Surface Topography Analysis and Enhancement of Laser Sintered Parts (STEP)

Objective surface qualification values are not defined nowadays and are therefore evaluated for laser sintered part surfaces. Also, subjective haptic impressions are considered and correlated to objective values. Furthermore, the surface quality in dependence to variations of manufacturing process parameters are investigated to identify the most influencing parameters. A variety of post-processing methods are also examined according their utility for smoothing laser sintered parts. The build orientation as a main influencing factor is considered with a newly built tool to predefine the optimal orientation for good surface quality of functional areas of a part.

1. Objectives

It is known that laser sintered parts have quite rough surfaces which additionally differs on the orientation of a surface inside the manufacturing process. At the same time no useful surface quality parameters are defined for this process and how they depend on process parameters. Therefore, objective surface qualification values correlated to subjective impressions, their dependence on several process parameters and the benefit of different post-processing methods are addressed within this project.

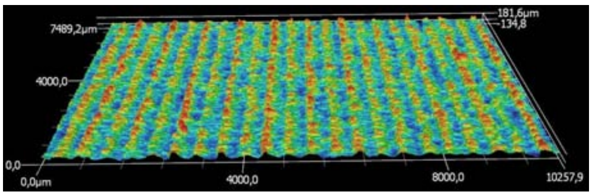

Figure 42: Exemplary 3D measurement of a 15° tilted surface. The shown field of view is used for the different analysis methods

2. Procedure

First, the identification of high potential surface characterization values and methods is done using optical 3D measurements of laser sintered parts. Both standard surface analysis values and image analysis methods known for product qualification in other areas are considered. A haptic testing setup is prepared for correlation of these values to subjective impressions of laser sintered part surfaces.

Further analyses are performed with parts build with varying manufacturing process parameters. Machine parameters (e.g. layer thickness, laser and scanning parameters, build temperature) as well as powder quality (virgin powder vs. used powder) and geometrical factors (e.g. wall thicknesses, surface orientation, spatial position, part distance, layer time) are evaluated.

Finally, different post-processing methods like mass finishing process, abrasive blasting and chemical etching are examined according their utility.

3. Latest results

A haptic test setup was prepared to get information about subjective impressions of defined sample parts. A correlation to objective surface qualification values identified at least one of them which represents the haptic impression very well.

Analyses of parts manufactured with varied process parameters showed distinct dependencies for some parameters while other showed no quantifiable influence on the surface quality. The evaluation of parts manufactured with used powder identified parameters that reduce the occurring of orange peel effect significantly.

The findings and results of the above analyses were in addition used to build up a surface topography simulation and a part orientation optimizer. The optimizer can be used to predefine the best build orientation if some functional areas of a part need to have an optimal surface quality. Simultaneously, the build height can be considered to reduce the build time and thereby the cost of that part. The validation of the tool was done experimentally with a real part from EOS, the monitor holder which is built in at their P machines.

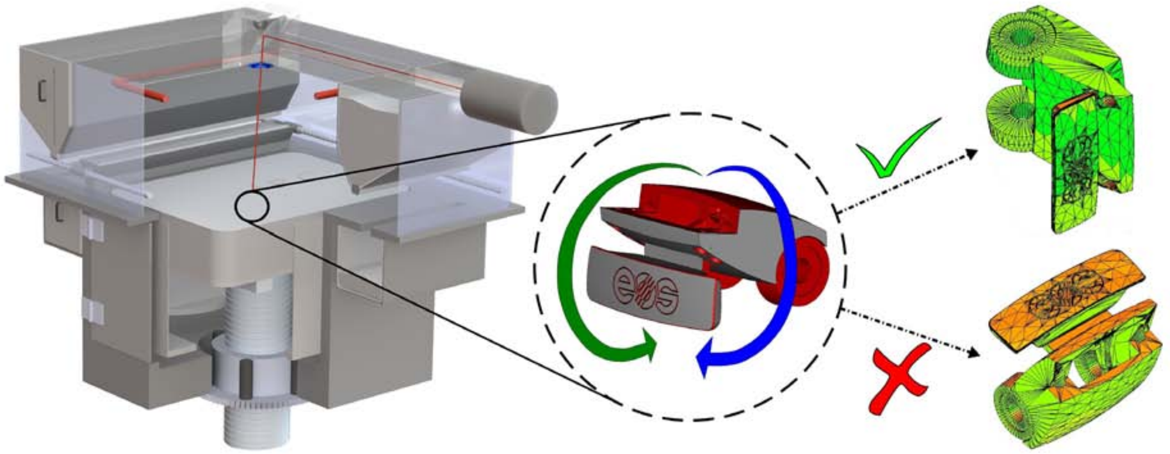

Figure 43: A part orientation optimizer calculates the optimal build orientation regarding surface quality of pre-defined functional areas and build height of a part.

4 Outlook

The project is finished this year. Also promising post-processing methods were found that need to be investigated more deeply to enable them as reproducible post-processing methods.

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