During the first week of February, I attended the American Astronautical Society Guidance, Navigation, and Control conference in Breckenridge, CO. The conference is an opportunity for researchers from universities or private companies to present research in a wide field of astrodynamics-related topics. This event in particular garners much attraction as it is often dubbed the "GN&Ski" conference, as attendees are encouraged to take advantage of the ends-of-the-day session scheduling in order to hit the slopes. I, due to the exorbitant costs of equipment rental, was relegated to enjoy skiing vicariously from the warmth of the host lodge.

My mentor and I both had the opportunity to present research at the conference as part of the "Advances in Software" session. His paper described a tool he developed that can be used to design highly accurate sun-synchronous repeat ground track orbits. My paper was on using the Laguerre method for solving the angles-only initial orbit determination problem as discussed in my seminar work updates. I presented to an audience of about forty space-business old-timers who seemed largely receptive to my talk. A couple of folks from NASA Johnson approached me after the conference to discuss their own frustration with the angles-only issue and to provide me with insight on new search parameters to implement. Although the thought of presenting put me on edge for a few days prior to that fateful Tuesday, the thing went off without a hitch and I am glad to have had the experience.

Figure 1. The helicopter test rig. LCAM, DIMU, and VCE corresponds to LVS Camera, Descent Inertial Measurement Unit, and Vision Compute Element.

While at the conference, I learned of some neat projects that should come to fruition within the next few years. There was much focus on the upcoming Mars 2020, which aims to land a new rover on our red neighbor in order to answer questions about the challenges future human expeditions. One group presented their work on the Mars 2020 Lander Vision System (LVS). The LVS is a sensor that will be used to target a safe landing site by using advanced photo-recognition techniques in conjunction with a catalogue of images of the Martian surface. They claim this capability has allowed for the selection of the "hazardous but scientifically compelling" Jezero Crater for the landing site. In their talk, they showed images of the testing phase in which they attached the LVS to the bottom of a helicopter and flew around the desert. They conducted the tests with varying sun intensities and angles and for a host of variably sized land features. The LVS was able to identify catalogued features within the mission's 40m position estimation requirement. An image of the test rig is shown in Figure 1.

Another NASA JPL engineer presented work on the rover itself. A fact that struck me as particularly surprising was that the new rover will have a feature called Thinking-While-Driving (TWD). This simply means that the rover will be able to identify targets and decide location goals while moving. Previous rovers used their cameras at a standstill, identified some object in the distance, decided to go toward it, moved, stopped, and then acquired a new target. This baffled me, just because I figured that the ability to “think”while driving would have been a long-standing capability of the rover systems.

One of the most interesting talks I attended was about a paper titled “The Voyagers: Risky Business Beyond the Heliopause.” It was the last presentation and the conference and was allocated extra time because of the historical importance of the matter. Voyagers 1 and 2 were launched in 1977 in order to perform flybys of the gas giants and eventually make their way out of the solar system entirely. The two spacecraft are currently performing science in order to measure cosmic rays, the strength of the magnetosphere, and the presence of charged particles in order to develop a better model for the material composition of interstellar space. The presentation showed some of the challenges the engineering team has faced and will continue to tackle in order to keep the lights on until 2030.

The major difficulty in keeping the Voyagers running has been the non-simultaneous degradation of key components. Some or all of the subsystems have continued to run well past their expected life. Occasionally, one component will shut off for good, and the Earth-bound engineers must then determine what combination of commands will allow the entire system to continue to function despite the loss of a crucial component. Figure 2 shows the block diagram for Voyager 2 and highlights which components are still active.

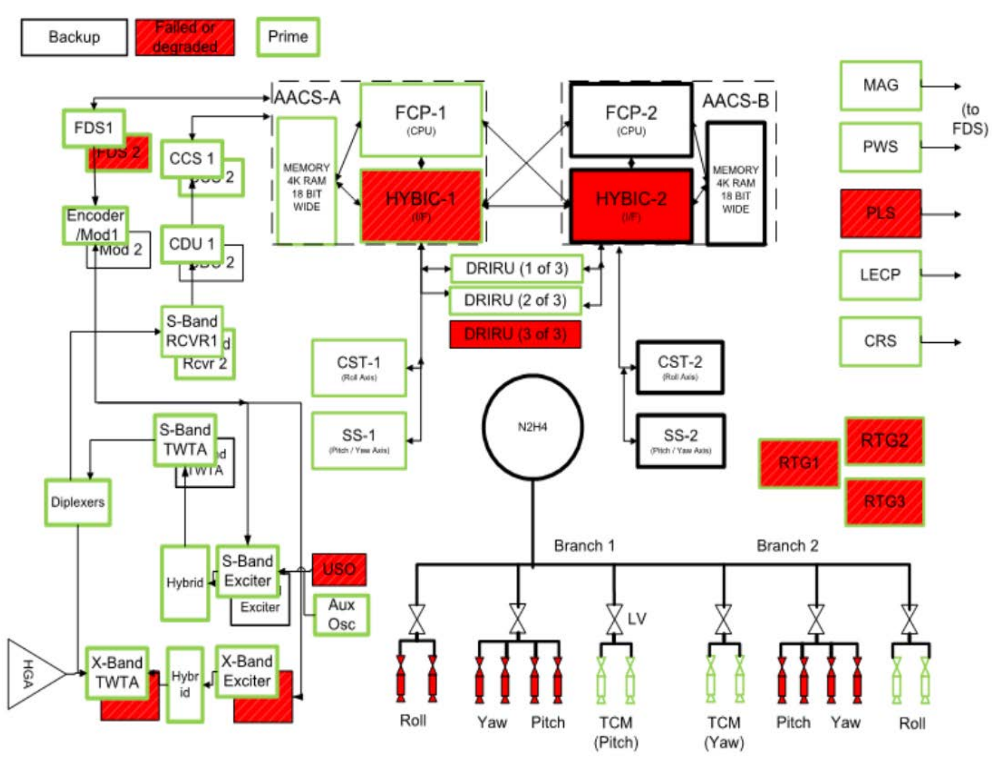

Figure 2. The system architecture for Voyager 2. Note that most of the actuators are non-operational.

All in all, the conference was one of the highlights of the 2019-2020 academic year. I received valuable presentation experience, was able to network, learned about some neat work that is happening at NASA, Ball Aerospace, and other corporations, and got to frolic in the snow. I believe that my publication at this conference was also a key element in my eventual employment with Dynamic Concepts Inc. DCI was excited to see an undergraduate candidate with a little bit of experience in GN&C, and they invited to meet their small team in Huntsville. I will be working on the flight software for NASA SLS, seen in Fig. 3, as a Mission Design Engineer at the Marshall Space Flight Center starting in June.

Figure 3. The NASA Space Launch System, seen here, will be the most powerful rocket ever flown.