2015 SECNAV Innovation Award Honorable Mention: MIDN 1/C James Catina

By DON Innovation

Midshipman First Class James Catina was recognized with an Honorable Mention for the 2015 SECNAV Innovation Awards in the category of Innovation Scholarship (Midshipmen) for his research, "Use of Additive Manufacturing to Model & Develop Advanced Liquid Propulsion."

Over the course of the last decade, additive manufacturing (AM) has become an increasingly more affordable and capable engineering tool. Its role in the engineering industry has become more important as the technology improves in accuracy, speed, efficiency, and affordability. AM gives researchers the opportunity to develop and manufacture new designs that would have been impossible to produce through traditional, subtractive means. This is particularly advantageous in the high-pressure and temperature environments in which liquid rocket engines perform. Along with its well-documented benefits in both cost and time savings, AM represents a more technically effective solution to the manufacturing of liquid propulsion systems.

Recently, researchers at the United States Naval Academy have worked to integrate additive manufacturing into the design, manufacturing, and testing of AM liquid injector plates in an effort to confirm the ability of AM injectors to reduce the weight of liquid propulsion systems while still maintaining functionality and structural reliability. Midshipman Catina's research covered the planning, design, and testing of AM for injector applications.

Midshipman Catina's research was multifaceted: its genesis sprung from the mission of the United States Naval Academy (USNA): allowing midshipmen the opportunity to learn. In a previous iteration of the Rocket Propulsion course at USNA, there was no hands-on research section for rocket injector study. The lab was developed, designed, and built with the sole focus on educating Midshipmen. However, the initial work performed for the course sparked an interest in Midshipman Catina, propelling him to pursue it further and expand his knowledge of AM and injector design.

During the course of the research, six different injector plate designs were printed at the USNA machine shop. He ran 150+ flow tests characterizing the injectors as well as the printed material. Remarkably, this research eclipsed its initial purpose to educate the 25+ Midshipmen in the Astronautical track at USNA each year; it had developed into a research effort of its own. The

liquid rocket community, as a whole, had significant interest in AM due to the latter's potential to reduce weight on propulsion systems, which is always a desirable goal.

To date, Midshipman Catina's research has been presented at five different conferences, garnering merited attention. Currently, there are very few researchers performing flow characterization on AM injectors and Midshipman Catina has been leading this branch of research for the rocket industry. Midshipman Catina's research is on the cutting edge of AM within the rocket community.

The full essay can be found at:
http://www.secnav.navy.mil/innovation/Documents/2016/05/MIDNCatinaThesis.pdf