Thesis Project Portfolio

High Resolution Satellite Imaging of Nitrogen Dioxide from Low Earth Orbit

(Technical Report)

Smart Cities: An Inspection of Cybersecurity Vulnerabilities and Prevention

(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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Sociotechnical Synthesis

The topics of my technical and STS theses differ very much. My technical research deals with satellite imaging of nitrogen oxides to allow for better knowledge of NO_2 sources over major cities while my STS research deals with smart cities, the vulnerabilities within them, and the response from policy makers and companies to the rising problem of cybersecurity. The choice to deal with nitrogen oxides through satellite imaging was interesting to pursue because the research that could come out of this project can help give a better idea of emission hotspots as well as better spatial imaging of nitrogen oxides over major cities. The cybersecurity part of my STS research was important to do because it is a problem that affects a vast majority of people today. With the rise in devices that are connected to the internet and collecting data the vulnerabilities to cyber attacks are also rising, so to see how laws or regulations as well as business practices are changing to this new digital landscape was important to research.

The primary objective of the technical thesis was to develop a spectrograph that is suited to be in a 3U CubeSat bus that can measure nitrogen dioxide columns at spatial resolutions better than one square kilometer. The data that is collected will be used to improve the understanding of NO_2 emissions and concentrations of urban landscapes. The secondary objective of this project was to further develop this educational program that connects a wide range of majors here at UVA. This project was a continuation of the same 3U CubeSat project that the 2019 graduates had worked on last year and this project will continue past this team's graduation in 2020 and into 2021.

The STS research portion dealt mostly with cybersecurity vulnerabilities within smart cities and how the world is reacting to this constantly changing problem. The three main vulnerabilities addressed were infrastructure within cities that can be compromised through their

computer control systems, the susceptibility to attacks through poorly protected edge devices, and the extensive use of wireless communications. These problems are not unique just to the US but are problems all around the world so these vulnerabilities were addressed in multiple countries. The solution to these vulnerabilities were looked at in two different categories. Those being the government or policy side of things and the commercial and business side. The government and policy side of things mostly dealt with US and UK laws and regulations that have recently been passed or proposed that show how these two different governing bodies have been dealing with these vulnerabilities. The commercial and business side looked at companies like IBM that started an educational program to help people in local governments and businesses become more aware of these problems and how to be more prepared for them if they need.