Thesis Portfolio

Voxelated 3D Bioprinting Highly Organized Yet Heterogeneous Tissue Constructs
(Technical Report)

The Classification of Bioprinted Organs and Its Legal and Societal Consequences
(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

3D bioprinting is an exciting and innovative technology in the field of tissue engineering with far-reaching applications in science and medicine. Over the past few decades, 3D bioprinting has rapidly advanced from printing medical implants with inert and inorganic materials to printing whole tissue constructs with living cells and biological components. With my technical project, I was able to work with the Soft Biomatter Laboratory at the University of Virginia to further study and develop a new 3D bioprinting method using 0D voxel hydrogel particles to create more highly organized and heterogenous tissue constructs compared to conventional methods. Though our project pertained to only a small and specific aspect of the overarching innovation of this 3D bioprinter, we hope that this novel technique will prove useful in tissue engineering more complex tissue constructs that can fully mimic native tissue to a level that was previously unattainable.

With this possibility of biofabricating and replicating human tissues and organs, there are many implications that have not yet been addressed. Though there are many applications of tissue engineering, such as drug development, tissue modelling, and regenerative medicine, one of the main goals of this field is to create whole organs that can address the growing organ donor shortage. However, as the notion of synthetic organs has not been tangible until recent years, many ethical issues are being raised about its wide-spread use. The largest issue looming over our heads as this technology emerges for the public is how it will be regulated. This is why I focused my STS research on the legal and societal implications of how 3D bioprinted organs are defined and classified. Governmental and legislative bodies have had a poor track record with keeping up with the rapid changes in technology, such as in the IT industry, and 3D bioprinted

products are no different. How bioprinted organs are defined and classified will play a critical role in how they will be regulated and how it will be introduced to society.

Though the ability to save lives by biofabricating organs seems like a revolutionary and welcomed technology in medicine, there are still many stakeholders outside of the scientist and patient. With such a new and groundbreaking technology rapidly coming into the market in the coming years, it is important to collectively determine what this technology will mean for society. From an engineer's viewpoint, the solution as to how to define and classify bioprinted organs seemed simple, but in order for this technology to be accepted and used in society, there are so many more viewpoints outside of science and engineering to consider, making the answer much more complex and multi-layered. Beyond this thesis, I hope that when the time does come when 3D bioprinted tissues and organs are available for wide-spread use, these various issues do not come in the way of patients being able to access this life-saving treatment, nor allow others to abuse the technology.