SAND2014-18230D

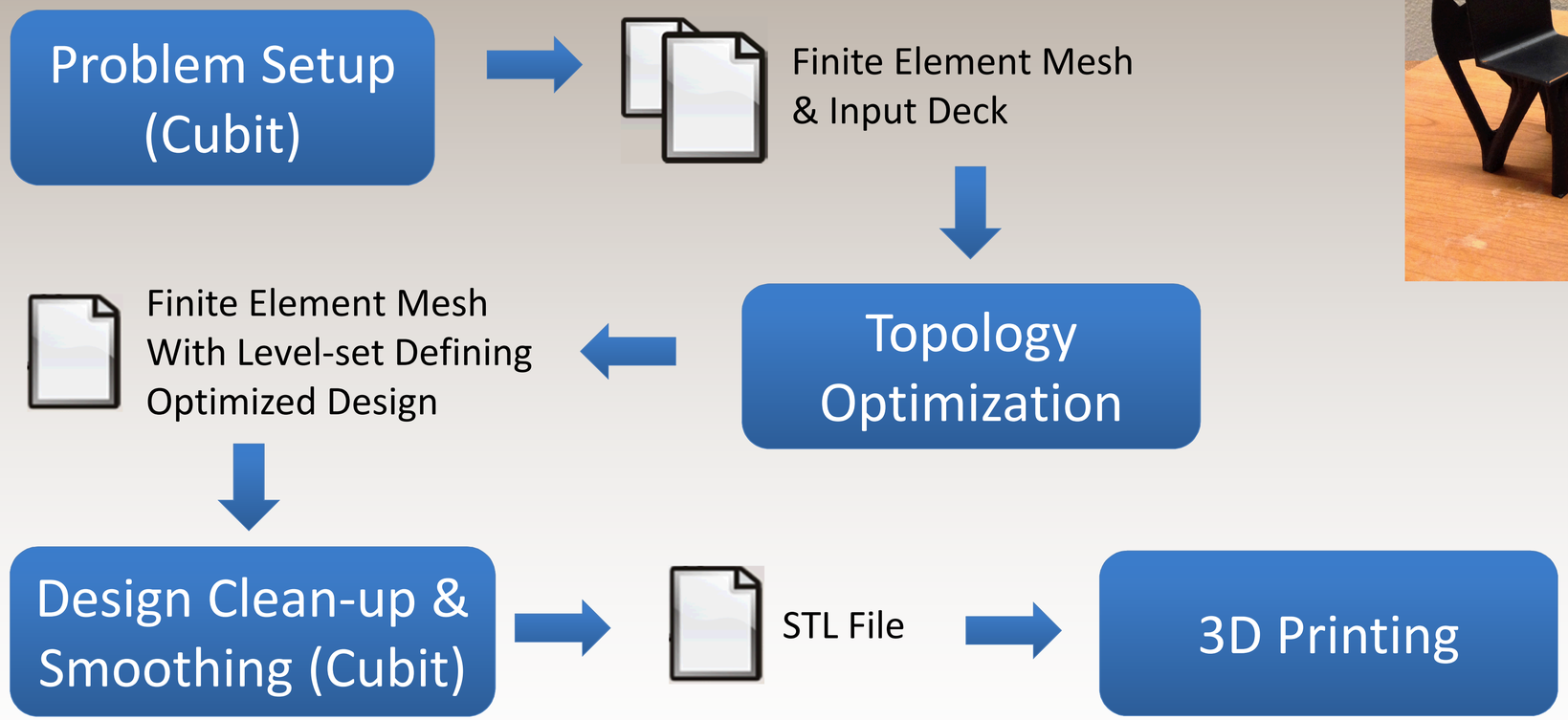
Supporting Optimization-based Design

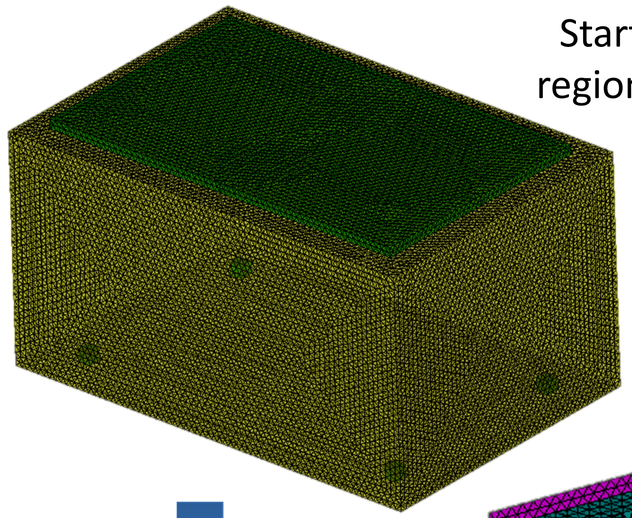
Brett Clark

Sandia National Laboratories

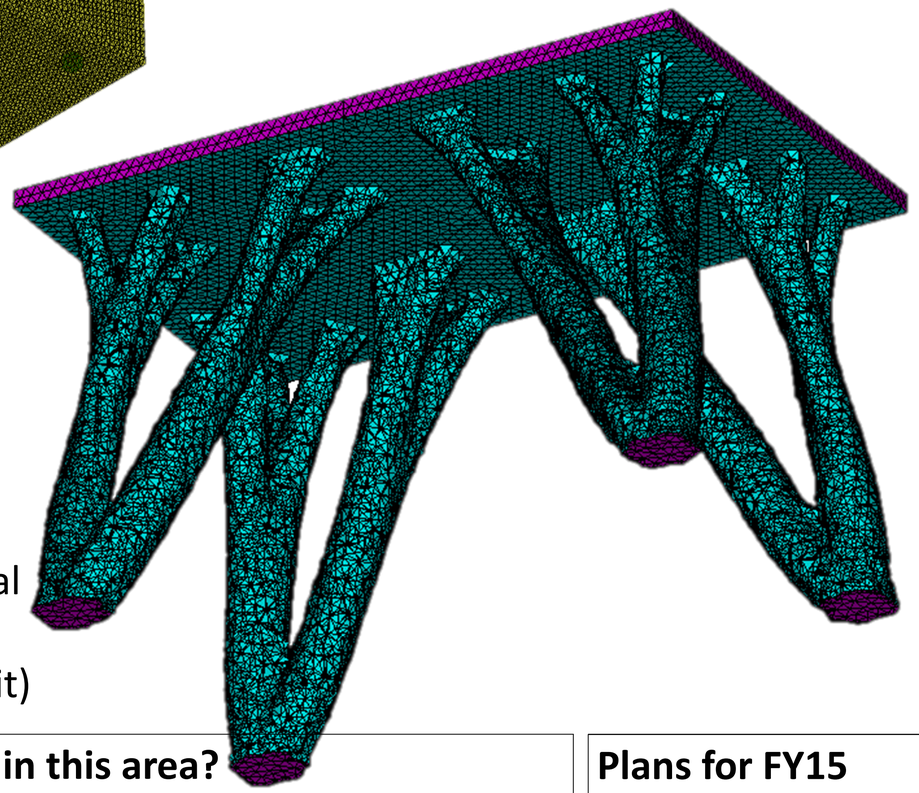
Description: Topology optimization (TO) promises part designs that use modeling and simulation to optimally place the amount and location of material to meet performance requirements. An example of this would be the design of the legs of a table and chair to support specified loads on the table top and chair seat and back (see pictures). The result is often very free-form or "organic" looking and is not readily manufacturable using traditional subtractive processes such as milling. However, additive manufacturing (AM) processes, such as 3D printing, provide a path forward to manufacture optimized designs. This poster describes how Cubit is playing a key role in this design through manufacture workflow at Sandia to help realize the goal of truly function-based design.

Design Workflow Using Topology Optimization and 3D Printing

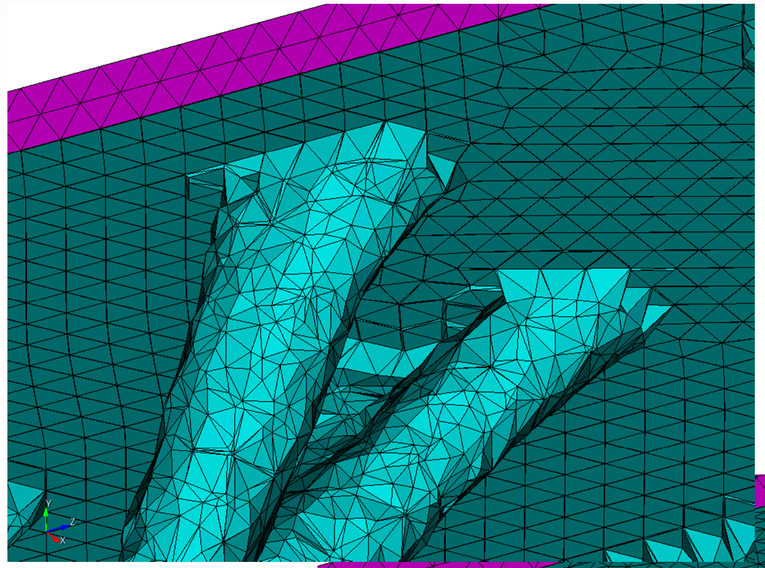




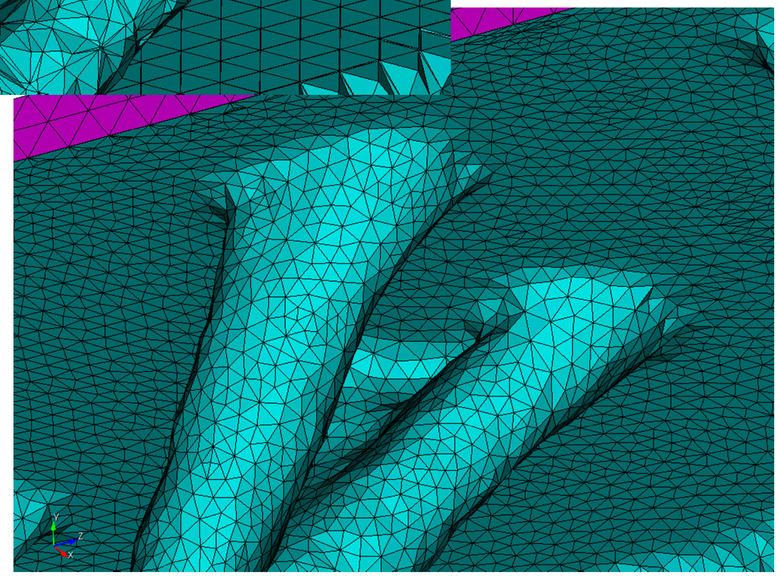
Starting mesh with constraint regions defined for optimization (done in Cubit)



Raw optimized shape extracted from TO nodal variable results (extraction done in Cubit)



Zoom of raw results.



Smoothed results (Smoothing and Editing done in Cubit)

Why is Sandia doing work in this area?

- Realistic TO problems require massively parallel computing power
- Advanced Sierra physics capabilities will provide powerful back-end for TO
- Open-source Albany physics platform for external collaboration
- SAW environment prime for TO Design Environment
- Experience in developing TO algorithms
- Strength in geometry and meshing

Plans for FY15

- Integrated Design Envrionment built upon the Sandia Analysis Workbench (SAW) environment that leverages:
  - Cubit geometry and meshing
  - Sierra input deck editor
  - Workbench job submission (for TO submission)
  - New mesh editing tools to “tweak” the optimized design
- Topology Optimization algorithmic development
  - Provide linear statics and modal analysis built on Sierra physics
  - Support optimization for multiple loading scenarios/multiple physics

U.S. DEPARTMENT OF ENERGY
National Nuclear Security Administration

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy’s National Nuclear Security Administration under contract DE-AC04-94AL85000.
SAND No. 2011-XXXXP