Thesis Project Portfolio

Design of a Thermal Conductivity Measurement Device for Cryogenic Applications

(Technical Report)

Engineering Undergraduates and the Moral Compass: How to Empower Students to Pursue Careers in line with their Ethical Code

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

The technical component of the undergraduate research addresses the accessibility and simplicity of material testing for semiconducting materials in cryogenic temperatures. Cryogenic testing is vital for supporting quantum computing research and expansion, as quantum computing chips operate in extremely low temperatures to manage delicate quantum states. The device, designed to be inserted into a dilution refrigerator, used a temperature sensor to complete thermal conductivity measurements on a semiconductor material sample. The final design improved on past iterations by relying on a stainless-steel rod for structural rigidity, durability, and precise placement of material in the vacuum. Over the past school year, the capstone team completed vacuum and room temperature testing to verify the structural integrity and functionality of the design. Although the widespread adoption of quantum computing promises many improvements for consumers, such as increased encryption strength, massive investments into quantum have been funded by defense contractors looking to leverage the emerging technology. Similarly to the rapid adoption of artificial intelligence, it is extremely important to grapple with the omnipresent influence of the Military Industrial Complex (MIC) over technology adoption, financial capital, and career pipelines.

The ethical component of the undergraduate research paper investigates engineering student career pipelines to the MIC, and how engineering ethics education (EEE) can help students make more virtuous career decisions. The research compared the impacts of deontological ethics (individuals shall adhere to explicit rules to determine moral decisions), and virtue ethics (individuals shall adhere to their personal and virtuous character traits to make moral decisions) on students' personal identity as an engineering professional. I collected data for my research project by conducting a workshop with UVA Engineering students, asking participants to rank virtues from the most to least significant, and encouraged reflection on their personal experiences

with EEE. Qualitative and quantitative data illustrated that engineering students are guided by the pursuit of helping other people, but a microethical view of their work demonstrated an apprehension towards more brave workplace decisions. Although it was originally categorized as a deontological virtue, responsibility was ranked as the most important virtue and was discussed by participants as a more virtuous value. Student rankings of virtues were driven by an overarching belief that engineers do not have much autonomy in their work decisions. Participant responses illustrated how students can identify the importance of virtue but are unsure on how to apply these values to their careers on a macroethical level. Hopefully, this research will continue to drive momentum towards virtue ethics-driven EEE, better preparing engineering graduates to make career decisions in line with their moral code.