

## EXTERNAL EXAMINATION OF MASTER THESIS

Master thesis: **Accuracy analysis of additive manufacturing of 3D printer using optical digitization**

Student's name: **Phaneedra Mantada**

Opponent's name: **Ing. Martin Frkal**

The main aim of this thesis was to analyze accuracy of different 3D printing technologies. Data collection should have been obtained by non-contact method. The thesis is divided in two parts. First – theoretical part - which continues freely to second part – practical one.

In the first part were described Rapid prototyping methods in general, beginning with manufacturing process description, material form, data conversion and post-processing. Eventually were chosen representative and available printing technologies of a different manufacturing systems (based on liquid, solid and powder base) including typical material characteristics. Chosen methods were also described well and in understandable way. Finally was very well described full procedure of 3D scanning in particular for ATOS system in TU laboratory with all complementary action.

The practical part consists of very detailed dimension analyze of all samples. Very interesting part is comparison of samples with the time effect. For the analyze student chose typical part with a lot of appropriate shapes and different dimensions to achieve best results.

There could be more comments for methods evaluation or highlighted low deviations (in tables) at least for better overview. There are some mistakes in charts description and more than one type of chart was used – it made data comparison little complicated.

In the conclusion there the student says the PolyJet Glossy mode provided accuracy (0.127 mm) was exceeded in most of the times, but according to presented result I can see just 3 of 55 items are out of spec, the rest is OK, so this is confusing. And surprisingly there is no final table of complete comparison for each printing method to declared values. And for more I don't agree with student that the PolyJet Matrix glossy mode has all the better results – regarding provided tables is clear that lowest deviations has the SLA method.

In total this thesis respects all aims set in the assignment. Accuracy analyses were made, recommended methods were used, both in a proper way. It is a pity student didn't do any recommendation or idea what kind of shape (flat, corner, cylinder) or dimension (small, big) should be produced with what kind of method. Despite the mentioned shortcomings - I suggest this master thesis for a title challenge.

### Complementary questions

- 1) What material is used as a support material for printing?
- 2) Why we cannot place reference points in a straight line?
- 3) For the results comparison with declared values – did you subtract matting (spray) layer thickness out of evaluated values? I believe manufacturer does not count with any other layer.
- 4) Let's say the printed part is used in a close area of the common car-engine. What technology of 3D printing would you use if there was a need to replace this part? Consider temperature influence to used material, price of material and price of printing itself. Focus to total cost (just estimate), accuracy is not so important.

Liberec 12.1.2018

Ing. Martin Frkal

A handwritten signature in black ink, appearing to read 'M. Frkal', written over the printed name 'Ing. Martin Frkal'.

## ASSESSMENT OF THE MASTER THESIS

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I assess by **2 .. very good**

Liberec 12. 1. 2018

Ing. Martin Frkal

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