Designing the Next Generation of Human Spacecraft

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Lunar Space Station Common Module: A new concept for a module for a lunar space station attempts to reduce the module's mass by abandoning the traditional rack structure currently used on the ISS for the mounting of internal hardware and replacing it with a core structure. By using this design, the pressure shell will not have to carry the loads resulting from the internal mass. I worked with another intern to create the initial design for the module, with him focusing on the core and myself focusing on the pressure shell. To start, I was given the shell overall dimensions and material and tasked with sizing the wall thickness and placing stiffeners such that the shell could withstand the required loads. At the same time, I had to keep the mass to a minimum to keep the overall module within the allowable launch mass. Once I had done initial sizing based on pressure loads, I combined the pressure shell with the inner core to perform optimization of the design. Currently, the design involves circumferential stiffeners along the entire length of the pressure shell with longitudinal stiffeners on either end. In addition, extra wall thickness was added around each of the hatches. At this stage, the design shows a comparable mass to a more traditional design, but we are hopeful that, through optimization, we will be able to reduce the mass even further. There is currently a patent pending for the module design, for which I am listed as a co-inventor.

ALON Material Testing: I was given samples of aluminum oxynitride (ALON) that had been impacted by a previous intern on which to perform residual strength tests as part of a plan to approve them for space use. Before testing, I measured the pucks and their damages using a ruler and optical micrometer in order to verify that the puck dimensions were within the tolerances set by the test guidelines and that the damages had not grown when the pucks were thinned. The test was a ring-ring test, which used two concentric rings to place the ring in axisymmetric bending, with the puck set up so that the damaged side was always in tension. Though I was unable to do the setup of the test or run the load machine due to a period of changing test procedures, I was able to observe the testing and perform the data collection. The pucks behaved as expected, breaking at the damage, as did the strengths calculated from the data, being lower than for the unimpacted pucks and having less scatter between the puck values. The attached image is of myself during the ALON strength testing.

Over the course of my internship, I was able to learn much more about real-life structural analysis and about the behavior of materials, and it confirmed my previous interest in structural analysis. At the same time, due to the opportunities offered to interns, I was able to learn a lot about mission control, and, in doing so, I developed a second interest in working in mission control. In addition, being able to meet the people here and learn about the type of work NASA does made me want to come back to work for NASA full time.