Thesis Project Portfolio

Harvesting Wind Energy via the Triboelectric Effect
(Technical Report)

Understanding Hype in Innovation: An Artificial Intelligence Case Study
(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

My thesis project seeks to design a novel technique for generating renewable energy using the triboelectric effect and to understand how hype and perception affect the responsible development of new technologies. My technical project examines the design process of a wind generator powered using the triboelectric effect, an unconventional method of collecting energy. This physical phenomenon allows electricity to be collected when varying materials come into contact, enabling new and creative methods in energy production. My STS paper builds an understanding of hype and its effects on developing technologies, exploring it in artificial intelligence as a case study. Through this research, I examine hype's role in climate efforts, economics, and technological development using the frameworks Gartner's Hype Cycles and Sarewitz and Nelson's Three Rules for Technological Fixes. This technical project and STS paper demonstrate the design process of a novel wind generator and explore how hype affects the success of similar new technologies. Together, these works show innovation as a practical design process and as a phenomenon that must be mindfully cared for.

My team's technical project focuses on building a wind-powered triboelectric nanogenerator (TENG). Utilizing triboelectricity, a phenomenon in which two materials exchange charge through contact (static electricity is a common example), low-velocity wind is converted to usable energy. This technical project presented unfamiliar challenges, as previously, few have attempted to use TENGs to charge batteries, and none have used wind energy to do so. Overcoming these challenges was accomplished in three steps: converting wind into mechanical motion that creates repeated contacts, using these repeated contacts to generate surface charge, and transforming that charge into usable electricity. This project primarily explores the first step, generating cyclical motion. Two main approaches were used: a series of leaf-like structures inspired by tree leaves moving in the wind, and a pinwheel-like design in which blade tips made from a triboelectric material would repeatedly contact another surface. Generating surface charge is accomplished when two triboelectrically opposite materials come into contact. To maximize efficiency, we tested different materials, determining which would be the most effective based on the charge generated and material properties. Once this was accomplished, the final challenge was converting this surface charge into usable electricity. This was achieved by creating a conductive pathway between the two materials before utilizing a rectifier to convert sporadic voltage spikes into a constant, steady voltage. Through iterative design processes, the desired outcome of generating a stable voltage was achieved by multiple methods, demonstrating the efficacy of triboelectricity as an energy source. This accomplishment showcases a meaningful improvement to current TENG technologies and displays the potential within the burgeoning field.

My STS paper explores the interplay between hype and innovation, drawing from artificial intelligence as a case study. I first examine Gartner's Hype Cycle framework, an analytical tool describing how new technologies develop in terms of expectations over time. I then explore the potential drawbacks of excessive investment in these technologies and the interplay between economics, innovation, and climate efforts. Contemporary artificial intelligence is then used as a case study in exploring how technologies interact with hype cycles. After building a history of AI and analyzing it through tools established in the paper, I construct a multifaceted understanding that can be analyzed with Sarewitz and Nelson's Three Rules for Technological Fixes, a framework that examines the grounds on which a technological fix is effective. Upon completing this analysis, I discuss the dangers of inflated expectations on developing technologies and explore how to temper these expectations and responsibly manage their development. By examining the role of hype in technological success, this work demonstrates the need for responsible development grounded in self-critical analysis and pragmatic goal-setting.

The interplay between my technical project and STS paper was interesting, each exploring the faults of, and adding dimensionality to, the other. Concurrently researching the role of hype in the success of new technologies and designing a novel power-generating method allowed me to deeply understand the lifecycle of innovation. By developing a triboelectric nanogenerator, my technical report explored the early stages of building innovative technologies, while my research paper enabled me to understand our responsibility to these developments throughout their lifetime. My STS paper reminded me not to fall for the hype-driven mystification of new technologies like artificial intelligence, and instead see them as progressions of former work capable of creating value under reasonable expectations. At the same time, working on an emerging technology in my technical report tempered unhelpful pessimism towards, and encouraged excitement regarding, innovations. In aggregate, these works explore innovation as something we must both enact and foster in its infancy and mindfully care for in its upbringing.