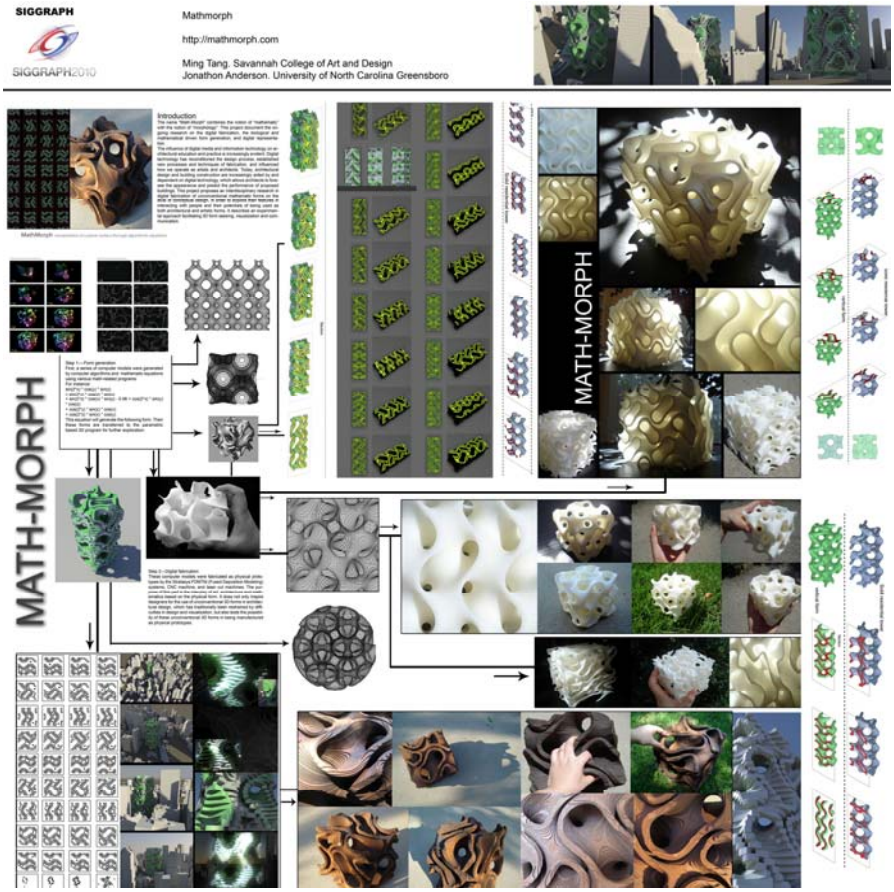

Mathmorph

The name "Math-Morph" combines the notion of “mathematic” with the notion of “morphology. This project focuses on the study of “mathematic” as an embedded variability of spatial arrangement with procedural model. The influence of digital media and information technology on architectural education and practice is increasingly evident. Digital technology has reconditioned the design process that establishes new processes and techniques of fabrication. This reconditioning has influenced how we operate as architects. Today, architectural design and building construction are increasingly aided by and dependent on digital technology. These technologies allow architects to foresee the appearance and predict the performance of proposed buildings. Mathmorph proposes an interdisciplinary research in digital fabrication of unconventional 3D forms on a conceptual design level in order to explore their features in interacting with people and their potentials of being used as architectural forms. It describes an experimental approach which facilitates 3D form generation, visualization and fabrication.

(new poster with architecture design projects added)

First, a series of computer scripts were generated using computer algorithms, and mathematic equations. Secondly, a series of 3D models were generated by importing these algorithms and mathematic equations into 3D programs. These computer models were fabricated as physical prototypes by the Stratasys FDM systems, CNC machine, and laser cut machines. The purpose of this part is bi-fold. It does not only inspire designers to use unconventional 3D forms in architectural design, which has traditionally been restrained by difficulties in design and visualization, but also test the possibility of these unconventional 3D forms in being manufactured as physical prototypes.

The use of these mathematically driven forms can generate porous structures that are non-site-specific and allow for maximum heat gain/loss and natural wind-flow. By interlocking two forms the generation of natural program issues solve themselves; for example a mix-use program naturally forms based on the two independent forms. The computational approach to design allows for two areas of interest in the architectural field to combine: digital form finding and digital fabrication.

A series of abstract sculpture designed with the focus on its potential transformative spatial layout was also explored. The generation of an abstract mathematic form using equations was studied and showed that the unlimited possibility of interlocking / intertwining between solid form and void space emerges. We adapted several variables to control the repetition and resolution of these interlocking spaces, by an exhaustive combination of several variables values. From a large number of outcomes, only several ideal spatial arrangement solutions were selected by reviewers and then used as the genotype for the next operation.

After exporting this parametric model into 3D programs, the continuation to building its procedural network was allowed though a non-linear information model. A sequence of deformation and control nodes were added. This additive information evolved independently in order to yield a more fabrication friendly form. As a result, we created a high degree of complexity and explored the dynamic possibilities of spatial arrangement with relatively simple input information. The method was used in the winning project of Evolo Skyscraper 2010 design competition.

In this process, the information model demonstrated itself with a great power and an unlimited potential of form exploration from sets of parameters. The reviewers selected the desired control nodes and manipulate them to create the new spatial organization and proving that a parametric model can be optimized by a fabrication limitation.

In the final step, a slice node was introduced into the network as a static representation for laser cutting. The contouring process produced the file documentation that was needed to digitally fabricate the form. The parameters of the laser cutter and 3D printing are well integrated into the information model. Another input variable, *time*, as the 4th dimension, was also added to snapshot all the layout possibilities into a motion. Expressions were evolved and various spatial arrangements were produced as the value of *time* was smoothly animated. Hundreds of the contour lines for laser cutting were captured into a single morphing animation.

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