The growing demand for organs is placing pressure on both doctors and patients on waiting lists. The gap between the number of organ donors and the number of organ recipients has caused doctors to look for alternatives, one of these is bioprinting.

Bioprinting is a growing field in tissue engineering which utilizes computer controlled three-dimensional printers for rapid and high-precision construction of three-dimensional biological structures. There are three main types of bioprinters: a. Inkjet bioprinter: involves the use of actuators to control the motion of inkjectors, b. Microextrusion bioprinter: uses three different pistons to print large organs, c. Laser-assisted bioprinter: uses a laser beam to saturate the biomaterial forming the “print”.

Situation

Table 1: Disparity between required and donated organs (USA) [1]

Problems

Compared with non-bioprinting, 3D bioprinting involves additional complexities that must be addressed:
1) The need to find suitable biomaterial for printing the organ, that will ensure the proper functioning of the organ,
2) Difficulty in printing thin blood vessels and organs with a long life span,
3) Expensive and time-consuming depending on the organ printed.

Table: Disparity between required and donated organs (USA) [1]

<table>
<thead>
<tr>
<th>Year</th>
<th>Waiting List</th>
<th>Transplants</th>
<th>Donors</th>
</tr>
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<tbody>
<tr>
<td>1991</td>
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<td>2004</td>
<td>29,830</td>
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</table>

![Figure 1: Different bioprinter models [2]](image1)

Bioprinting is an evolving tissue engineering technology. It utilizes computer controlled three-dimensional printers for rapid and high-precision construction of three-dimensional biological structures [3]. There are three main types of bioprinters:

1) Inkjet bioprinter: involves the use of actuators to control the motion of inkjectors, which are then extruded to form the desired structure.
2) Microextrusion bioprinter: uses three different pistons to print large organs, which are then extruded to form the desired structure.
3) Laser-assisted bioprinter: uses a laser beam to saturate the biomaterial forming the “print”.

![Figure 2: Organs and time required to print [3]](image2)

Evaluation of Solutions

There are three basic types of 3D bioprinters that provide different printing options ranging from relatively affordable to expensive.

1) Printing quality
   - Inkjet printers have wide error margins
   - Microextrusion bioprinters are able to print high cell densities with high precision
   - Laser assisted bioprinters are the most accurate and precise bioprinters to date

2) Printing speed
   - Thermal inkjet printers are relatively slow
   - Microextrusion bioprinters print at a relatively convenient speed
   - Laser assisted bioprinters are very fast

3) Practicality
   - Advanced replacement tissues are being researched and are still in the experimental stage. Currently, bio-printing is used in operations such as supplemental tissues, that aid regeneration.

![Figure 3: Layering Process [4]](image3)

![Figure 4: Different types of bioprinters [2]](image4)

References