

## **Thesis Project Portfolio**

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

(Technical Report)

### **Evaluating the Impact of Racially Biased Highway Infrastructure Developments on Black Communities Using Actor Network Theory**

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
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In Fulfillment of the Requirements for the Degree  
Bachelor of Science, School of Engineering

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## **Sociotechnical Synthesis**

### *Framing Engineering in the Context of Identity*

In his 2003 publication in *Natural History* magazine, famed astrophysicist Neil deGrasse Tyson writes "Knowing where you came from is no less important than knowing where you are going." This idea is reminiscent of the term Sankofa, originating from the Akan tribe in Ghana, which means to "go back and get it," in other words, bringing knowledge and experiences from the past into the present. Early in my undergraduate career, I decided to embrace these concepts in my engineering, tying my Black identity and low-income upbringing into my projects. My technical capstone involved producing a preliminary design concept of a CubeSat to analyze real-time weather conditions for roadways. Influenced by underrepresentation in my field, I decided to use my voice to analyze an issue related to the design and implementation of this CubeSat that impacts Black communities. I singled out the roadway infrastructure analysis component of the capstone, and, after preliminary research, found a link between American segregation and the development of highways and interstates. This link led me to pursue actor network theory (ANT) as a tool to evaluate the negative impact of the development of roadway infrastructure on Black communities.

In the technical portion of my capstone, I worked alongside my peers in the Spacecraft Design course to create a satellite solution to Virginia's roadway infrastructure and traffic problems by improving roadway safety in adverse weather conditions and efficiency in relaying information to drivers. The solution called the Commuter Live -Yield Traffic Observation Network (CLAYTON), involved a network of 24 6U CubeSats for monitoring real-time weather data. I worked on the power, thermal, and environment team, evaluating how the conditions of orbit impact the thermal systems and devising possible environmental protections, and

determining the power requirements and battery necessities. We developed a power flow chart and made selections for solar panels and batteries to power the system.

Throughout the project, I asked myself how I can use my knowledge and experiences to tie the proposed CubeSat design together with its possible societal impacts as a sociotechnical system. I was raised in Atlanta, Georgia, south of I-20. A racial demographic map of the city shows that south of Interstate 20 is majority Black while the north is majority White. It was in high school where I noticed the disparities between the two parts of the city. Lack of access to healthy foods, failing infrastructure, and fewer school resources were among them. With my STS research, I sought to understand how the interstate through the city was effectively a racial border that caused the disparities I saw. I explored case studies involving specific cities to understand how roadway infrastructure impacts segregation and influences inequality through the lens of actor network theory. Through this exploration, I found that highways and interstates were intentionally designed and implemented to physically reinforce preexisting racial barriers and to destroy or alienate existing Black communities.

Working on these projects deepened my understanding of how aerospace engineering projects can impact society and how diverse perspectives can add new levels of understanding to our work. I constantly face ethical dilemmas within aerospace engineering, with many of the jobs and projects being utilized to support the military-industrial complex. I often ask myself how I can justify my participation in a profession that supports violence. Our development of a satellite concept that can be used in the analysis of infrastructure to benefit society, providing weather information to average citizens to improve their daily lives and safety, was a relief. Integrating my own experiences and beliefs to analyze the impacts the project could have on disadvantaged communities, and how it could be positively implemented to analyze biased infrastructure

patterns was inspiring as well. It is important to incorporate your own cultural experiences and to understand ways that established projects can positively impact and solve problems in communities. My advice is to always bring your true self to the table. Engineering is about problem-solving; Different experiences and upbringings allow problems to be identified for engineering solutions.

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