ETHICS AND BUSINESS CONDUCT
EXCELLENCE THROUGH INTEGRITY

LOCKHEED MARTIN

2022 LM Ethics in Engineering Case Study

Background

Poseidon Orbital

Led by Dr. Brody Tempestas, Poseidon Orbital is a remote sensing company specializing in monitoring and forecasting severe and dynamic weather conditions through its multiple satellites. Poseidon recently launched the first of its Atlantis-class satellites which incorporates innovative use of AI algorithms and cutting-edge satellite positioning technologies. The Atlantis series generates more accurate early predictions of weather patterns, proven to save lives when extreme weather is approaching. With the continuing trend of more severe storms, hurricanes and other weather patterns, Poseidon has entered into a major contract with the National Oceanic and Atmospheric Administration (NOAA), to become a leading provider of specialized weathering monitoring. Success in this NOAA contract will open the doors for more Atlantis-class customers.

Locus Aerospace

Locus Aerospace started as a small engineering firm performing modeling and analysis for government space programs. With its strong track record, Locus has become a leading subsystem component supplier and engineering services company with over $250M in annual sales. With space technology advancing at an incredible rate, founder Dr. Hunter Nimbus positioned Locus to be on the forefront of new capabilities for space payloads and communication technologies, for both government and commercial customers.

Since releasing its proprietary laser communication capability, Locus is poised to become a leader in CubeSat communication satellites. Locus' CubeSats will provide the most precise and secure communication network in the world. If successful deployment of the constellation is achieved, Locus could experience monumental growth by providing satellite-based communications at a fraction of the current cost to govern Air Traffic Control (ATC) communication, primary military operations communication, and even a globally accessible civilian communication network. In order to fit in the very small form factor, Locus is using cold gas thrusters instead of traditional rocket thrusters to control the attitude of the CubeSats. The use of cold gas thrusters reduces the design complexity which permits its cost-savings size and weight.

Preliminary analysis indicates that a minimum of 145 3U CubeSats must be deployed and operational at all times to maintain line-of-site during orbit. This analysis revealed though that if less than 145 CubeSats were operational, there could be up to a 10-minute outage in communications coverage.

With venture investment in place, Locus began its first full deployment. In Phase 1 of the mission, five CubeSats were launched, successfully reaching their desired orbits, and proving functionality of the laser communication system. Two weeks ago, Locus initiated Phase 2, with the goal of establishing the integrated global reach of the network by launching 150 additional satellites to achieve the constellation needed to create the desired coverage with an orbit of 90 minutes.

Monday

With the initial operating capability (IOC) performing to plan and ATC and military operations in full use of this system, Dr. Nimbus received news late on Monday night from the US Space Force that a close approach of an object could impact up to 15 CubeSats over the course of several hours. The closest

approach would be on Friday night and that some action was needed to mitigate the potential space collision.

The approaching object is Poseidon's new Atlantis-class weather satellite in a low earth orbit (LEO). Upon receiving the news, Dr. Nimbus immediately called Poseidon and both companies agreed to immediately look into the issue and reconvene for a detailed briefing early on Tuesday.

Locus put two teams into action. One team determined that a loss of these 15 CubeSats would prevent the constellation from reaching the full global reach of the constellation needed to achieve the required coverage and therefore the operational availability required for their customers. Another team ran the ephemeris data for the CubeSat constellation and requested specific details on the 15 CubeSats in question. The ephemeris data showed that those CubeSats were holding to their intended locations and did not drift. Dr. Locus was hopeful that Poseidon's data would validate that their spacecraft was the one in question.

Poseidon also ran ephemeris data that did in fact show that it was their weather satellite that had drifted slightly from its intended orbit resulting in the reported close approach. Even though the Poseidon satellite was in the reported potential collision envelope, Dr. Tempestas was not concerned as the projections still showed enough margin to not raise the risk level to one requiring action.

That Monday Poseidon had been instructed by NOAA to track a developing powerful storm confluence. Dr. Tempestas believed that performing a collision avoidance (COLA) maneuver would jeopardize the data collection event. This was one of the largest storms ever recorded by a weather satellite that was poised to hit the Gulf Coast on Saturday and a gap in coverage could prove detrimental to the emergency response and evacuation of people in the danger zone.

Just to keep options open, Luna Blazar, who leads Poseidon Orbital's engineering and space operations organization, asked John Allen, one of her engineers, to evaluate whether the thrusters on this satellite could potentially move it out of the collision window. John reminded Luna of the fuel issue[1] as well as the time repositioning would halt any data collections occurring at the time of the maneuver. And once repositioned, the satellite would require re-calibration. However, after his analysis, John felt that the repositioning could be completed before the storms reached a critical stage.

Tuesday

For the meeting with Dr. Tempestas and the Poseidon team, Dr. Nimbus brought with him Dr. Cherice Malleus, a recent PhD with recognized expertise in orbital mechanics and space phenomena.

Dr. Malleus reported the ephemeris data of the 15 Locus' CubeSats to the group and recommended that Poseidon perform a COLA maneuver to reposition their weather satellite back into its intended orbit.

Dr. Tempestas acknowledged Dr. Malleus' findings but assured both teams that the risk of collision was below any threshold for action as the CubeSats were so small and the collision envelope was conservative. Dr Tempestas reminded the assembled group that close approach notifications are very common. This position was alarming to Dr. Nimbus and his team and it also surprised a couple individuals from Poseidon's chief engineering organization.

[1] Poseidon Orbital's weather satellites do have thrusters to help control the attitude and positioning of their satellites, but as with all thrusters there is a limited fuel supply, and faster attitude changes use more fuel.

Dr. Nimbus quickly chimed in and expressed the urgency of the matter and candidly shared that Poseidon needed to take action since their satellite was not in the intended orbit. Dr. Tempestas quickly countered and shared that if Locus was so concerned that they should perform COLA maneuvers to get out of the hazard area. The meeting ended with many members concerned, upset, and frustrated, and no clear direction was agreed to. Locus and Poseidon agreed to reconvene early on Wednesday once additional analyses could be performed.

Following the meeting, Luna Blazar approached Dr. Tempestas and asked him why he was unwilling to perform the COLA maneuver since it was their own satellite that was out of its intended orbit. Dr. Tempestas, frustrated and demeaning, chirped back at Luna stating that there was enough margin and that he was not willing to risk not fulfilling Poseidon's obligations to NOAA during this weather event, especially with the lives of so many on the line.

Luna, surprised by Dr. Tempestas aggressive response, nodded with acceptance and walked away to avoid any additional reprimands from Dr. Tempestas. She had her team run some probabilistic scenarios of the event to assess the potential margin. Luna was generally a conversative engineer, but also heavily supported her recommendations based on data rather than her gut. Once the analyses were complete, they yielded differing results due to the orbital velocity and inertia deviations from the Earth's gravitational pull. The data was not conclusive that staying the course would be safe.

Upon direction from Dr. Nimbus, Dr. Cherice Malleus conducted similar probabilistic analyses. Dr. Malleus' results yielded similar data – it was inconclusive on whether no action was safe or not. Being the problem solver that she is, Dr. Malleus ran an analysis with the 15 Locus CubeSats performing COLA maneuvers. Much to her surprise, the thrusters did not provide sufficient directional change to reposition the CubeSats out of the area of concern in time even though original analyses stated they should have been able to perform a series of maneuvers within the allotted time interval.

She quickly shared her results with Dr. Nimbus.

Today

Both Locus and Poseidon are members of the International Satellite Collision Avoidance Agency (ISCAA) which provides arbitration services in situations such as these. Leaders from both companies contacted ISCAA to arrange for today's urgent meeting. Your team will be assigned to represent either Locus Aerospace or Poseidon Orbital at this crucial meeting to develop a plan of action before the Friday close approach.