Thesis Project Portfolio

Is Cubic + Octet an Ideal Material Geometry for Impact Resistance?

(Technical Report)

Sports Helmet Impacts and Their Relationship to Traumatic Brain Injury

(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

The technical capstone research addresses the capabilities of foam structures in a sports application by assessing a specific geometry and its potential for high energy absorption. By optimizing the geometric shape of a liner, it can allow for increased energy absorption and distribution when the compressibility is assessed. This research can also be applied to other applications including sports helmets, packing materials, construction, and insulation. To address this problem, the use of 3D printing to create pucks that simulate a specific foam geometry shape was created to test and compare to a current liner consisting of a cylindrical lattice within a football helmet. The use of 3D printing and Additive Manufacturing has made it easier to create more complex geometries to implement in lattice structures which can be used as liners within a helmet's energy-absorbing system. It is important to consider the human and social dimensions of this technology because it has the potential to further protect a specific group of people while also influencing products like it such as helmets for other sports and motorcycle helmets. Ensuring the safety of athletes at all levels is important due to the risk of head injury and helmets are found in many other settings in which this research can benefit. Actor-Network Theory is applied to this research due to the many actors contributing to ensuring the effectiveness of a football helmet such as researchers, medical professionals, and football players themselves. Literature review played a major role in conducting the STS research as plenty of prior research has been done on helmet safety, the effect of playing surfaces on helmets, and how rule changes have contributed to player safety. The question being investigated is, what is being done to make football safer and is it enough? By analyzing different sources, a research-backed opinion was able to be developed on sports helmets and their relationship to traumatic brain injuries. Through my STS research, I expect to identify an area in which player safety, with a focus on helmets and the physical impacts they experience while being worn, has fallen short and what is being done to make football safer.

Together, the technical capstone research and STS research intertwine through the importance of the structure and function of football helmet parts. The technical research aims to optimize the material geometry of foams to improve its application in football helmet liners while the STS research analyzes the relationship between sports helmet impacts and traumatic brain injuries. The implications of the technical research can help contribute to the increased efforts of safety being analyzed in the STS research regarding helmet safety.