

1 Summary of the Master Thesis

This document is a summary of the master thesis "Voxel 3D printing and bioinspired bimaternal attachment" by Quentin Grossman in the master studies of "ingénieur civil biomédical, à finalité spécialisée (AMUBIO009901)" for the academic year 2018-2019. The promotor is Davide Ruffoni and the work was done at the university of Liège.

Today additive manufacturing is developing very fast and has reached a level of technology that allows to investigate deeper the understanding of the structures that it is possible to create with this method. It is especially interesting because of its ability to print multimaterial at once with complex architectural structure as the ones present in biological livings. This work investigate voxel 3D printing of material jetting type of printer as well as how to improve bimaternal attachment using this voxel printing. For the voxel printing, an investigation on quality of elongated features of size close to the voxel size depending on the printing direction is conducted. Samples are printed using a Stratasy Objet260 Connex 1 and then polishing to be looked at with an optical microscope. Results are there is anisotropy in the quality of the elongated features : those printed along the printing direction are of better quality than the one printed perpendicular to it. Another anisotropy was observed revealing that the less present material was actually behaving like an inclusion in the base material resulting in elongated inclusions stacked on top of eachother. Concerning bimaternal attachment, three designs differing from the gradient transition strategy at the interface : one with no gradient (flat interfac), one with a vertical gradient and one with a vertical gradient. They were printed and tested to extract their mode I fracture energy. The results are that the sample with horizontal gradient presents the highest fracture energy followed by the flat interface one and at last by the vertical gradient. Post-failure analysis revealed that there is a repeating defect pattern at the bimaternal attachment of the both gradient samples but it matters only for the horizontal one. There it is inducing a serration in the graphs of the fracture energy and the sample can be considered as having an alternation of homogenous material properties at its interface. The conclusion are that the printing method of this technology induces a strong anisotropy in the printed structures and that the use of gradient transition for improving bimaternal attachment is a promising field but requires still a lot of investigation and understanding of the software of the 3D printer.