

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

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NASA Space Grant Symposium

(University of Arizona) – April 14, 2018



What I have Done

- Overview
- Production of samples
 - Modeling
- Production results
- Testing of fuel grains
- Final thoughts



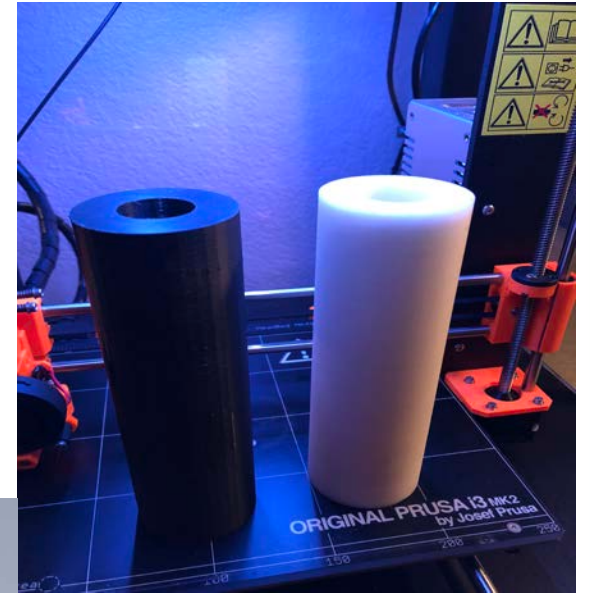
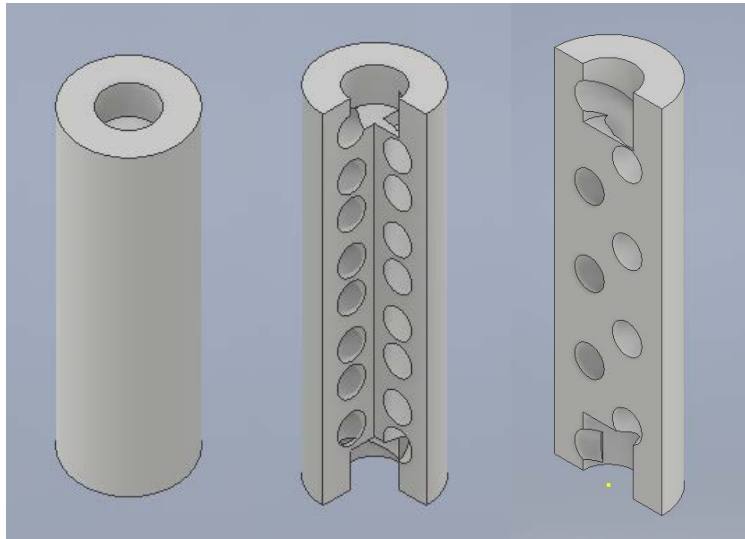
3D printed Rocket fuel

- 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



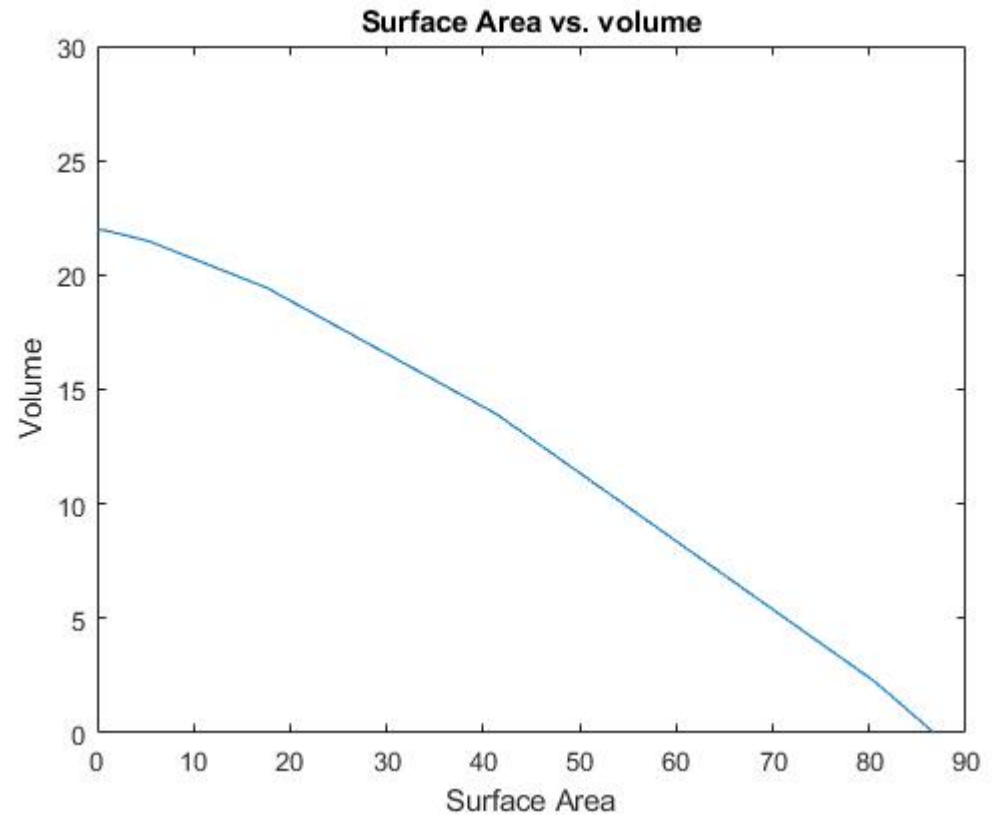
Production of Samples

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



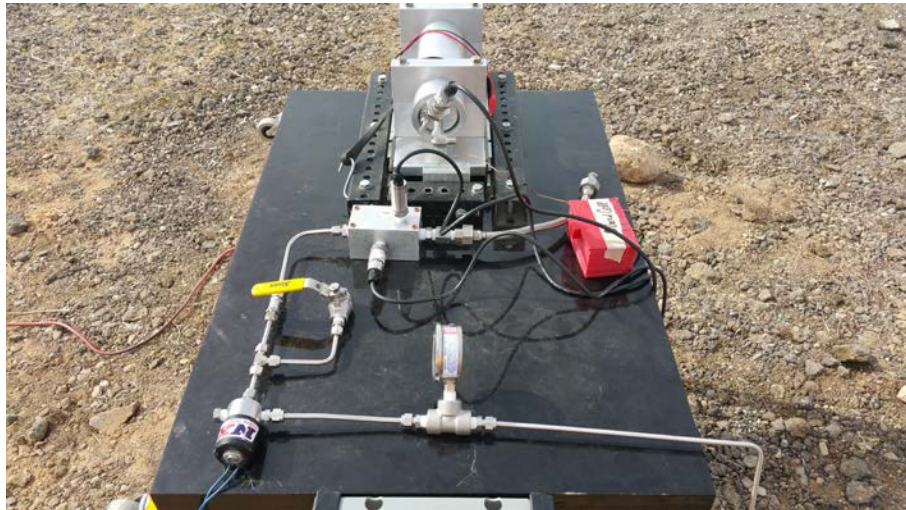
Production of samples

- 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?

