Osseointegration Structures

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

Additive manufacturing allows to print structures which promote osseointegration of an implant into the bone. In this project, software to apply osseo-integrative structures to implants should be improved and further developed.

This is done by means of Blender scripting, i.e. a Python Add-on which was integrated to Blender by means of the scripting platform that this 3D computer graphics software provides.

Background and Motivation

In a previous work, a Blender script/Add-On was developed which enables the insertion of osseo-integration structures in existing parts. Besides, the shape of osseointegration structures must be optimized for Fused Layer Manufacturing (FLM) printing. This requires taking the required paths during printing into account, when generating the osseo-integration structure. Furthermore, the Add-On must allow for parametrization and the osseo-integration structures must follow the geometry of the underlying part.

However, the existing script does not yet allow to crop the desired ROI. In addition, it presents several issues which should be improved:

- When defining the inner path (the filling) of the part, the Add-On fails to draw sharp edges in a consistent manner, resulting in an abnormal twist when turning around.
- The resulting dimension of the part is slightly modified by the algorithm because of internal computations and adjustments and thus it does not comply with the user input anymore.
- Non-convex cross-sections are impossible to print in a continuous manner with this Python script.

The prototypes are printed with the company's own printers, using PEEK. Kumovis develops printing solutions to enable medical technology companies and hospitals to manufacture patient-specific medical devices and small series products. The company offers a variety of resorbable and other polymers in addition to the well-known PEEK for fused layer manufacturing in medicine.

Student's Tasks Description

The student should find an appropriate solution for the above stated problems. This is:

- Enabling the cropping of the ROI. For this the student should get familiar with boolean_tools, a Python Add-On for Blender which allows for this manual type of segmentation.
- Find a reliable strategy to handle sharp edges in the osseo-integrative structures.
- Fix the dimensioning by default which the algorithm introduces to the part.
- Try to find a solution for the non-convex type of structures. Propose a new way of designing the path or changing the printing strategy.

Besides, the student will be supported to test the outcome of the newly designed code in order to see the real effect of the implemented changes. Thus, the student should be able to apply changes to the code accordingly, so that the printing complies with the required features as accurately as possible. The

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printed outcome of the osseo-integration structures allows to improve the path strategy.

When finished, the student should be able to:

- Develop a software with the given tools.
- Have an insight of how a 3D computer graphics software scripting such as Blender's works.
- Be familiar with the osseo-integration concept and related fields, and how it can be affected by the coding and printing strategies.
- Be familiar with the type of implants which would benefit from the osseo-integration or would need it in order to minimize the rejection response from the immune system.
- As soft skills, self-organization and time management will be acquired in order to have satisfying results for the project in due time.

Technical Prerequisites

- Blender
- Python (bpy, bm)
- Printer R1/HTRD for testing of printability of the generated structures

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