SAND2015-6658C

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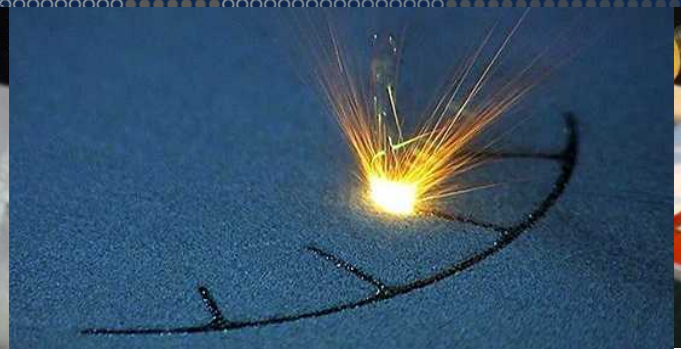

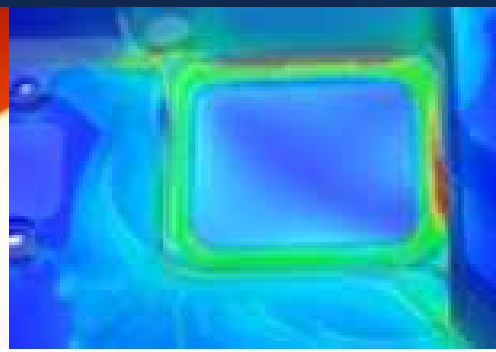

Adaptive Topology in Dynamic Applications

Nicholas Leathe, Russel Teeter,
and Louis Vaught
Sandia National Laboratories

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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What is Different?

- ATO conventionally used in static applications
  - Supports
  - Fixtures
  - Brackets

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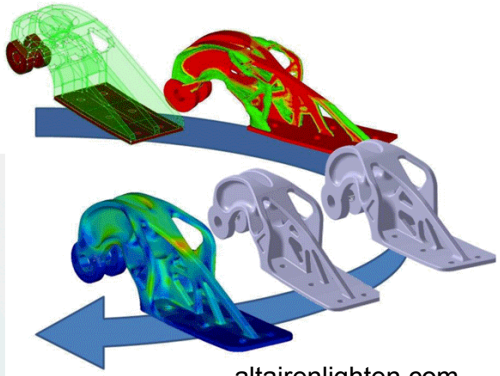

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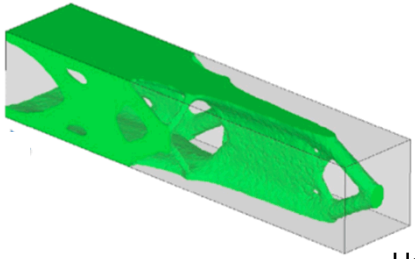

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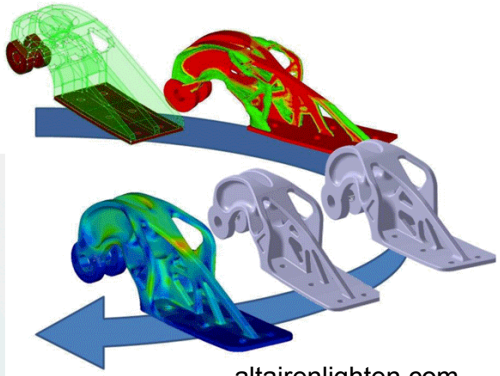

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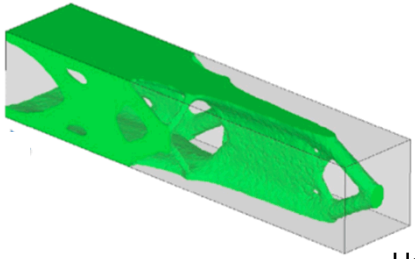
- What is the common theme?
  - Increasing stiffness
  - Reducing weight



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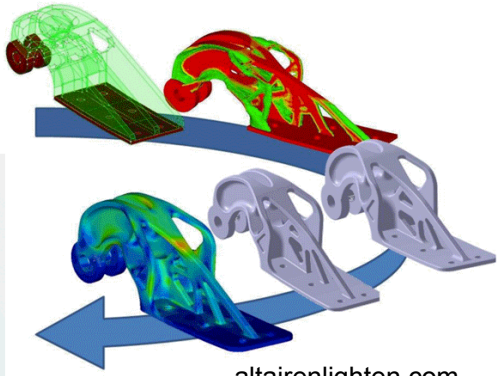

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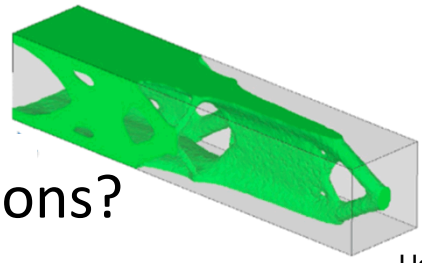

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- How adaptable is ATO for dynamic applications?

Component Housing

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- Topology Optimization used to investigate response
  - Mode changes
  - Input Amplification

Component Housing

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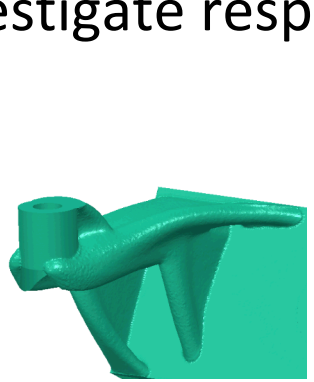
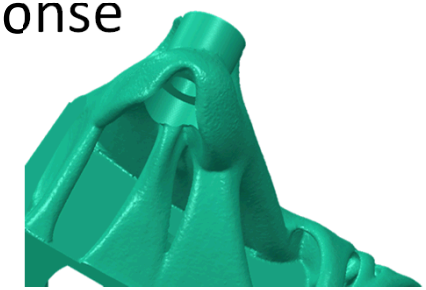
  - Mode changes
  - Input Amplification
- Three housings compared
  - Original with Phenolic
  - Original design with Aluminum
  - ATO with Phenolic





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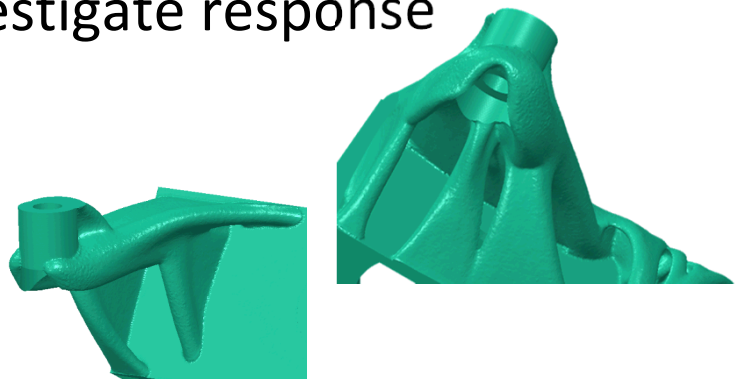
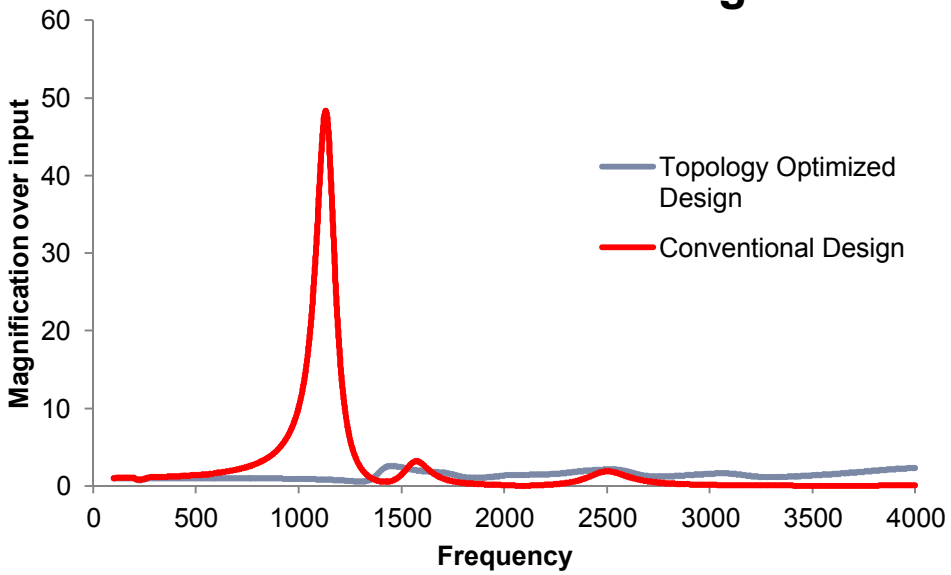


	GRMS Amplification
Original Phenolic	2.0
Original Aluminum	1.9
ATO Phenolic	1.1



Component Supports

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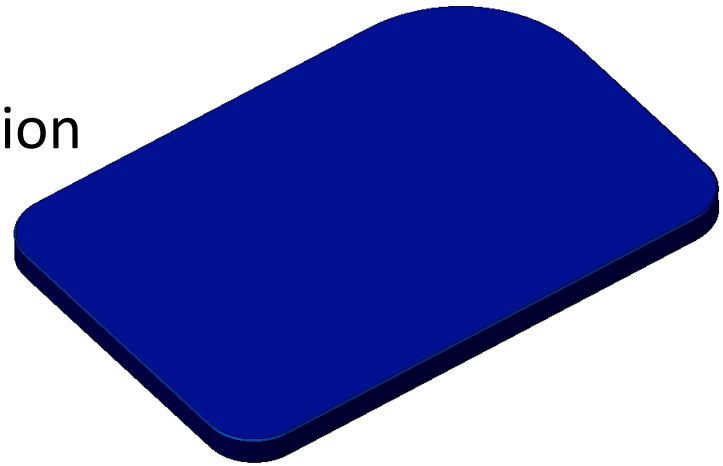
- Can AM and ATO be used to modify pre-existing pieces?
  - Increase robustness of plate
  - Increased durability in shock environments

Component Supports

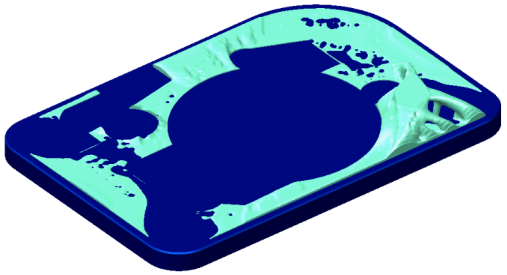
- Can AM and ATO be used to modify pre-existing pieces?
  - Increase robustness of plate
  - Increased durability in shock environments

- Support plate used as a starting position
  - Easy to print onto
  - Room for optimized structures
  - Simple to test and model



Component Supports

- Three Different Levels of Modification
  - Light (4.3% Volume Increase)



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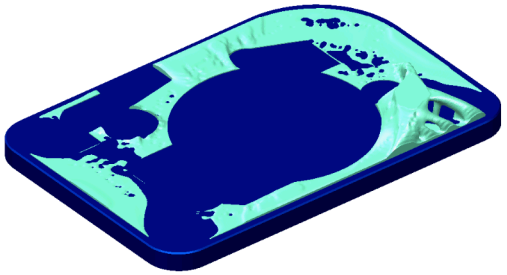
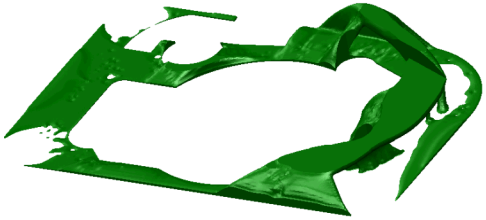
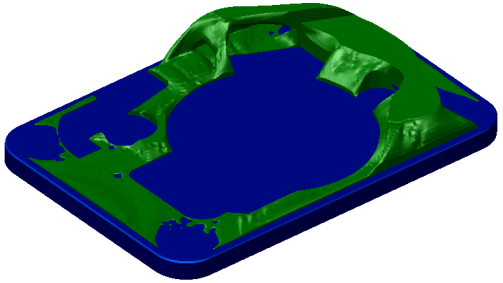


  - Medium (10.9% Volume Increase)





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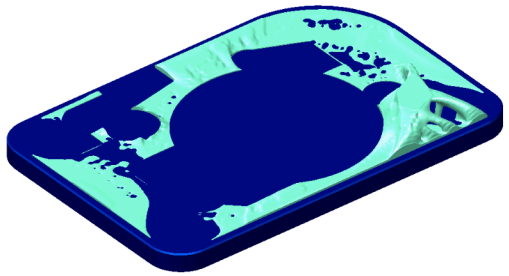

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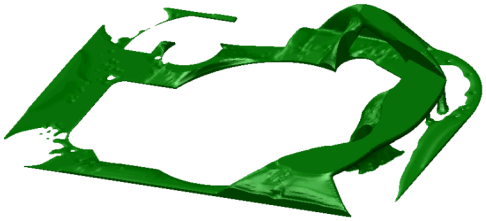
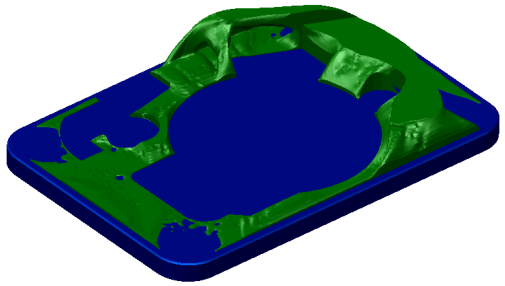
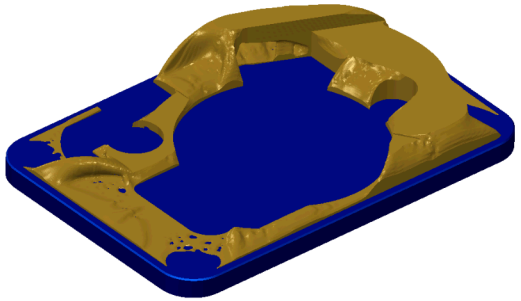


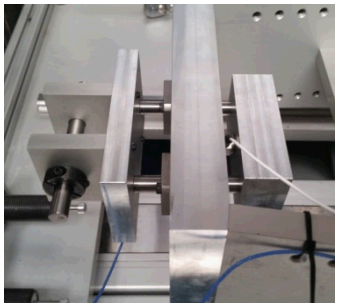


  - Heavy (18.4% Volume Increase)



Tester Pieces

- Impact within tester causes high levels of dynamic resonance
  - Overlays onto signal – difficult to filter out
  - Tester components heavy and stiff
    - Attempt to increase rigidity to decrease noise



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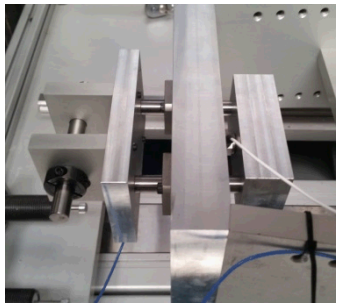
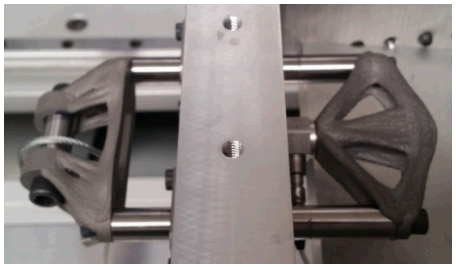
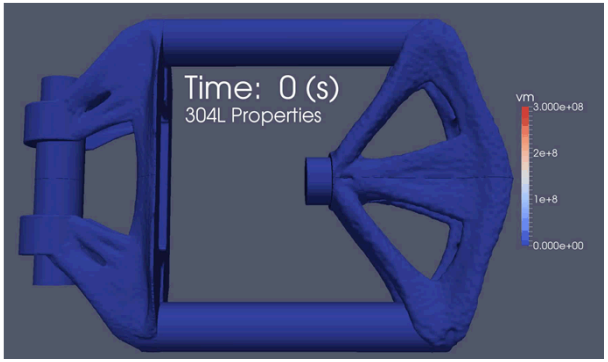
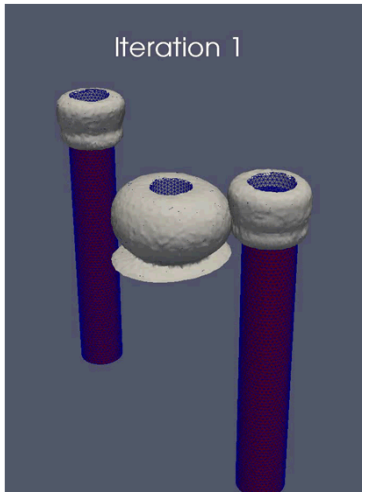


- Topology optimized components printed with Ti-6Al-4V
  - Reduce coefficient of variation from 25% to 10%
  - Reduced noise for better results
  - ATO Survives dynamic impact loading

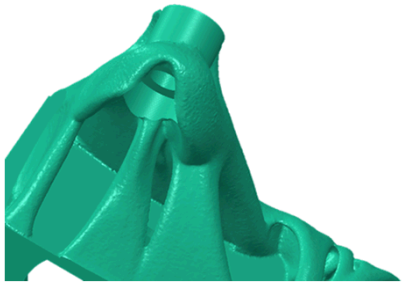




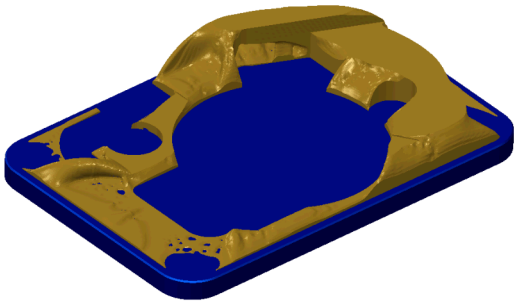


Conclusion

- Static ATO adapts well to dynamic applications
  - Improves vibration response
  - Increased stiffness and durability for pre-existing parts
  - Reduces noise from dynamic resonance



- Further testing and analysis underway
  - Physical testing for model correlation
  - Better characterization of AM properties



- Additional adaptation of ATO into workflow
  - Additional exemplars of ATO needed
  - Identification of immediate and future applications