

# Digital Image Processing Techniques Enabling Bioprinting

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Bioprinting is a recent concept that comprises a large number of techniques and applications. It allows the fabrication of complex three-dimensional (3D) structures, such as customized implants for patients, through printers by an additive deposition of biological material. Although it is a new technology, the field of bioprinting has advanced rapidly.

Tissue spheroid deposition for organ printing [6] is a biofabrication approach that employs cell aggregates as its bioinks. This process requires high accuracy and correct manipulation of cells that constitute the tissue spheroid and the biomolecules, which are essential for the viability, proliferation and cell differentiation/maturation. Such properties can be ensured through the use of image processing techniques [2].

For the result analysis, it is necessary to acquire images at various scales, where each image scale can be obtained by different imaging techniques. Medical tomography images can be used for shape analysis, microtomography images [7] for the analysis of cell structures, whereas nanotomography images [3, 5] for protein analysis. Figure 1 illustrates our idea. Nanotomography and microtomography images typically occupy hundreds of gigabytes, which demands efficient data structures to support multi-resolution and a parallelizable computational architecture.

An image pyramid [1] is a multi-resolution [4] representation that allows information to be stored, processed and analyzed at different levels of details. Furthermore, since distinct imaging modalities can provide complementary information, such hierarchical structure offers advantages in dealing with structures at different sizes or viewpoint.

**Keywords:** Image processing, bioprinting, medical imaging, multi-resolution pyramid.

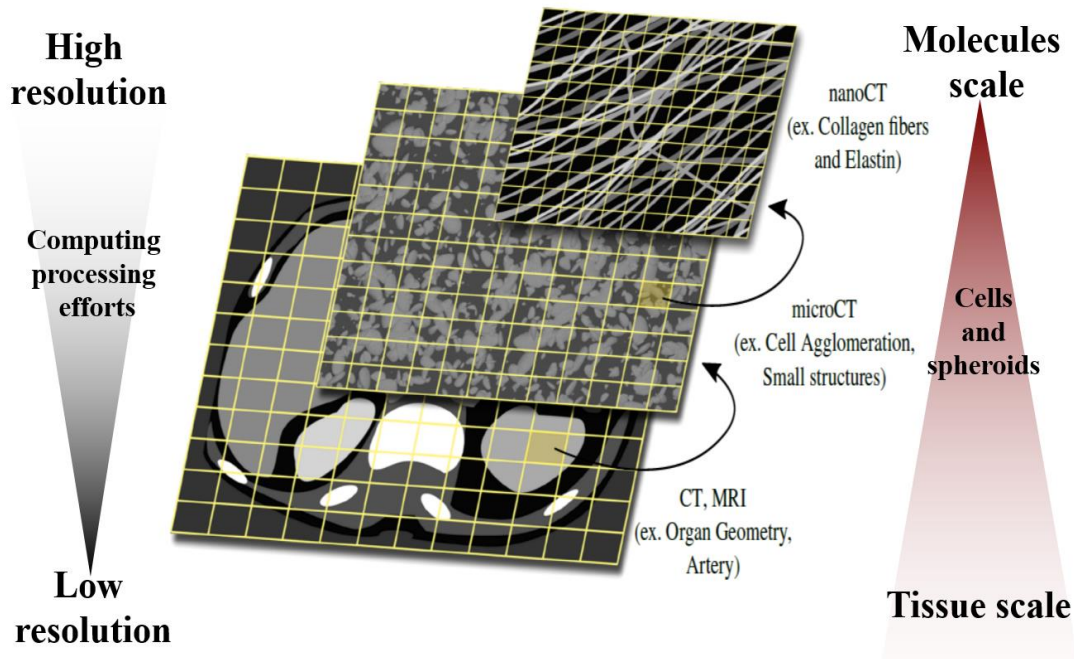


Figure 1. Concept of a pyramid data structure with images from different modalities

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