldering
- Plastic welding



Additive Manufacturing – 3D Printing Lab



Driftmier 1503



Additive Manufacturing - FDM



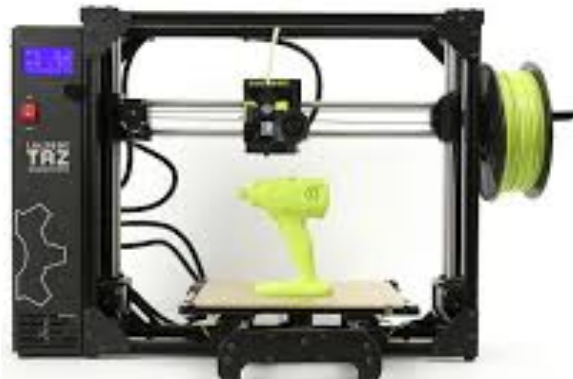
Stratasys uPrint SE
Build vol: 203 x 203 x 152 mm



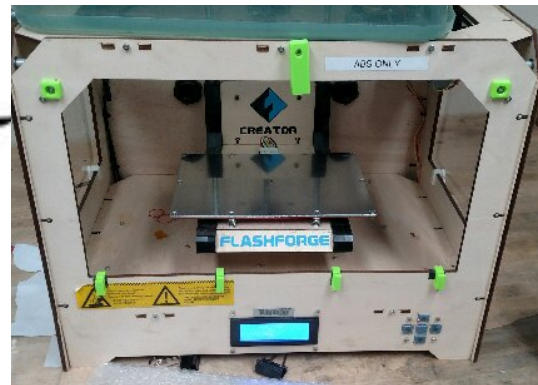
Dremel 3D45 x 6
Build vol: 254 x 154 x 170



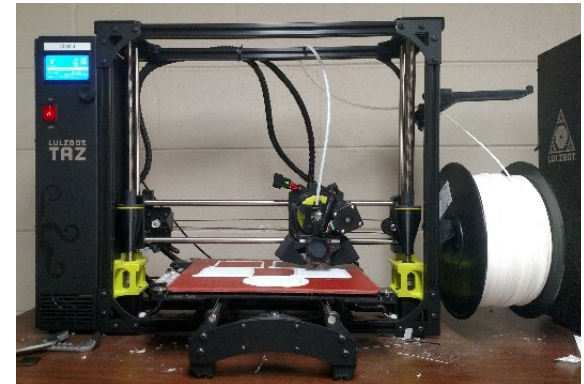
Makerbot Replicator x 3
Build vol: 252 x 200 x 150 mm



Lulzbot Workhorse x 2
Build vol: 280 x 280 x 285 mm



Flashforge Creator x 5
Build vol: 227 x 148 x 150 mm



Lulzbot TAZ6 x 4
Build vol: 280 x 280 x 250 mm



Additive Manufacturing – FDM (nylon-CF)



Machine
Shop

Stratasys Fortus 450mc

Build vol: 406 x 355 x 406 mm

Materials: ABS, Nylon 12, Nylon 12CF, ULTEM, PC, ASA

Accuracy: 0.0015 mm/mm



Markforged Mark II

Build vol: 320 x 132 x 154 mm

Materials: Onyx, CF, Fiberglass, Kevlar

Accuracy: 100 um layer height



Additive Manufacturing - FDM

- **Pros:** easy to learn, quick prototyping, options for infill, many options available, inexpensive for small parts
- **Cons:** surface finish, limited strength of parts, part size, runtime, difficult to automate, machine down time



Additive Manufacturing - SLA



Pros: Functional prototyping, higher resolution versus FDM or SLS, minimal training

Cons: Low throughput, sensitive to UV, washing/curing stations required, solvent waste generated, low strength parts

Formlabs Form 3 x 2

Build vol: 145 x 145 x 185 mm

Materials: photopolymers

Accuracy: 85 micron laser spot size, 25-300 micron layer thickness



Additive Manufacturing – DMLS & SLS



3D Systems DMP Flex 350 (DMLS)
Build vol: 275 x 275 x 380 mm
Materials: stainless, Ti, Al (powder)



Formlabs Fuse 1 (SLS)
Build vol: 1295 x 902 x 1984 mm
Materials: Plastics / Composites

Pros: Higher resolution than FDM, functional parts, short run production, custom manufacturing

Cons: Rough surface finish, moderate training required, potential for airborne hazards, post processing required, lots of waste if powder not reused

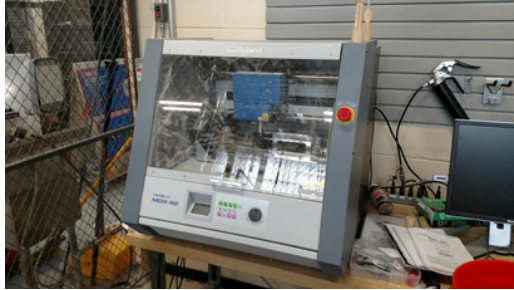
Which printer is right for your job?

- Material properties: strength, resilience, plasticity, millability, biocompatible, color
- Resolution: SLS > FDM
- Speed: FDM > SLS
- Print Size: Dremel < Lulzbot Workhorse < Stratasys Fortus
- Functionality: Dissolvable support media, e.g.
- Availability / Accessibility: 24/7, by appmt only

For help in choosing, email enr-labsupport@uga.edu



Subtractive Manufacturing – CNC Milling



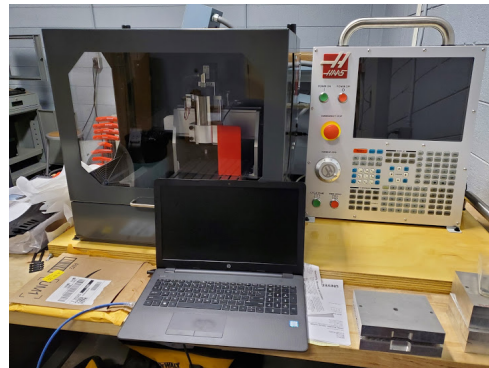
Roland MDX-50 4-axis
X: 400mm; Y: 305mm; Z: 135mm



Sherline vertical mill
X: 220mm; Y:
228mm; Z: 159mm



Shopbot Desktop MAX router
X: 965mm; Y: 635mm; Z: 140mm



HAAS Desktop Mill
X: 152mm; Y: 254mm; Z: 76mm

Pros: all materials, very precise, low maintenance
Cons: excess material, specialized training necessary, high initial cost, hard to machine complex/hollow shapes

Subtractive Manufacturing – CNC Milling



HAAS Minimill-EDU VMC
X: 406mm; Y: 305mm; Z: 254mm

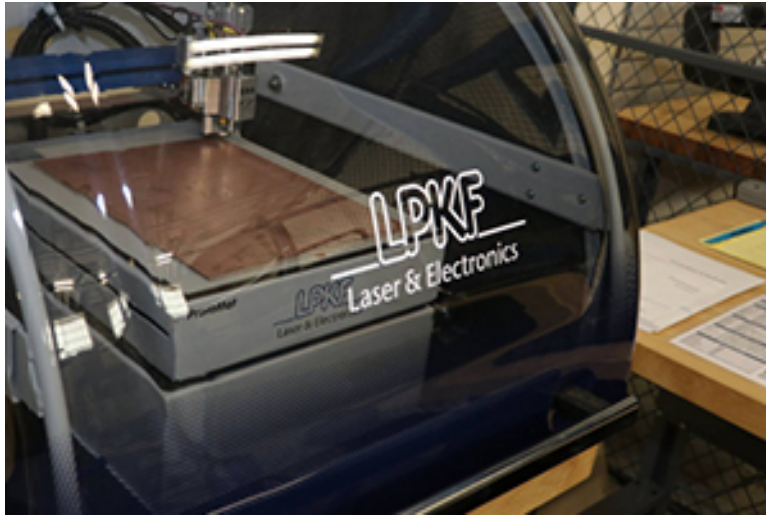


Sharp Knee Mill w/ ProtoTrak CNC

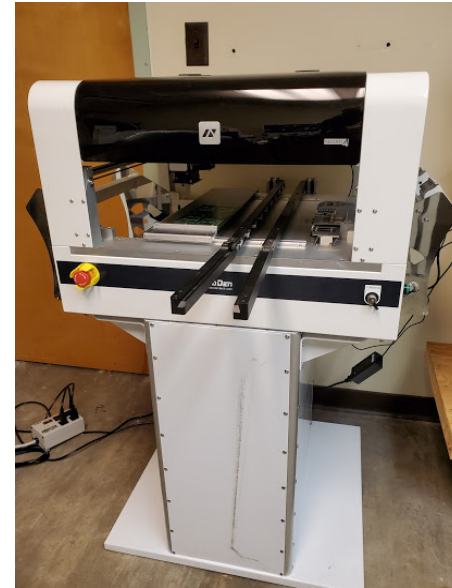
Pros: all materials, very precise, low maintenance

Cons: excess material, specialized training necessary, high initial cost, hard to machine complex/hollow shapes

Subtractive Manufacturing – PCB mills



LPKF Protomat E44
229mm x 305mm x 5 mm
Traces to 4 mil (0.1mm) and spacing
of 6 mil (0.15mm)



Neoden 4 SMT - Pick and place

Subtractive Manufacturing – CNC Lathes



Sherline CNC Lathe (0.08hp)
L: 430mm, Dia: 90mm



HAAS ST15 CNC Lathe (20hp)
L: 406mm, Dia: 419mm

Pros: fast, precise, versatile, mechanical skill minimal

Cons: programming challenge, expensive as size increases, difficult to automate

Subtractive Manufacturing – Manual Lathes



Sharp 1340VS Lathe

Subtractive Manufacturing – Manual mills



Dayton Surface Grinder



Sharp LMV-50 vertical mill

Forming – Bending, pressing, braking



Mittler Bros tube bender



Hydraulic Press



Mittler Bros sheet metal brake

Molding - plastics



Belovac 4'x4' vacuum molder

Pros: Relatively fast production, lower startup cost, large parts

Cons: lower detail, inconsistent wall thickness, labor intensive if not automated, large mold req'd



APSX-sim Desktop Injection Molder

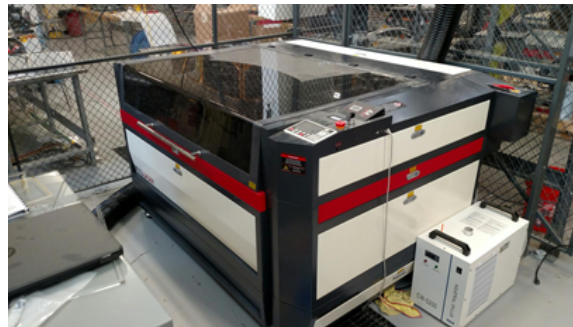
Pros: High volume production, high surface quality and detail, minimal waste (can reuse)

Cons: No large, single pieces, high initial investment for production quality/volume

Cutting – CNC



Boss Laser 1630



Boss Laser 3655



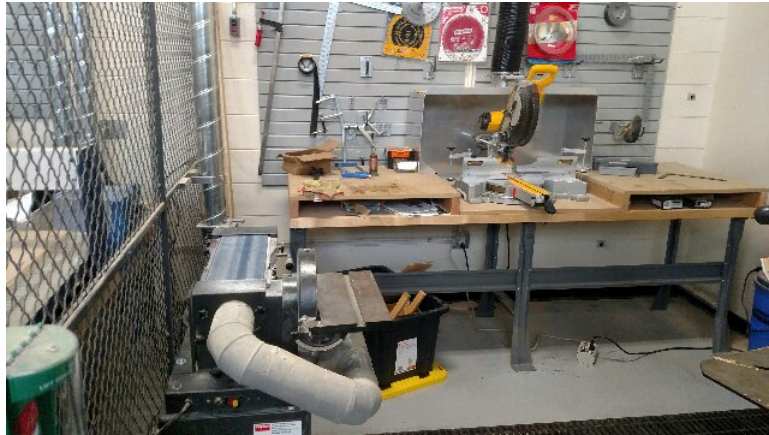
Baileigh plasma table – 4'x4'



OMAX ProtoMAX waterjet
12"x12"



Cutting/Drilling – Manual



Wood cutting, sanding



Cutting, drilling, routing



Wood cutting, drilling



Sawstop table saw



Power hand tools



Miter saw, table saw



Joining – MIG, TIG, stick, gas welding



Materials availability



Tech Lending – items available

FLIR	FLIR-E4_02 Thermal Camera	seed studio	SD Card Shield For Arduino
DIYMALL	0.96 inch OLED Display	QunQi	L298N Arduino DC Motor Control
Cytron	DC Geared Motor with Encoder 12V	SparkFun	Single Axis Accelerometer Break
SparkFun	Raspberry Pi 3 B+ Starter Kit	Diymall	OLED LCD LED White Display Module for Arduino
Canakit	Raspberry Pi 3 Model B+ Complete Starter Kit	DaytonAudio	ND65-8 Aluminum Cone Full-Range Neo Driver
StepperOnline	3d Printer Stepper Motor 17HS13-0404S1	Lavalier Microphone	
Omega	Omega OM-USB-TC-AI	Omega	CNI32 Temperature and Process Controller
Elegoo	37 Sensor Kit Model V2.0	Extech	Sound Level Meter
SureGear	Precision Planetary Gearbox PGCN23-0525 ????	Sunfounder	Super Starter Kit for Arduino
Allen-Bradley	I/O Module 1734-IE2C C	Extech	Power Monitor
Lightmax	Zippy2200 Li-Po Battery 30 C Series 4S1P 14.6 V	Panasonic	Solid State Relay
NDI	Polaris Vega Position Sensor	Actuonix	Micro Linear Actuator
Demotor	Linear Actuator PL14-10	Amprobe	Solar Power Meter
Nasiff	CardioCard PC Based Resting/Stress ECG System	EcoSense	EC30A Conductivity, TDS and Temperature Pen
Elegoo	Stepper Motor and ULN2003 Driver Board	SparkFun	Microclimate Kit
Biqu	Stepper Motor Driver Module for 3 Controllers	SparkFun	Inventor's Kit for RedBot
Elegoo	37 Sensor Kit V2.0	SparkFun	Raspberry Pi 3 Starter Kit
Elegoo	Super Starter Kit UNO R3 Project	SparkFun	Vel of Things Kit
SparkFun	Inventor's Kit for Arduino UNO	SparkFun	Microsoft Azure Internet of Things Starter Kit
Elegoo	Arduino UNO R3	SparkFun	E-textile Basics Lab Pack
Elegoo	Mega 2560	Canakit	Raspberry Pi Zero Complete Starter Kit
Elegoo	Arduino UNO	Woodpeckers	Precision Woodworking Squares
DFRobot	Prototyping Shield for Arduino 200090	Demotor	Linear Actuator
Raspberry Pi	Raspberry Pi 3 Model B	Demotor	Linear Actuator
Unknown	Cable for Raspberry Pi or Arduino	Westward	Cable Coarse Point Drill Bit Set
Gikfun	SD Storage Board TF Card Memory Shield	KEO	Countersinks Set
Osoyoo	Due R3 32 Bit Board	Jameco	Solderless Breadboard
Seek	Seek Thermal Xtra Range Thermal Imaging Camera	SureGear	Precision Planetary Gearbox 5:1
Elegoo	Stepper Motor and ULN2003 Driver Board	onn	USB Extension Cable 6ft
Samsung	32 GB microSDHC UHS-I Card with SD Adapter	FLIR	Thermal Camera
Raspberry Pi	Preloaded 8GB MicroSD Card	Mediabridge	Multi-purpose USB cable
Extech	Digital Luggage Scale Model SC50	Shimpo	Digital Force Gauge
Raspberry Pi	Raspberry Pi 3 Starter Kit	Extech	Sound Level Meter with PC Interface
Measurement Specialties, Inc	Pressure Transducer	Starrett	Portable Hardness Tester w/Printer
Uctronics	.5 Inch HDMI TFT LCD Display with Touch Screen	Alnor	Anemometer
Oakton	Waterproof TDS Testr	TSI	Air Velocity Meter
Extech	pH Pen PH50		

All current Engineering students were sent an invitation to the CENGR library of items. If you cannot find this, please request an invite at:
enr-labsupport@uga.edu



Access to the Fabrication Center

Requirements:

1. You must be an Engineering Student
2. You must complete Orientation and Safety Training Modules in “**Engineering Workshop Safety**” eLC
3. You must make an appointment using SAGE

All requests can be submitted to:

engr-labsupport@uga.edu



Machine training and Usage

Two-Part Training:

Part A

eLC course, “Engineering Workshop Safety” Orientation and
Safety Training Modules

Part B

Individual machine training using SAGE, “General Use”
appointments thereafter

All requests can be submitted to:

engr-labsupport@uga.edu



Access to the Machine Shop resources

In the Fabrication (Machine) Shop:

1. You must complete the eLC modules
2. You must schedule a consultation with George Haynie using SAGE
2. You must complete appropriate Shop training
3. You may only work during a scheduled appointment when CENGR staff is present

All requests can be submitted to:

engr-labsupport@uga.edu



Fabrication Laboratory Rules

1. Clean up after yourself

- Put tools & materials away
- Store projects & throw away trash
- Ask for help if you don't know where something goes

2. Do NOT remove any items from the Fabrication Lab without express permission

- A check out system. i.e. Lend-Items, is available

3. Be responsible for yourself and respectful to others

- Do not work alone with tools that could cause bodily harm
- Know where the First Aid Center is located
- In case of emergency, **dial 911**
- Be mindful of other people's projects and ongoing 3D prints

4. Working on projects unrelated to the College of Engineering is prohibited

5. Know where to ask for help

- Ask a Fabrication Lab Team Member for any assistance
- Visit the Help Desk in room 1520; visit George Haynie in 1570 (by appmt)
- Check out the FabLab website: <http://engr.uga.edu/student-resources/current/undergraduate/experiential-labs>
- Email engr-labsupport@uga.edu for any additional requests



Contact Us

engr-labsupport@uga.edu

Dr. Roger Hilten, Lab Director (111 Driftmier Annex)

George Haynie, Shop Manager (1570 Driftmier)

Joseph Snavelly, Student coordinator (1520 Driftmier)





Visit Us (virtually)

Virtual Lab Tour

**[https://www.engineering.uga.edu/
fablab](https://www.engineering.uga.edu/fablab)**

