User Experience Design for Human-Machine Teaming in Commanding a Distributed Constellation of Unmanned Assets in Search and Rescue
(Technical Report)

Complex System Failures: Analysis of the Boeing 737 MAX Accidents using Actor-Network Theory
(STS Research Paper)

An Undergraduate Thesis Portfolio

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Socio-technical Synthesis: Preventing and Analyzing Complex System Failures

My technical work and STS research are connected through the idea of integrating complex systems and preventing system failures. As systems become increasingly more complex, the opportunities for failure grow. My technical work focuses on an effective visual representation displaying information from a drone constellation. My research explores what can happen when these systems fail with tragic results through an examination of the Boeing 737 MAX accidents in 2018 and 2019. Both works explore complex systems and human interactions with technology. However, my technical work focuses on how system failures can be avoided, while my research focuses on an analysis of why system failures occur.

My technical project focuses on facilitating human-machine teaming for commanding unmanned assets for search and rescue purposes. As autonomous technologies, such as drones, are given more responsibility, it becomes extremely important to ensure understandability and develop trust in the system between users and the technology. It is also critical to consider effective methods to alert the user of unexpected behavior. My capstone team and I designed a user interface to reduce uncertainty and monitor and control unmanned assets. Our interface includes system alerts as well as visual representations of potential positional errors. By creating an on-the-loop experience and clearly communicating alerts and errors, the risk of system failure will be mitigated.

My research project focuses on the consequences of system failures. Using Actor-Network Theory, I analyze the factors leading to the Boeing 737 MAX accidents in 2018 and 2019. This analysis showed that a combination of factors contributed to the accidents, instead of a specific actor. Although attributing the cause of an accident to a single-point failure may seem

like the simplest solution, complex systems rarely fail due to a single-point failure. The tragic accidents were caused by the system breaking down at various points throughout the network.

Working on these two projects simultaneously provided different perspectives and increased the quality and robustness of both. My technical work provided me with a greater understanding of human-machine teaming and how trust can be built between autonomous systems and their users. The research I did for the STS paper showed the importance of considering the entire system. It also showed the terrible consequences that can result from system failures. This was a strong motivator to ensure that our project not only considered normative scenarios, but also unexpected scenarios. Developing both my technical and STS research projects together this year has given me the opportunity to consider system integration and failure prevention from different perspectives. These different perspectives helped create stronger and more cohesive works.