

Thesis Portfolio

Voxelated 3D Bioprinting Highly Organized Yet Heterogeneous Tissue Constructs

And

The Rise Of Anti-Resistant Bacteria In China, Sweden, and United States

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

Bioprinting is an emerging field where 3D printing technology is utilized to produce tissue and organs similar to natural human body parts(*BIOPRINTING | Definition in the Cambridge English Dictionary*, n.d.). Through the use of an additive manufacturing process, where biomaterials such as growth factors and cells are combined, 3D tissue constructs can be made to mimic the micro and macro environment of human tissue. This can potentially reduce the need for organ donors/transplants(Vijayavenkataraman et al., 2018) and be used for drug testing and clinical trials. Although there have been established methods (extrusion-based printing, inkjet printing, and stereolithography) that have had varying degrees of success in creating tissue constructs, there are limitations in controlling cell distribution and density due to the variability in bulk printing and difficulty in reaching deep regions of the construct due to small pores(Vijayavenkataraman et al., 2018). This has led to challenges in building a construct that can fully mimic the highly structured microenvironment of tissue that would normally be seen *in vivo*(Gillispie et al., 2020). Nearly all extrusion based 3-D printing methods print 1-D filaments, which are then stacked to create 3-D tissue constructs. However, this leads to a lack of porosity and thus limits nutrient transport essential for cell growth.

One ethical/societal issue that may rise as bioprinting evolves and advances, is the risk of widening the socioeconomic gap in medical treatments. Currently, new technology and personalized therapies, such as gene therapy and cancer treatments are expensive and are not widely accessible to the general public. 3D bioprinting may run into the same problem of only

being accessible by people who can afford it. However, the technical subject of the STS prospectus and the technical topic for the Dept. of Biomedical Engineering is **not related**

Antibiotics are medicines that are used to treat once deemed incurable bacterial infections. They have saved the lives of millions, but are in danger of being obsolete. Currently, the rise of antimicrobial resistance (AMR) is occurring throughout the world and if not properly addressed, may leave us in a worse state than before the invention of antibiotics. There are a variety of reasons that have led to the abuse and inappropriate use of antibiotics that will be discussed in depth later in this paper.