Digital glassblowing fabrication research is exploring computational strategies for simulating highly skill-required glass fabrication craft. The ongoing project emerged from collaborative workshop between Academy of Arts, Architecture and Design in Prague and LASVIT–Czech Bohemian glass factory. With understanding the basic principles of material properties as well as the fabrication process such as glass-blowing, slumping, fusing and cutting (Figure 3), we deployed Autodesk MAYA nDynamics and used nCloth mesh animation to digitally recreate glass behavior during its heated liquid state.

As in any manufacturing industry, the mold production for glass-forms represents expensive part of fabrication process, although in case of irregularities and mistakes, the glass as material can be recycled multiple times on-site. Nevertheless, most of glass-blowing is done by highly skilled craftsmen and sculptors called Masters and their hourly rate is high-priced. Thus, digital glass-blowing fabrication offers benefits to both designers and industry in terms of form finding and cost efficiency.
DIGITAL GLASSBLOWING TESTS

Glassblowing is using heat and pressure for generating forms and patterns. For recreating glassblowing in Maya, an oval nCloth shape has been placed inside a mold (passive collider) and after an animated simulation, there were realistic results in terms of material behavior (Figure 4). The outcome can vary its morphology with adjustment of nCloth material properties inside Maya Attribute Editor. By changing Stretch and Compression Resistance, the object is changing behavior during simulation (Figure 5).

DIGITAL GLASS SLUMPING TESTS

Slumping technique is generating surface patterns on glass with the help of gravity and heat. Depending on the mold’s form and structure, the glass sheet can be deformed in various ways, but the most notable attribute is the perforation density of optical mold made out of bars or ribs. In case of large gaps, the glass will melt into deeper convex patterns, whilst in small gaps there will be insufficient space for material to deform under its own weight, thus leaving the pattern on glass flat (Figure 6). Physical models show that plexi is behaving in same fashion as standard glass, however the heat and duration in the oven is significantly reduced due to its material characteristics (Figure 7).

CNIDARIA MAGNUS LIGHT

The Cnidaria (phylum—marine animal) Magnus Light is a concept designed with a goal to explore morphological complexity and intricacy of digitally fabricated glass piece. In this case, form’s complexity evolves from relatively simple and symmetrical configuration of multiple parts that are interlocked closely together to generate a larger complex composition (Figure 1, 2, 9).
**GLASSBLOWING**

Volumetric modelling

- A - Blown air pressure
- B - Pre-heated molten glass with air pocket
- C - Material expansion
- D - Form rotation (for symmetry)
- E - Mould

**FUSING**

Glued geometry

- A1
  - B
  - C

- A2
  - D
  - E

- A1 - Pre-heated glass
- A2 - Heated oven
- B - Separated volumes
- C - Fused volumes
- D - Separated sheets
- E - Fused sheets

**SLUMPING**

Surface modelling

- A - Heated oven
- B1 - Cold Glass Sheet
- B2 - Heated Glass Sheet
- C - Gravity
- D - Mould

**CUTTING**

Cold process

- A - Diamond sawblade
- B - Cold glass sheet/volume
- C - Full cut
- D - Engraving

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4 Glassblowing Techniques (Vukmanov 2014)

5 Digital Glassblowing Test 1 (Klaban 2013)

6 Cnidaria Magnus–Rendering 3 (Vukmanov 2013)

7 Cnidaria Magnus–Simulated fabrication (Vukmanov 2013)
IMAGE CREDITS
Figures 1, 2. Vukmanov, Adam (2013) Case-study design for LASVIT
Figures 6, 7. Vukmanov, Adam (2013) Case-study design for LASVIT
Figure 9. Michalek, Ondrej (2013) Glass Mutations Workshop

ADAM VUKMANOV received his master degree in architecture (with honors) in Greg Lynn's studio at dieAngewandte Vienna, 2009. He worked with Span-arch on design and construction of Austrian Expo pavilion in Shanghai, and until July 2012 continued his career in London as Project Architect at Acme. Prior to teaching at AAAD and ARCHIP in Prague, Adam taught at Lunds University, AA Visiting School in Paris and CITA, Copenhagen. Adam’s work has been widely published and he has won several awards including a scholarship for a six-month MAK Schindler Artist and Architect in Residency program in Los Angeles in 2010.

ONDREJ MICHALEK is currently studying Masters program at Academy of Arts Architecture & Design in Prague, Czech Republic in the experimental architecture studio of professor Imrich Vasko. After earning his Bachelor degree at Faculty of Arts and Architecture in Technical University of Liberec (with Bachelor project of context-aware architecture in a historical small town), he developed interest in computational design and started learning programming languages (Grasshopper, Processing) as well as rapid prototyping by building a DIY 3D printer.

TADEAS KLABAN is currently finishing Master degree in architecture at Academy of Arts, Architecture and Design in Prague, in Architecture Studio III of professor Imrich Vasko. In winter semester of 2013, he was an exchange student for one semester at CITA, studio Masters Program: Computation in Architecture at The Royal Danish Academy of Fine Arts, Schools of Architecture, Design and Conservation in Copenhagen.