Additive Manufacturing, Topology Optimization and ANSYS Mechanical

Steve Pilz, Roman Walsh
Additive Manufacturing

- What’s the big deal?
- Who stands to gain the most?
- Why topological optimization?
- How do you get ANSYS Topology Optimization?
Revenue from AM worldwide

In 2010, the AM (products and services) grew 24.1%.
In 2011, the AM (products and services) grew 29.4%.
In 2012, the AM (products and services) grew 32.7%.
In 2013, the AM (products and services) grew 33.4% to $3.033 billion.
In 2014, the AM (products and services) grew 35.2% to $4.103 billion.

Grew 34% to $5.5 billion this year

NASA turbopump:
• 45% more parts
• Runs at 90,000 rpm, and creates 2,000 hp
• $220,000 each using conventional methods
• NASA can 3D print 2 of them in Inconel for $20,000
Fewer Parts, Less Cost, Better Reliability, Better Performance

GE Aviation fuel nozzles:
• The new design is **25% lighter**
• **5 times more durable** than the previous design
• the previous design took 20 different parts to assemble to make one fuel nozzle.

• Automotive, Biomedical, Energy, Military, Dental, Tooling, Prototyping, Patterns etc.
• **LIGHTER, CHEAPER, FASTER, BETTER**
In the Additive Manufacturing Age, Who Does Design?

- Human Intuition Based Design
- Physics Driven Design
Workflow Step Example

Initial Geometry Boundary Limits

Prep for Topo Optimization

Optimized Geometry

Exported STL Model in SC
Fix, Clean, Reduce, Smooth

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PRINT Optimized Model

Analyze Optimized Model

Re-mesh Optimized Model

Convert to Solid in SC
ANSYS R17 Topology Optimization

• Mechanical Physics
  – Linear Stress
  – Steady State
  – Linear Bonded Contact
  – Solid Bodies (2D and 3D)

• Constraint Functions
  – Local Degree of Freedom
  – Reaction Force
  – Volume, Mass
  – Local Stress
  – Global Stress

• Objective Functions
  – Single and Multi Compliance
  – Local Degree of Freedom
  – Local Displacement
  – Reaction Force
  – Volume, Mass

• Manufacturing Constraints
  – Maximum Member Size
  – Minimum Member Size
  – Symmetry
  – Extrusion

• R17 ANSYS Topology Optimization is a free ACT Extension that can be used with any workbench based ANSYS Mechanical Solver. We plan to release commercial tested with a native workbench interface at R18
Where Do You Get ANSYS Topology Optimization?

ANSYS Customer Portal
ACT Application Store