The Effects of Core Geometry Manipulation of 3D Printed Rocket Fuel

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What I have Done

- Overview
- Production of samples
  - Modeling
- Production results
- Testing of fuel grains
- Final thoughts
3D printed Rocket fuel

• Three types of Rocket fuel: solid, liquid, and hybrid
• Hybrids offer unique opportunity to 3D print fuel
• Standard Hybrid fuel is Hydroxyl-terminated polybutadiene (HTPB)
• 3D printed Acrylonitrile butadiene styrene (ABS) alternative
  • Not as good as HTPB
  • Complex Geometry of core could alleviate this
Production of Samples

• ABS 3D printed grains
• Single and double helix core geometry
• SolidWorks modelling
• 3D printing: 10+ hours
• Post processing in Acetone
Production of samples

- Modelled in MATLAB for maximizing volume and surface area.
- Conclusion:
  - .2 in Helix radius
  - 2 rotations
  - 2 in pitch
  - .2 in circumference of helix
Testing of Fuel Grains

• Testing:
  • 12 test fires: 3 HTPB grains, 3 ABS straight core, 3 ABS single helix, 3 ABS double helix.
  • Regression rate, and thrust measurements

• Testing has been a struggle
  • National shortage of Nitrous oxide (oxidizer)
Conclusion and Recommendations

• Production Process
  • Longer and harder than anticipated
• A combination of grains HTPB and ABS may be a viable option.
  • ABS skeleton and HTPB filling.
• Future testing
  • Possible other cores
  • Multi-material 3D Printed fuel
  • Molding
Thank You

Any Questions?