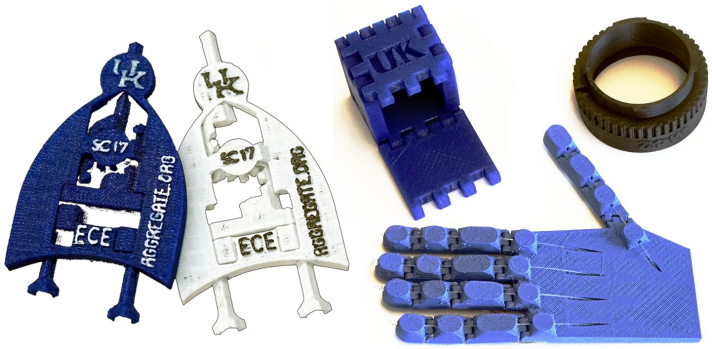
Making Time Tooling Around

Perhaps you're wondering what the computer engineering research group that created PCCTS/ANTLR, SWAR (SIMD WITHIN A REGISTER), the first Linux PC cluster supercomputer, FNNS (FLAT NEIGHBORHOOD NETWORKS), and MOG (MIMD ON GPU) is doing playing with machine tools? We began using these machines to make camera parts for our computational photography research, but we're really about making the hardware and systems software components of a computing system work better together, and those **machine tools *are* computer systems**. Here's a little overview of some of the ways we are working to make commodity-level machine tools better and give them new capabilities.

Safer, Better, Laser Maching. For under $150, you can buy a SUPERCARVER 1000mW laser cutter/engraver... that is capable of doing wonderful things and/or permanently injuring you. Using our 3D printers, we made a set of simple modifications to safely enclose the laser light, filter the smoke, replace the dangerously shiny bed with modular 3D-printed part-holding jigs, and even add a webcam for 100% eye-safe viewing; it's all described in **`http://www.instructables.com/id/Making-Your-Mini-Laser-Engraver-Safer-and-Better/`**

Macro Metamaterials. A metamaterial is an object in which different properties are obtained not by use of different materials or multiple-part assemblies, but solely by engineering the shape of the structure. The concept of using a single homogeneous material is particularly attractive for 3D printing, but conventional repeated-cell structures (left) don't deliver the desired mechanical properties. Our 3D-printed macro-scale metamaterial structures (right) operate smoothly without degrading.



Design For Manufacturability. 3D printers cannot print arbitrary objects, but we have been working to devise ways in which manufacturable structures can be substituted for problematic portions of a design. For example, a conventional hinge uses a central bar to span between posts – but that bar will sag during 3D printing. Our hinge design substitutes nested cones using a self-supporting 45° angle, enabling structures like this print-assembled fold-up hinge-box and prosthetic hand. The same 45° trick allows us to consistently print fine screw threads, such as the M42 (42mm diameter, 1mm pitch) lens adapter shown. It's also used in our span-free, print-assembled, mechanical NOR gates, which contain a double rack and pinion using a herringbone gear, as well as trapped input and output rods. All are parametric OPENSCAD programs, not fixed designs.

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Trace2SCAD. A common problem in 3D design is conversion of 2D raster images into 2.5D multi-layer models, and we had the extra motivation of converting diagrams into maps that a blind student could "see" by feel. Our **`trace2scad`** software tool intelligently converts an image into an optimized 2.5D OPENSCAD model suitable for 3D printing: **`http://aggregate.org/MAKE/TRACE2SCAD`**

Want To Know More? Most of our work in this area is linked from **`http://aggregate.org/MAKE`**

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