3-D Bioprinting
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Abstract—Through tissue engineering it has become possible to grow cells, tissues, and organs. Through the use of 3D printing technologies and biomaterials, advancements in engineering of living cell matter have been made. These advancements hope to propel the medical field into a new age.

I. INTRODUCTION
Throughout the years people have searched for a method of treatment for cancerous, tumor filled organs. Through the use of 3-D bioprinting organs may be printed using cells that are taken directly from the patient leading to a lower rejection rate. Since every ten minutes another person is added to the national transplant waiting list and 120,000 men women and children are awaiting organ transplants pressure has been put onto scientists and engineers alike to solve this problem.

Bioprinting seems to be the most promising option as cell viability is has shown to be high. This method of tissue engineering allows not only for the creation of organs, but also has shown to be affective in creating more accurate drug screening. Printed scaffolds may also be used for the regeneration of joints and ligaments. [1] Three-Dimensional Printing, or “stereolithography”, is the process of depositing materials in layers to form 3D objects. [2] “Bioprinting” involves the use of modified 3D printers, enabling them to print biological materials. Advancements in this technology, along with biomaterials, will allow a patient’s own cells to be used to build replacement tissues & organs for those in need.

II. METHODS
Bioprinting has several methods that have proven to be effective each with their own pros and cons. With that in mind these methods are not to be compared as to which is necessarily better but rather how to use them together to form complex tissues with the highest viability. Inkjet, Laser powered, and extrusion based bioprinting are the three main methods of bioprinting used today.

The process in which the “printing” of these tissues involves: imaging, Design approach, Material/Cell selection, Printing and Application. [4] Imaging of the environment of the damaged tissue is helpful in the design process, and involves the use of X-ray, CT scan, & MRI imaging. Minitissues are the smallest structural & functional components of a tissue, like a kidney nephron. These are used in both “Biomimicry” & “Self-assembly” techniques. “Biomimicry” is the design and production of materials, structures, & systems that replicate biological entities and processes. “Self-assembly” involves replication similar to that of embryonic organ development, where the cells direct their own composition, localization, functional, & structural properties of the tissue.

Depending on the function of the tissue, Biomaterials from Synthetic/Natural polymers and ECM are used with the cell source. Differentiated cells can be deposited with each other in patterns that represent the native tissue, or stem cells are printed and proliferate as necessary. After being printed tissues are either cultured in vitro where they mature, or in vivo where they can be deposited into the patient immediately.

IV. DISCUSSION
Bioprinting is just one of many approaches to a growing problem effecting people everywhere. One day this practice hopes to grow entire organs for those in need. The biggest challenge of Bioprinting is rigging modern day printers that use nonliving materials such as plastics and metals to dispense living cells. This process of “bioprinting” must also achieve the reproduction of the complex shapes & patterns of the micro-architecture of extracellular matrix components & different cell types in a high enough quality to allow for biomimicry of the required function(s). [5] Finding “bio-ink” that is compatible with biomaterials & the 3D printing process, and can provide the needed mechanical & functional properties for bioprinting tissue is an issue being worked towards in this field.

References