Design Machines

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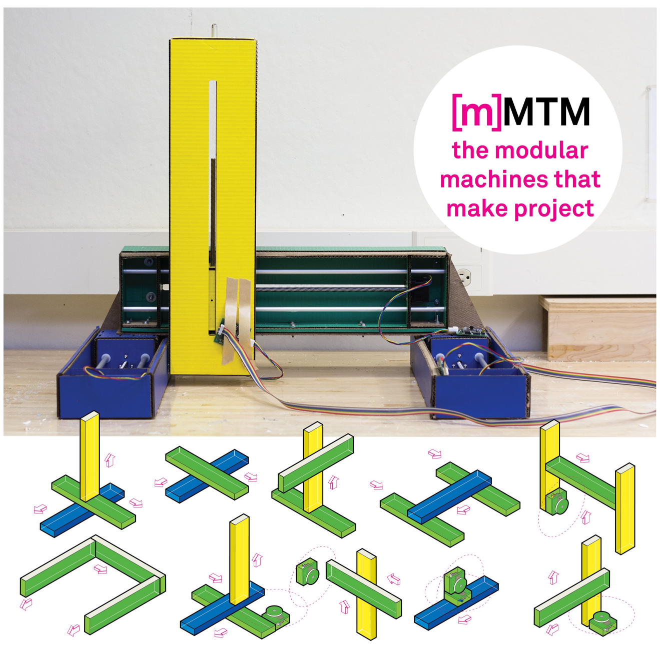
Abstract

Hardware and software are disjoint in their representations, their production methods, and their validation. Machine design, machine building, and machine control have historically taken place separately, and correspondingly, machine tools are not well integrated systems addressing an automation or fabrication need.

However, digital fabrication tools are becoming increasingly ubiquitous. Digital fabrication introduces precision and accuracy to the prototyping process. Without requiring a craftman's attention to toolmaking, users can prototype tools for rapid prototyping– the precision and repeatability required is now readily available. Rapid prototyping tools can become one-off interventions tailored for a task at hand.



In this studio course, we will condense the steps of prototyping rapid prototyping equipment into an afternoon. We will use the Modular Machines that Make Construction Kit, which offers modular software, hardware, and end effectors for users to prototype with. The Modular Machines that Make project uses 1-axis motion stages that can be connected together in different configurations to produce different motion systems. For example, 2 stages placed together horizontally can make a XY stage, or 3 stages can give 3 axis motion. The stages themselves are made out of laser cut cardboard, and their design can be parametrically modified to accommodate different work envelopes. To prototype the control systems and software for the machines, users will use the pyGestalt machine control library and corresponding network-programmable hardware nodes. The end effectors for the machines can be prototyped on the fly, but the construction kit also contains a variety of end effectors as a point of departure, including milling heads, 3d printing heads, plotter heads, usb microscopes, and syringe pumps.

By spanning the layers of implementation (in mechanics, in electronics, and in software), users will be able to think of designing digital fabrication tools as a cohesive whole, instead of the disjoint application of a variety of different fields. This kind of remix prototyping will create new kinds of CAD/CAM/machine tools that can better address the individual needs of the users. Simultaneously, this kind of accessible automation explores broader applications of precision– by lowering the threshold to precise, repeatable automation, users can e.g. start automating a production run of 100 units, or a biology experiment that would be tedious to pipette by hand, or the synthesis of a material.

By the end of the course, the users will have an understanding of the subcomponents of machine and machine interface design and how a machine system is integrated. The course will be hands-on, and by the end of the course participants will have created a working machine, as well as discussed distributed manufacturing, rapid prototyping, and advanced manufacturing and automation.

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