Thesis Project Portfolio

A Space-Based Solution to Improve Roadway Safety and Efficiency in Virginia: Real-Time Winter Weather Data for Navigation

(Technical Report)

The Impact of Society on Satellite Technology and Interpretive Flexibility

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Spring, 2021

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Sociotechnical Synthesis

The technical portion of this thesis is concerned with the design and systems architecture behind creating a satellite capable of detecting snow and ice on roadways from low Earth orbit. In conjunction with the MITRE corporation, a team of undergraduate students from UVA designed a modular miniaturized satellite, commonly called a CubeSat, to carry a satellite imager. This imager can sense and differentiate between different wavelengths of light, such as light reflected by colors indicative of snow and ice (i.e., white) and thus can report to ground stations which areas of interstate highway are experiencing heavy snowfall or icing. From there, ground stations can direct this information to news stations, commercial phone applications, or radio services to warn drivers. This is important, as icing can cause hazardous road conditions and have been reported to instigate fatal accidents and traffic problems. Weather reporting may help to deter some drivers, but photo evidence of current road issues would help to keep many more drivers off the road or would help to divert them to safer roads, helping to prevent crashes and traffic backups. In addition, the Virginia Department of Transportation (VDOT) relies on road conditions and not weather data to determine the safety of roads. Currently in the design phase and limited to Virginia roadways, this project has the intention of detecting hazardous road conditions across the contiguous United States and beyond using a connected system of satellites called the Commuter Live-Yield Traffic Observation Network (CLAYTON).

The STS portion of this thesis describes in detail the relationship between the needs of society and the furthering of satellite technological advancements through the lens of the Social Construction of Technology (SCOT) STS framework. This framework, which outlines the key actors and motivations behind the creation and advancement of technological artifacts, is heavily referenced in the explanation of how satellite technology has evolved since its creation during the Cold War. This paper also heavily concentrates on interpretive flexibility, a key tenet of SCOT that focuses on how a technological artifact has been used by vastly different groups for different purposes. For instance, hospitals and military forces may both use communication methods routed through satellites in low Earth orbit, but doctors utilize this to communicate with peers and patients while military organizations employ this to communicate plans of action. Using the lens of SCOT and interpretive flexibility, as well as the perception of satellite technology by stakeholders, this paper seeks to determine if closure has been achieved between users and of satellites and the manufacturers and bystanders witnessing these advancements. In the context of doctors and military organizations, use of satellites by the former may be seen as wholly good, while use by the latter may be frowned upon by dissidents and enemies to the organizations in question. This topic is so important because the world is stepping into a new age of space exploration, one that may soon be dominated by private corporations like SpaceX and Blue Origin. To determine how the world will react to a myriad of new uses for satellites, historical and modern evidence on society's views of satellites must be taken into account.

Tying the technical and STS sections of this thesis together is the idea of interpretive flexibility. Just as different social groups have adopted the same satellite technology and capabilities for their own purposes, so to has the technical team adopted the technology to help solve road hazard detection issues. Originally created as a low cost way to send experiments to

space, the CubeSat has been the basis of structural design to house the imaging, power, and transmission technology required to accomplish this team's goals. Furthermore, rather than being used for a simple experiment with immediate reportable results, the technical team plans to create a permanent network of CubeSats (CLAYTON) for long-term and widespread observation.