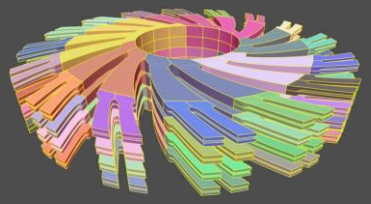
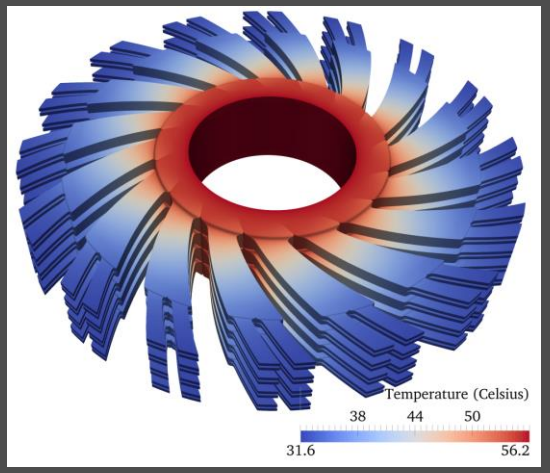
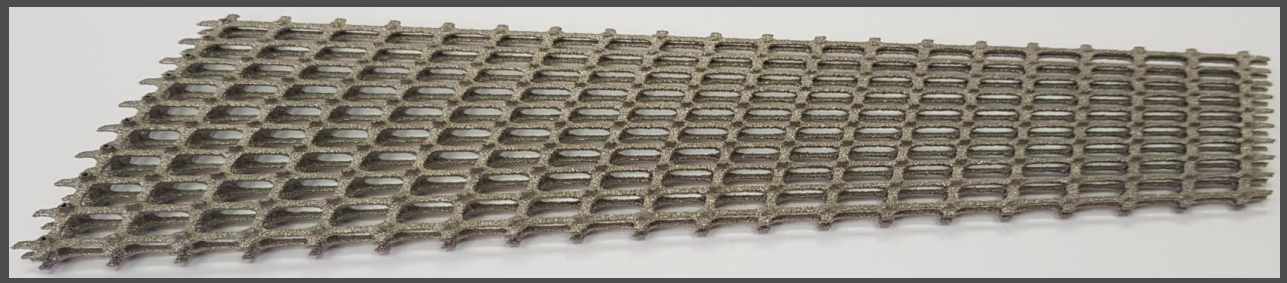
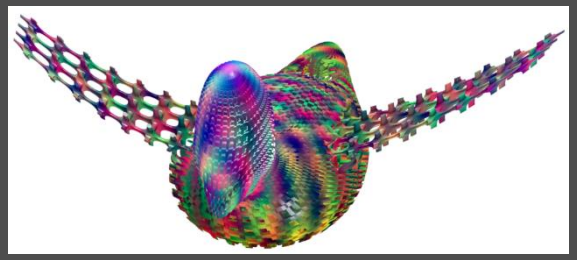
Volumetric Representations (V-reps): the Geometric Modeling of the Next Generation



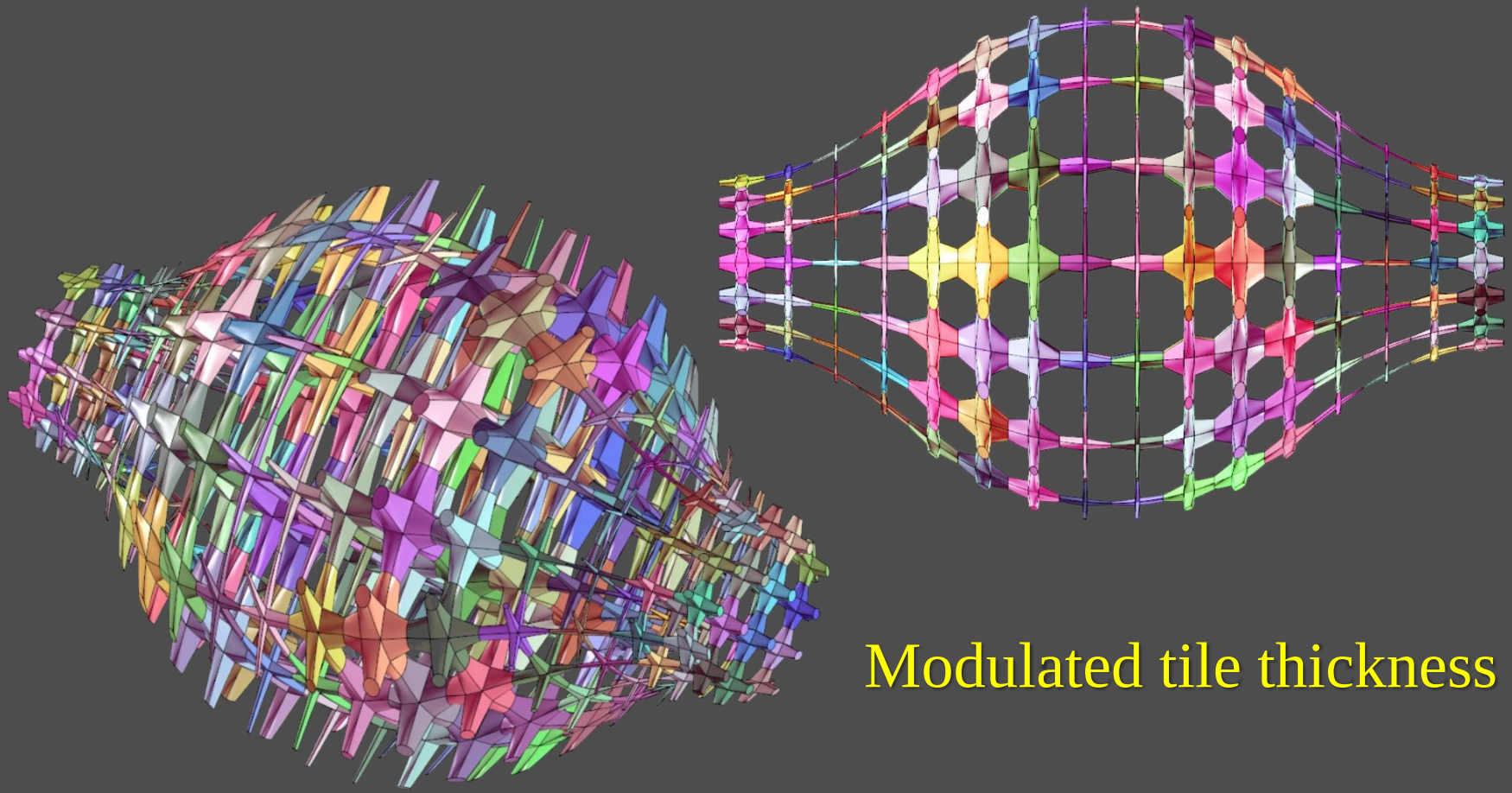
Gershon Elber
CS, Technion,
Israel







Local Tile Control in Composition



Modulated tile thickness

Local control over *n*-parameters families of tiles.

- Allowing full geometric optimization.
- While preserving continuity.

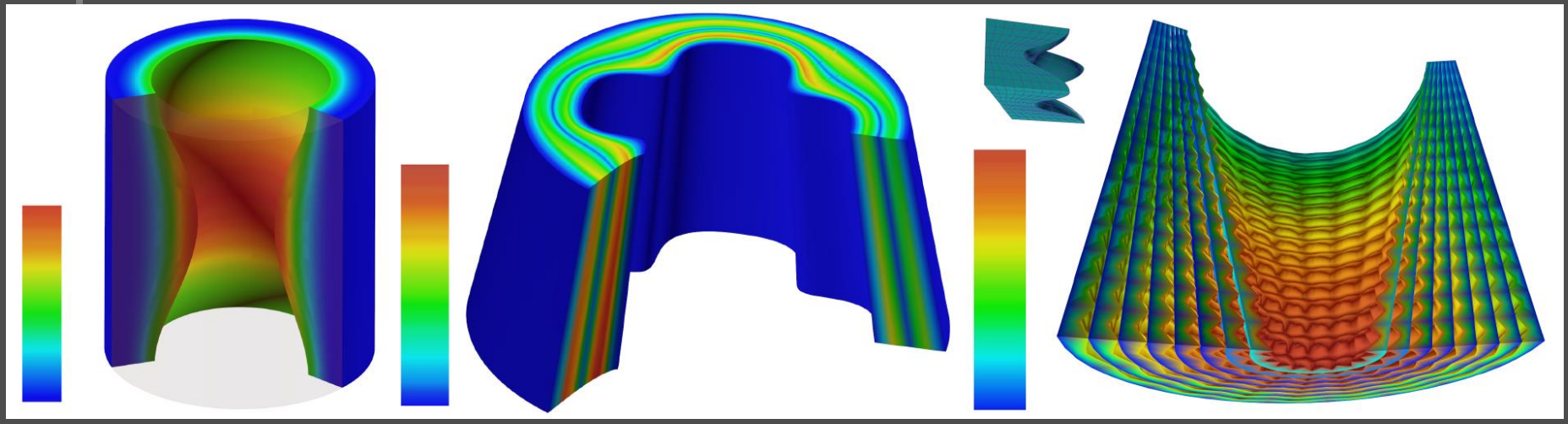
Managing the Interiors of V-reps

Slicing and 3D printing a heterogeneous (Utah) teapot.

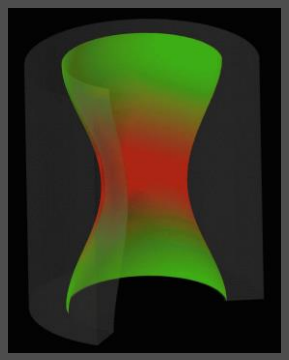
- Printed on a J55, Stratasys.
- Slices are heterogeneous.

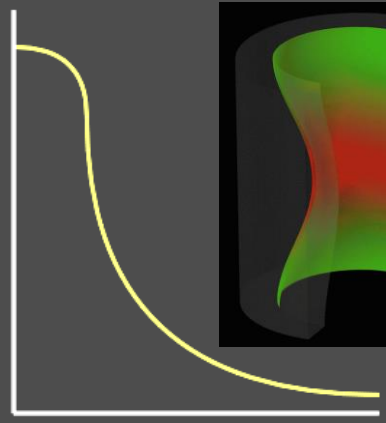
Heterogeneous Solid Fuel

- Red – accelerants
- Blue - retardants

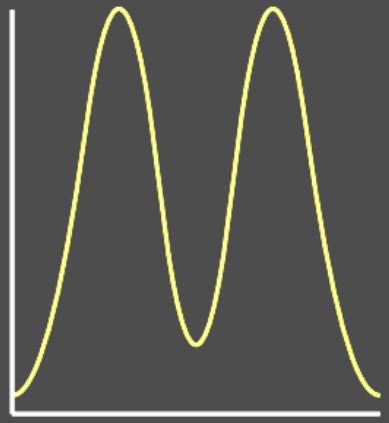


Solid volume-of-revolution with large initial burning profile

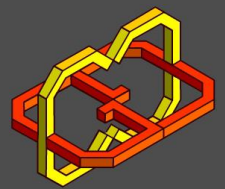




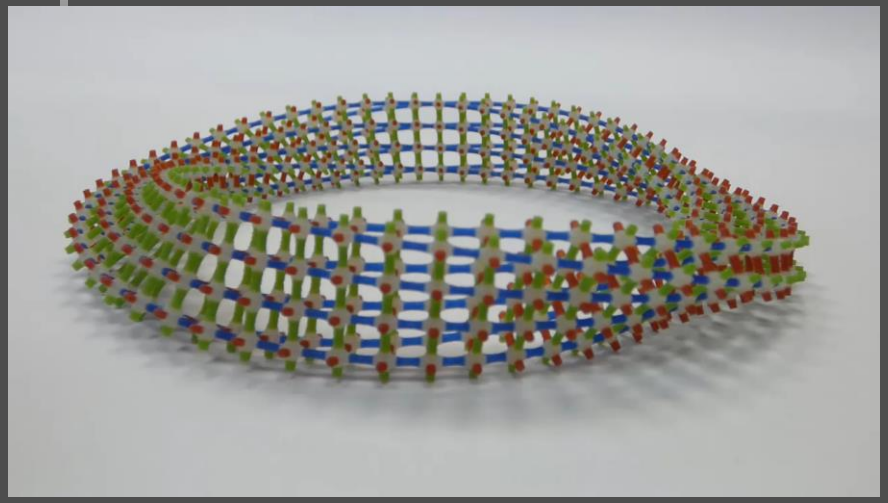
Solid non-volume-of-revolution with two burning peaks' profile

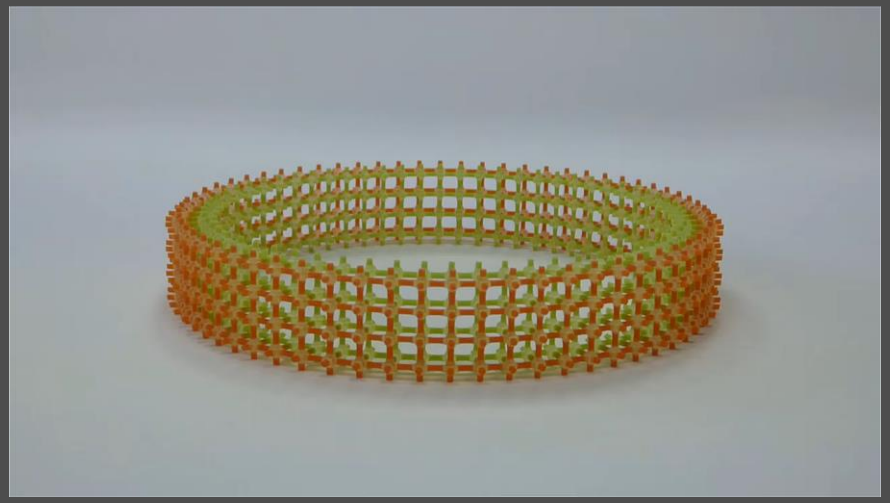


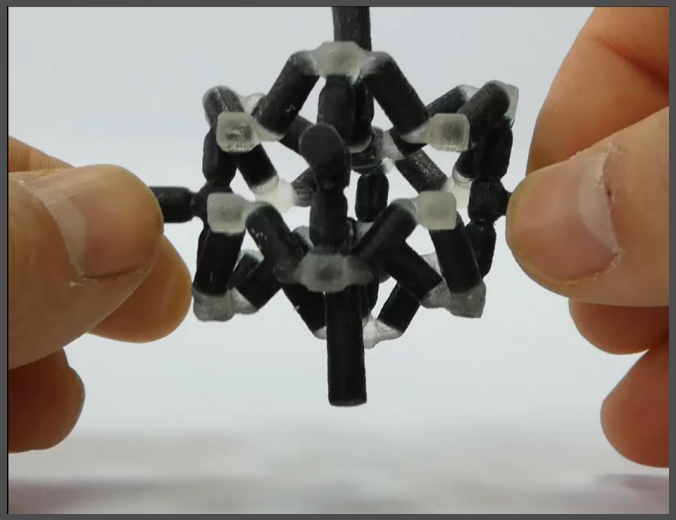
Porous volume-of-revolution with constant burning profile

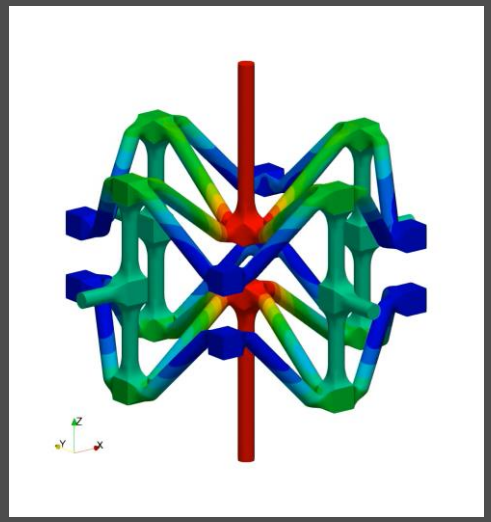


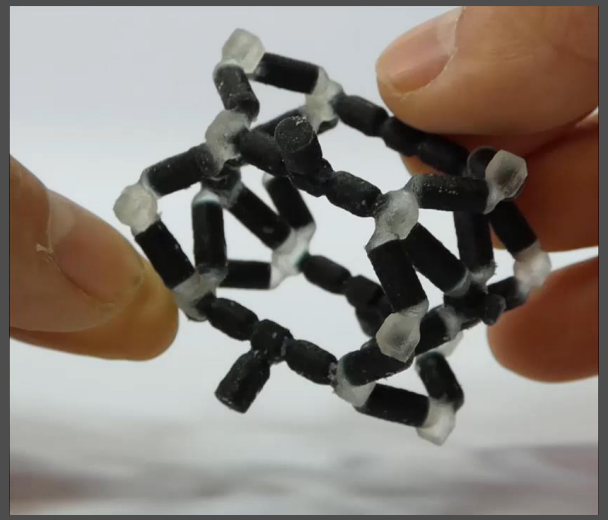
Managing the Interiors - Flexibility









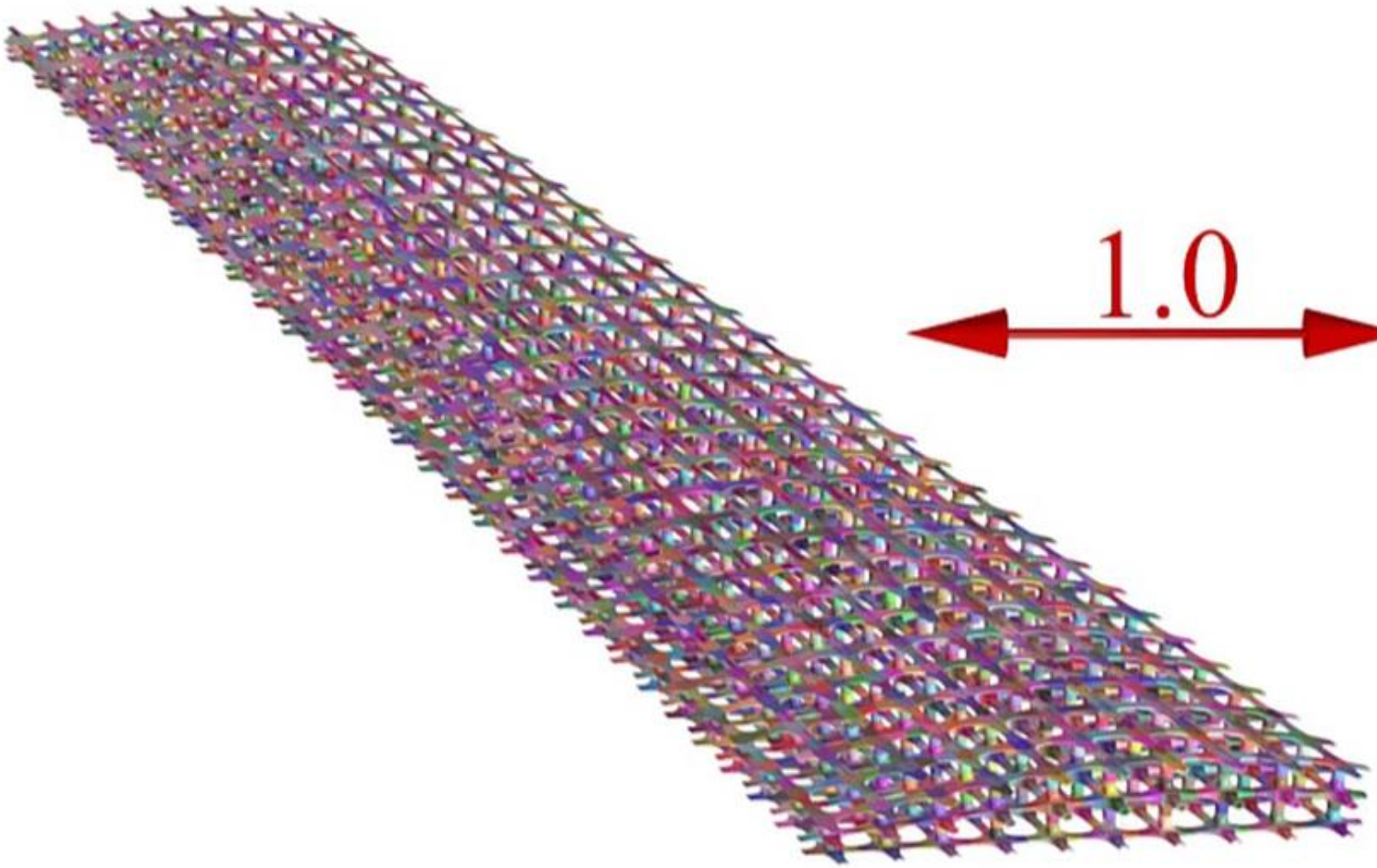


Poisson's Ratio -1

Poisson's Ratio +1

Elastico (flexible) material, J55, Stratasys

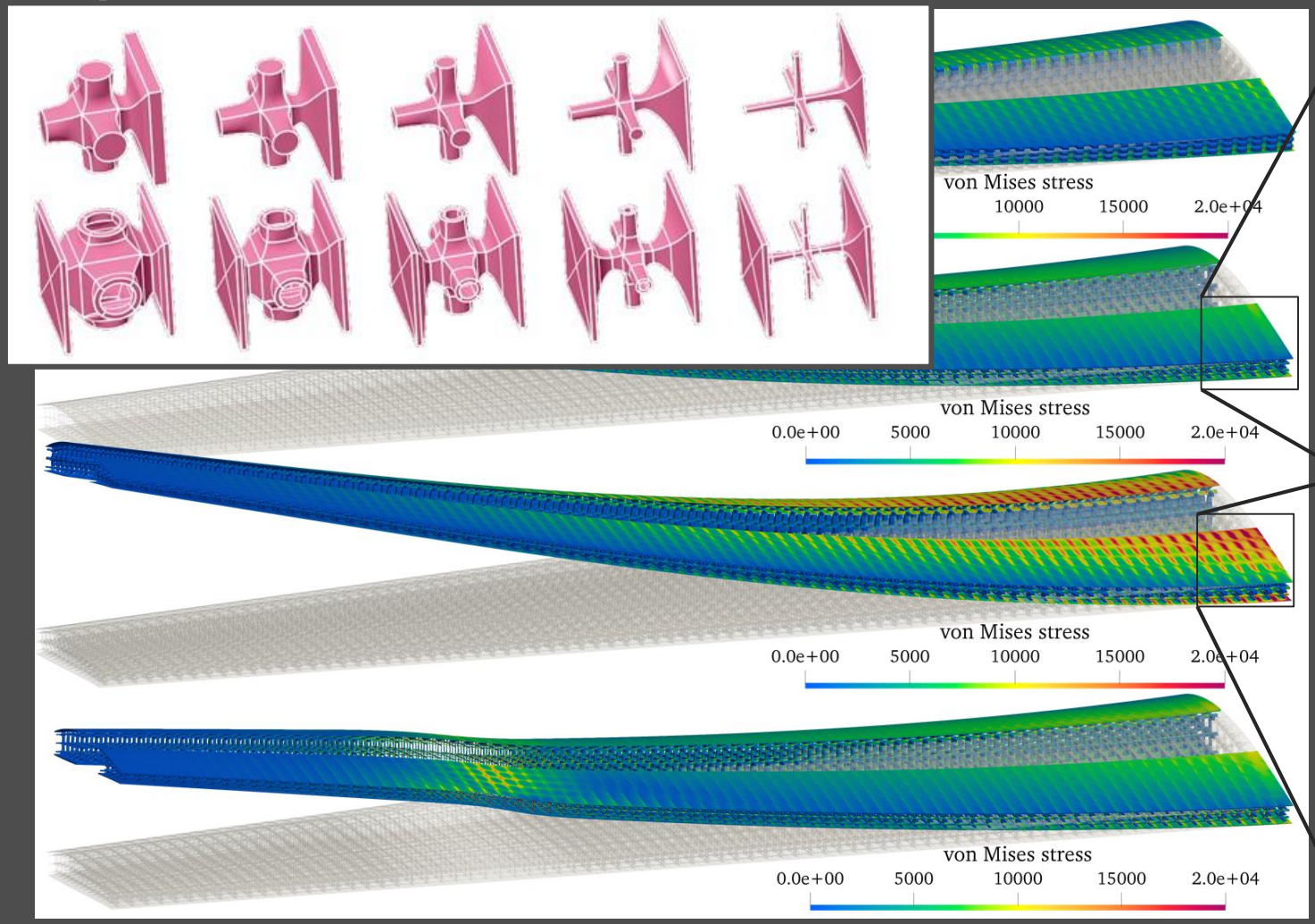
Multiresolution Microstructures (MrMs)



Feasible due to the closure established by the degree reduction.

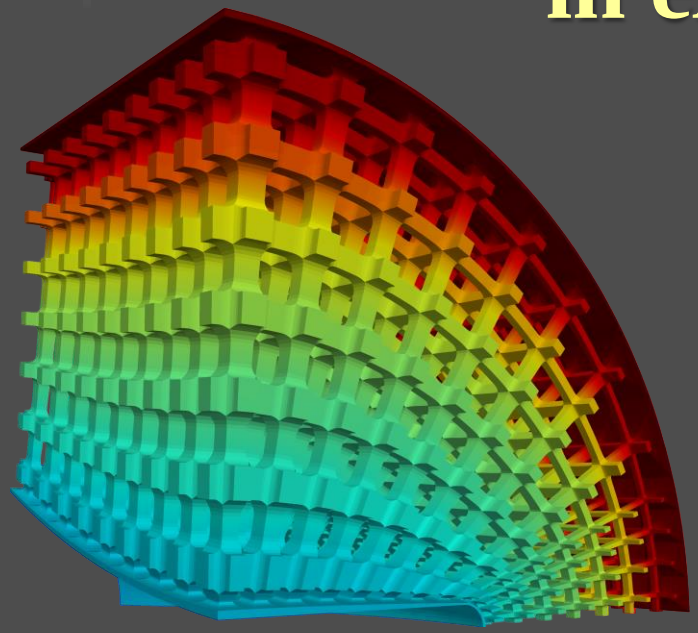
https://youtu.be/u-A_HrqvkGU

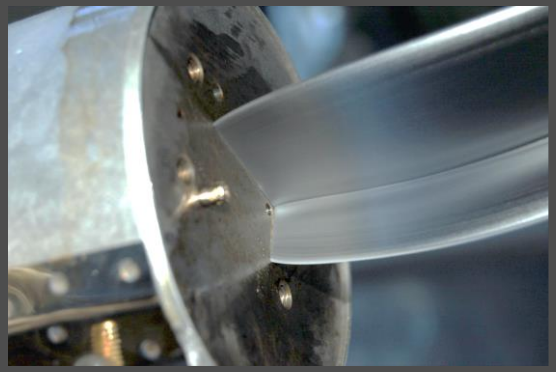
Iso Geometric Analysis/Optimization of a Wing

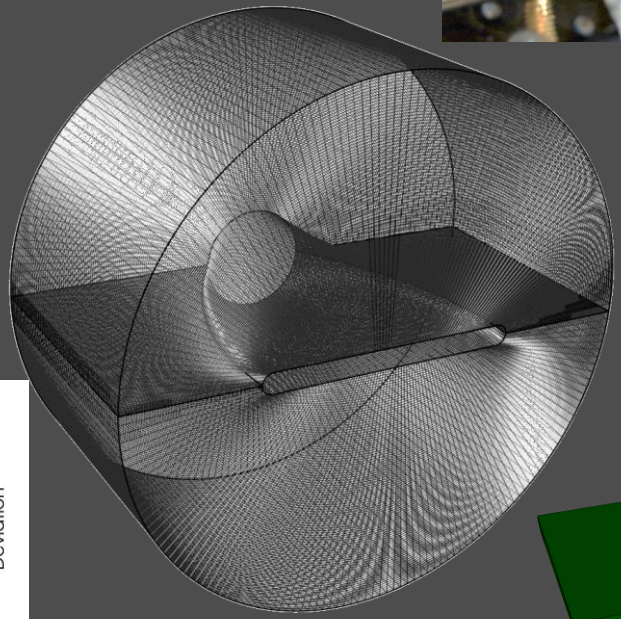


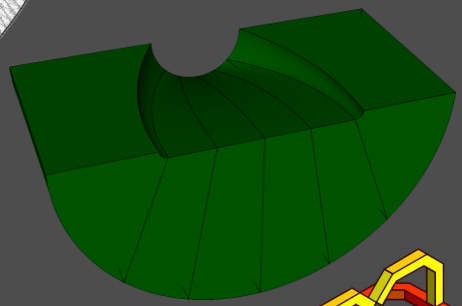
Iso-geometric analysis (IGA) in collaborations with Pablo Antolin (EPFL Lausanne), Annalisa Buffa (EPFL Lausanne and IMATI-CNR Pavia), Massimiliano Martinelli (IMATI-CNR Pavia), Giancarlo Sangalli (University of Pavia and IMATI-CNR Pavia)

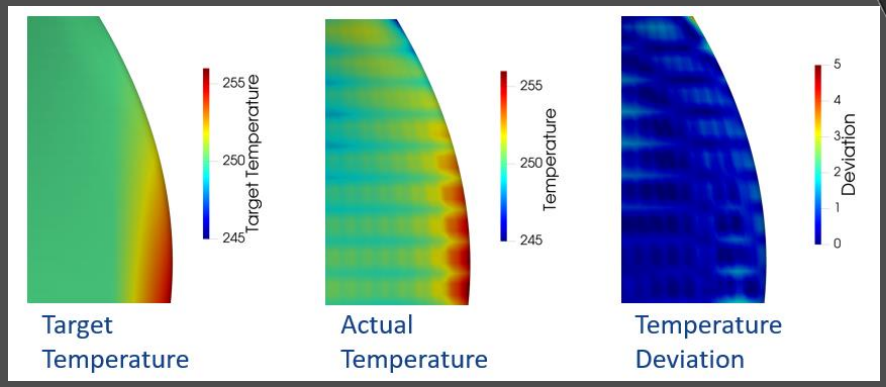
Locally controlled heat transfer, in extruders







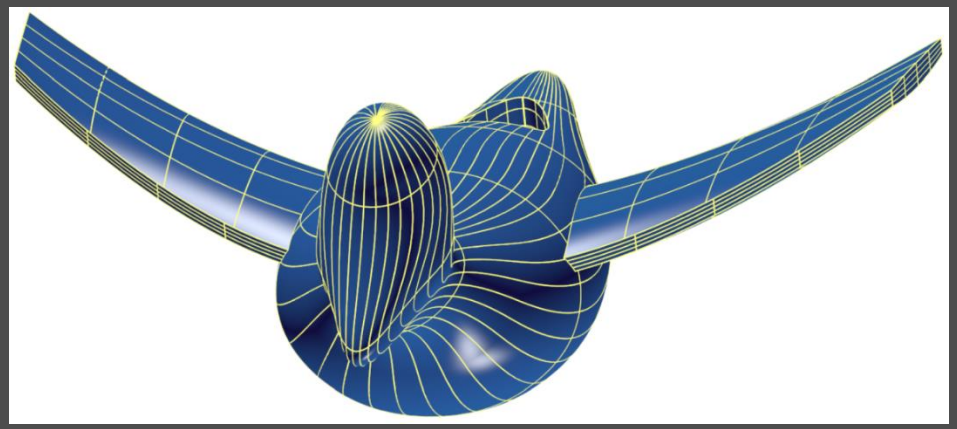


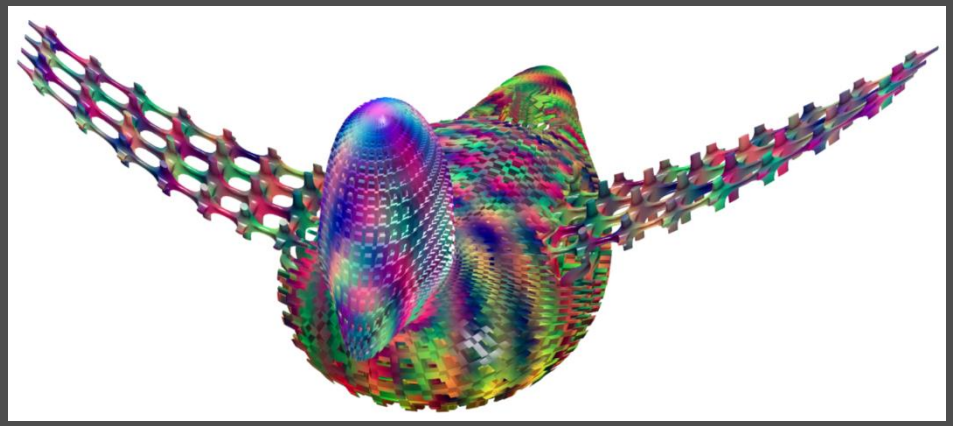


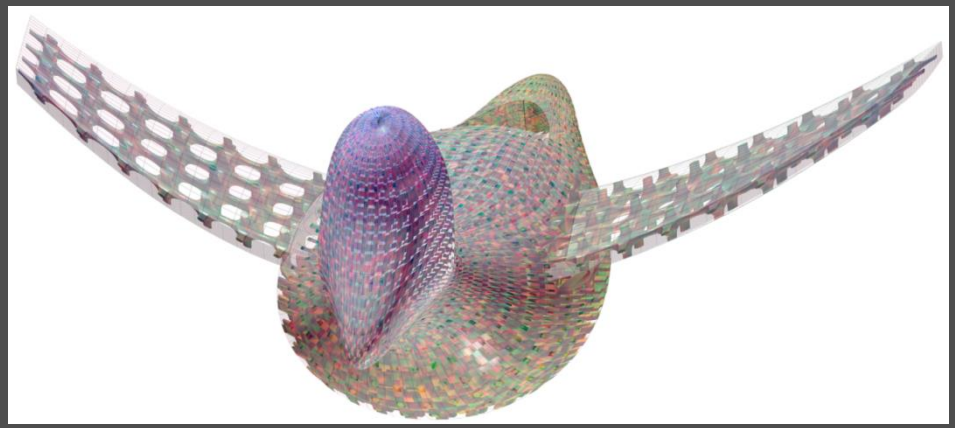
In collaboration with Stefanie Elgeti, TU Vienna

A Word on V-rep microstructures

Duck := Body ∪ LeftWing ∪ RightWing – Tail:





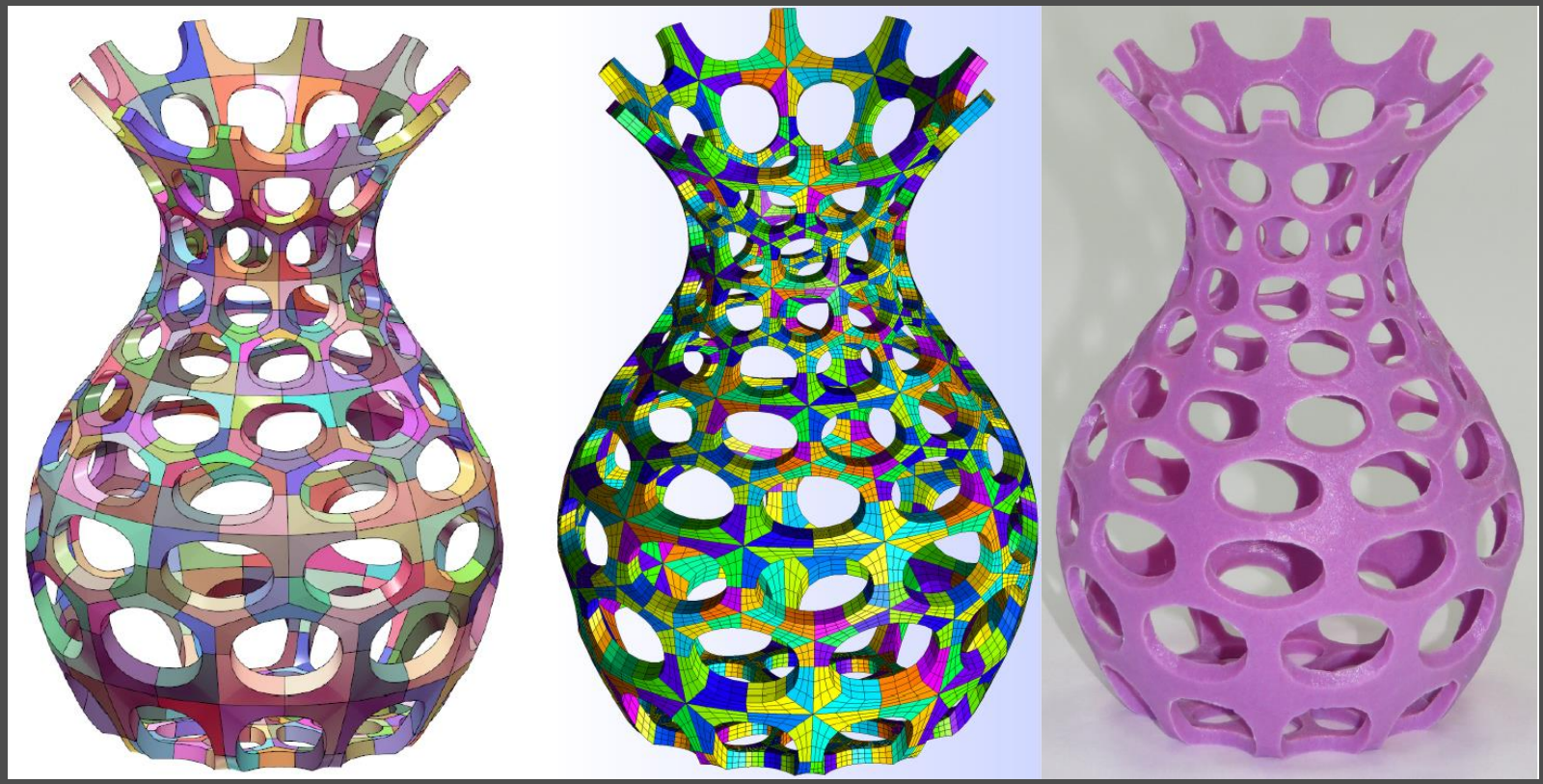


Some more potential Applications

- Static mixers are common in the food and pharma/medical industries.
- Highly efficient batteries (e.g., for electric cars)
- Artificial implants (Bones, Breast, etc.).
- Reinforced gloves, blast absorbing walls, helmets, vests, etc.

Shell lattice Structures

Direct path to IGA (providing trivariates), FEM, and 3D printing



Trivariate splines

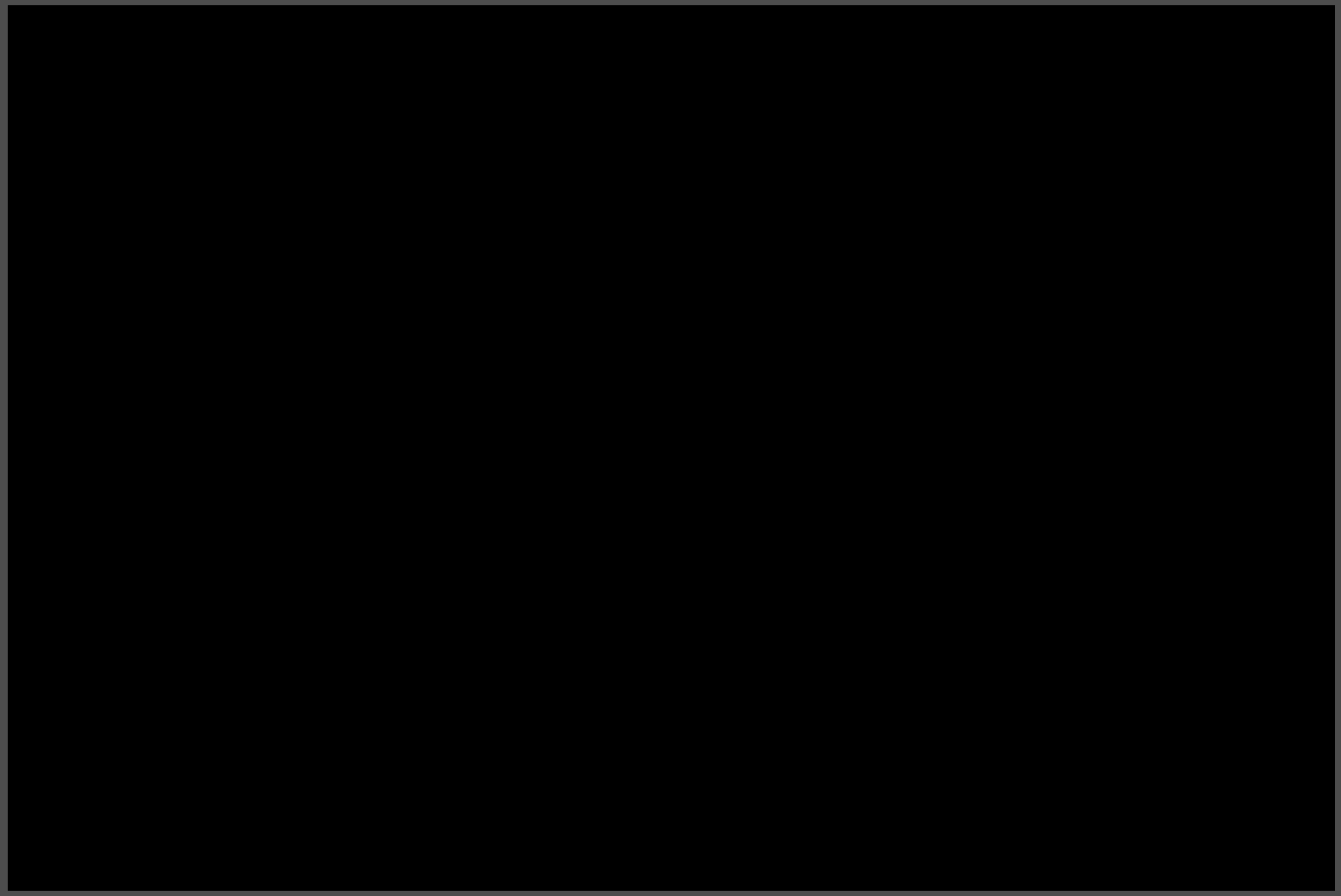
Gmsh display

https://gmsh.info

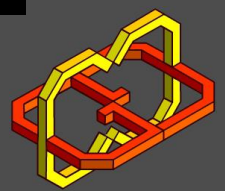
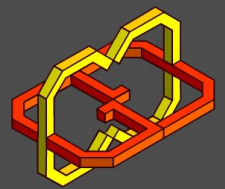
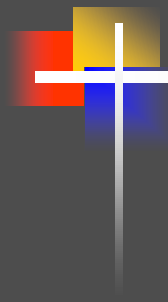
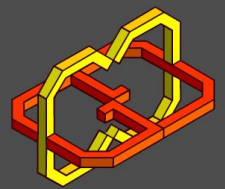
3D printed

J55, Stratays

Incision simulations



Work in collaboration with U. of Washington, 2007



In collaboration with many others, including Ben Ezair, Fady Massarwi, Boris van Sosin, Jinesh Machchhar, Ramy Masalha, Q Youn Hong, Emiliano Cirillo, Sumita Dahiya, Pablo Antolin, Massimiliano Martinelli, Annalisa Buffa, Giancarlo Sangalli, Stefanie Elgeti, and Robert Haimes