



TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. XX, Issue xx, Month, 2025

INTEGRATED STUDY OF SURFACE ROUGHNESS PARAMETERS AND DIMENSIONAL ACCURACY IN FDM 3D-PRINTED

Patricia Gabriela RAKOS, Ioana-Maria DAN, Eva Maria WALCHER, Osman BODUR
Günther POSZVEK

Abstract: This study focuses on analysing how surface quality and dimensional accuracy are affected by the measurement processes and printing parameters of a 3D-printed timing belt pulley of a Dacia Logan engine. This project is aiming to investigate how different 3D printing parameters and PLA filament brands influence surface quality while also testing the consistency of prints made with identical settings.

The parts were produced using the FDM method on a Bambu Lab A1 Combo printer, known for its high speed, precision, and automatic calibration features. Surface roughness, affected by factors such as layer height, print bed temperature, and cooling rate, was measured using a high-precision Jenoptik Waveline W912RC profilometer. The results showed that smaller nozzle sizes and finer layer heights achieved smoother surfaces, with varying nozzle dimensions of 0.2mm, 0.4mm and 0.6mm. Perpendicular measurements showed consistent values, confirming surface profile stability.

The study concluded that both printing parameters and filament brand have a measurable impact on surface roughness and that even under identical conditions, environmental factors may cause minor variations. Continuous parameter adjustment and monitoring were identified as essential for optimising surface quality, reducing defects, and meeting ISO standards for surface roughness and measurement accuracy.

Key words: polylactic acid (PLA), fused deposition modelling, surface roughness, prototyping, machine learning, 3D printing.

1. INTRODUCTION

Additive Manufacturing (AM) also known as 3D printing builds three-Dimensional (3-D) solid objects. The object is built layer-by-layer using different materials such as polymers, composites, ceramic and metallic pastes depending on the requirement using digital data from a computer.[1]

It provides a flexible and cost-efficient alternative to traditional mass production, especially for small batches of customized parts. By building components directly from 3D CAD models, it eliminates the need for tooling and molds, reducing setup time and costs. The digital nature of the process allows for easy sharing and modification of designs, supporting rapid customization. Material efficiency is another key benefit - since only the required amount of material is used, and unused materials (such as metal powders or resins) can often be recycled, overall waste is significantly reduced. AM also

enables the production of complex internal structures and geometries, such as lattice frameworks or enclosed channels, that are difficult or impossible to achieve with conventional methods. The final parts typically have low porosity, ensuring good mechanical performance. Moreover, on-demand manufacturing helps minimize inventory and financial risks by producing only what is needed, when it is needed. This decentralized model also enhances communication and collaboration between manufacturers and end users.[2]

The surface quality of the parts produced has a profound impact on local microstructure, surface irregularity, internal anomaly, product accuracy and functionality. The factors affecting the surface quality include material properties, particle size range and distribution, part orientation, layer thickness, STL file preparation, surface angle, finish type, scanning parameters and post-processing.[3]

Will be used a surface roughness measurement machine, Jenoptik model W912RC ,and this machine is a high-precision measurement system designed for comprehensive surface analysis, combining both roughness and contour measurements. This integration allows for detailed assessment of surface textures and geometries, making it particularly valuable in quality control and manufacturing processes. [4] This study presents the dimensional accuracy and surface roughness of eight 3D printed parts by Fused Deposition Modelling (FDM). [5] Four of the samples were printed using different thermoplastic materials to examine how material composition affects surface finish and dimensional accuracy. An additional three components were printed using the same material, but with varying nozzle diameters to assess the impact of extrusion width on print resolution.

The final part was fabricated using the same material and nozzle diameter as one of the previous three, but with modified print settings such as layer height, print speed, and temperature, to isolate the effects of process parameters from material and nozzle variables. Therefore, this research will concentrate on how we can optimize the surface quality and dimensional accuracy of timing belt pulleys. Proper calibration of printing parameters, combined with predictive simulations and design refinements, ensures high-performance components with minimal surface defects. By aligning with ISO, we can systematically evaluate and improve manufacturing processes.[6]

2. METHODOLOGY

To measure the roughness will be used the Jenoptik W912RC profilometer, a high precision metrology system, part of the Waveline W900 series, which includes combined measurement parameters.[3] This measurement system is ideal because it offers a resolution up to 0.6 nanometres and a measuring accuracy of 0.1 micrometres, so we can ensure detailed and accurate surface analysis. [3]

These profilometers have a stable base with precise horizontal and vertical motion, its expandable due to the axes for automated

measurements. It uses an adapter to switch between probes and the software it is using, Evolis, ensures easy operation with international surface measurement standards.

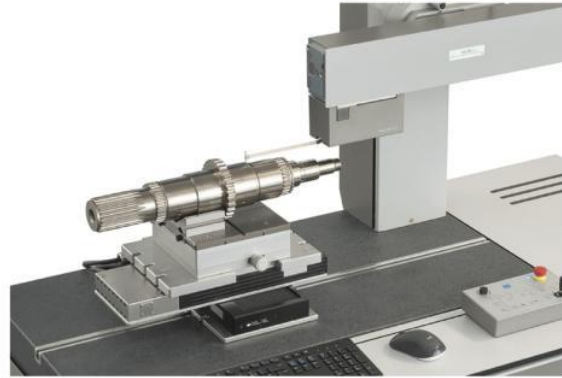


Fig. 1. Working principle of Entoptic Profilometer.[7]

Preparing a timing belt pulley for measurement involves several important steps to ensure accuracy. First, the pulley should be thoroughly cleaned to remove any dust, oil, or machining residues, as contaminants can affect measurement precision. Next, it's crucial to allow both the pulley and the measuring equipment to reach room temperature to prevent thermal expansion from distorting results. [8]

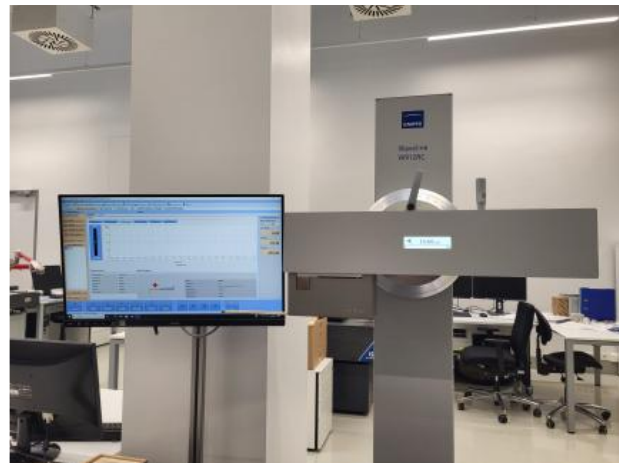


Fig. 2. Working principle of Entoptic Profilometer.[7]

The pulley must then be securely mounted on the measuring platform, ensuring it is cantered and aligned correctly, especially if a rotary axis is used for circumferential measurements. Selecting the appropriate probe such as a contour or roughness probe is essential, and the probe should be calibrated using a reference standard to verify accuracy. Proper alignment of the probe with the tooth profile is critical to obtain

accurate readings. Finally, the measurement software should be configured with the correct parameters, including scan length, resolution, filter settings, and tolerances, in accordance with the pulley's specifications.[4]

In the next phase, it was used an Alicona microscope Infinite Focus, to measure the shape, dimension, and surface roughness of this samples. They work by scanning a sample's surface vertically and capturing a series of 2D images at different focal planes. By analysing the sharpness of each pixel in these images, the microscope determines the z-location with the highest focus for each point on the surface. This allows for the creation of a detailed 3D model of the surface topography, including features like roughness and step heights.[9]



Fig. 3. Measurements of the surface fixtures with Alicona Microscope

3. COMPONENTS USED AND 3D PRINTING SETTINGS

Regarding this research, will be presented eight parts printed using FDM (Fused Deposition Modelling), with the goal of analyzing how different materials and printing parameters

influence the surface quality of 3D printed components. [5]

All parts were measured by the profilometer presented above and by an Alicona microscope, so the differences between the outcomes will be analyzed. [10]

Since the same material was used for all sections, but the printing parameters were adjusted, (particularly the nozzle diameter and layer height), the parts were divided in two groups.

The first one will be called group X and the second one Y.

Group Y is using the same printing parameters were kept for all parts, but the material was different for each one.

For Group X, the material used was Bamboula PLA Matte. The purpose of this group was to see how the nozzle diameter influences the quality and accuracy of the printed parts. Three different nozzles were used: 0.2 mm, 0.4 mm, and 0.6 mm.

Each nozzle had a different layer height: 0.1 mm for the smallest, 0.2 mm for the medium, and 0.3 mm for the largest. Two identical parts were printed with the 0.6 mm nozzle to check if the results are consistent.

The temperature of the nozzle was set at 220°C for all prints. The infill pattern used inside the part was Gyroid, with a density of 20%. For the top and bottom surfaces, the Grid pattern was used again. The slicing profile used the Arachne strategy for generating walls, and the walls were printed in the order inner first, then outer. These settings were chosen to observe how print speed and nozzle size affect the final shape of the parts. In figure 4 we can observe the parts, the upper left one was printed using 0.2ø mm nozzle, upper left 0.4ø mm nozzle and the lower ones both were printed with 0.6ø mm nozzle. The lower ones were printed using the same settings to test how consistent the printer can produce the same part. Using different nozzle diameters the print required varied, 5 hours for the part using the 0.2 mm nozzle, 2 hours 15 minutes for the 0.4 mm nozzle and 54 minutes for each part printed with 0.6 mm nozzle. In this time, it is also included the self calibrations of the printer which it does before starting a new print which are around 6 minutes.



Fig. 4. Samples from group X

For Group Y, the printing parameters were the same for all parts, and only the material was different. The nozzle had a diameter of 0.4 mm, the layer height was 0.2 mm, and the nozzle temperature was also 220°C. The infill pattern inside was Gyroid, which offers good strength in all directions, and the surface layers were printed using the Concentric pattern. The same wall generation method was used, and support structures were activated only on the build plate. Even though the printer settings were the same, each part from Group B was printed using a different type of PLA (polylactic acid) filament, coming from four different manufacturers. The materials used were Prusa PLA Galaxy Black, Bamboula PLA Matte Red, F3D PLA+ Black, and Reality Hyper PLA Blue. All materials had a 1.75 mm filament diameter, with a declared tolerance between ± 0.02 mm and ± 0.03 mm.

In figure 5 there are the parts used for Group Y, three of them were printed using Bambulab A1 combo (the upper right and the bottom ones) and the upper left one was printed using Prusa MK4. The parts made with the Bambulab printer took 2 hours and 15 minutes, and the part made with Prusa MK4 took 2 hours and 30 minutes.

The reason for making this separation into two groups was to study, in Group X, how the printer's hardware settings (like the nozzle size) affect the accuracy of the final part, and in Group Y, how different materials behave under the same print conditions.

PLA was chosen because it is a common material in 3D printing, it has low shrinkage, is stable during cooling, sticks well to the bed, and it usually gives good dimensional results in parts that do not need high mechanical resistance.[11]



Fig. 5. Measurements of the surface fixtures with Alcona Microscope

4. RESULTS

This document shows a detailed surface roughness analysis performed using the Jenoptik T8000 system, equipped with a W912RC stylus arm. The measurement was carried out on a 25 mm section of a component, and the data includes both a graphical surface profile and numerical roughness parameters based on ISO standards.

The key roughness parameter R_a , which represents the average surface deviation from the mean line, is $5.39 \mu\text{m}$. This indicates a relatively coarse surface, typical of parts that have undergone processes like rough turning, milling, or other mid-level machining operations. It's not smooth enough for high-precision fits or sealing surfaces without further finishing.

The R_z value, which captures the average peak-to-valley height over several segments, is $31.15 \mu\text{m}$. This tells us there are significant highs and lows along the profile. Combined with the R_t value (the total peak-to-valley height) of $38.35 \mu\text{m}$.

μm , it's clear that this surface has noticeable texture and variation.

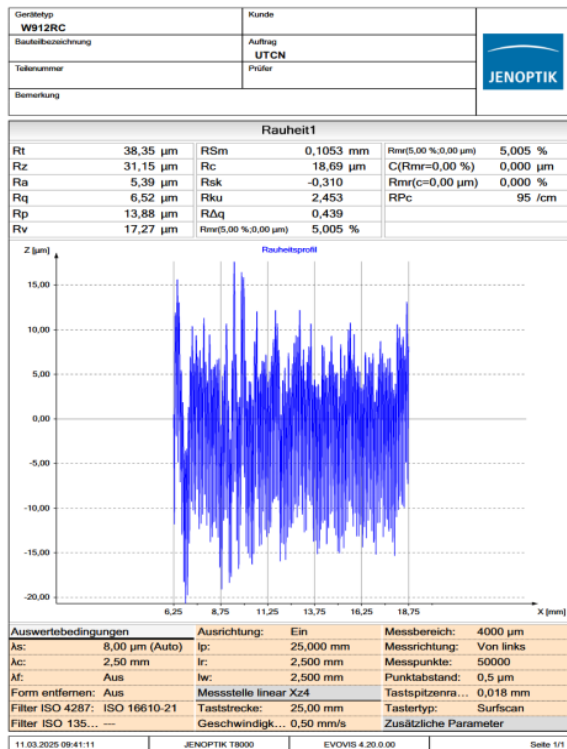


Fig. 6. Sample with 0.2 mm nozzle group X

The central graph provides a visual representation of the surface's height profile over the 25 mm length. The amplitude of the peaks and valleys varies significantly, with some features extending more than 15 microns above or below the baseline. This fluctuation confirms the numerical data — the surface is visibly textured and far from flat.

Overall, the surface quality is moderate, with some significant roughness and visible valleys. For the second component measured, the results you can see in figure 7.

This measurement report indicates a significantly rougher surface compared to the previous sample. The numerical roughness parameters reveal a surface that has undergone minimal or no finishing, and likely results from rough machining processes.

The surface shows high roughness ($R_a = 11.81 \mu\text{m}$, $R_z = 61.58 \mu\text{m}$), indicating a coarse, unfinished texture with deep valleys and peaks. Negative skew ($R_{sk} = -0.689$) suggests good lubricant retention, but the surface is unsuitable for sealing or precision fits without further finishing.

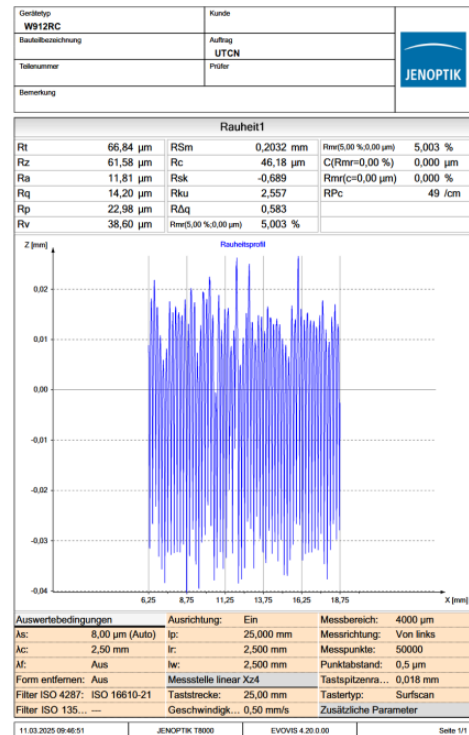


Fig. 7. Sample with 0.4 mm nozzle group X

For the third sample, we obtained the following results, you can see in figure 8.

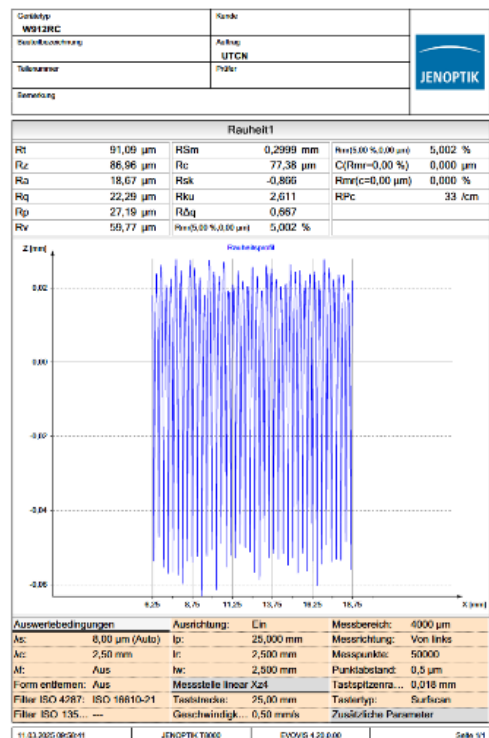


Fig. 8. Sample with 0.6 mm nozzle group X

The surface has very high roughness ($R_a = 18.67 \mu\text{m}$, $R_z = 86.96 \mu\text{m}$), indicating a very coarse,

In the next step, the measurements for the Y group were made and we can see the results in the figure below, starting with the blue part (see figure 9).



Fig. 9. Blue Part made with Bambulab A1 combo

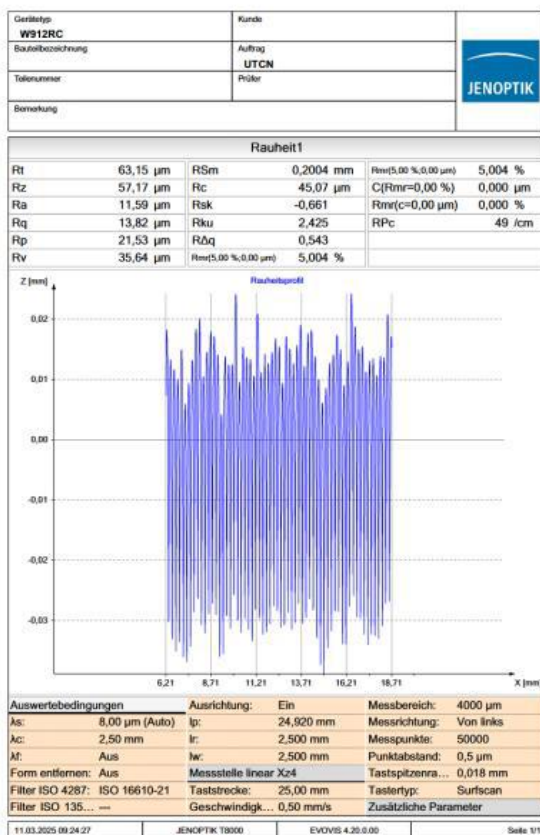


Fig. 10. Specific Report

The surface roughness report for the part made by Bambulab A1 combo shows that the measured part has a relatively rough surface, with an average roughness (Ra) of 11.59 μm and a total height variation (Rt) of 63.15 μm , indicating significant peaks and valleys.

The roughness profile graph confirms a surface with frequent and pronounced irregularities. The negative skewness ($R_{sk} = -0.661$) suggests the surface has more valleys than peaks, while the kurtosis ($R_{ku} = 2.425$) indicates a somewhat flatter texture, lacking sharp spikes. The high peak-to-valley values ($R_z = 57.17 \mu\text{m}$) and a peak count of 49/cm suggest a densely textured, non-uniform surface typical of unpolished or roughly machined components.

This level of roughness may be unsuitable for high-precision or sealing applications and would likely require additional surface finishing to meet tighter tolerances or smoother surface quality standards.

For the second piece (the black one), made also with BambuLab A1 combo, the results are shown in figure 11:



Fig. 11. Black Part made with Bambulab A1 combo

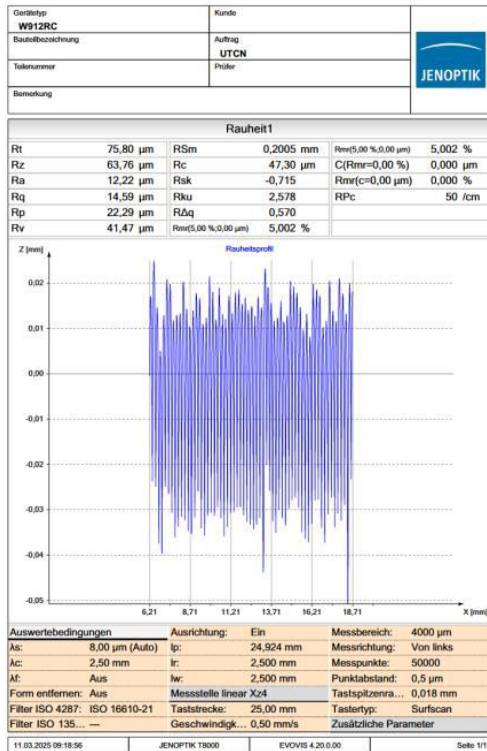


Fig. 12. Specific report

In the following, the measurements for the third part are considered (see figure 13):



Fig. 13. Sample from group Y made with Bambulab A1

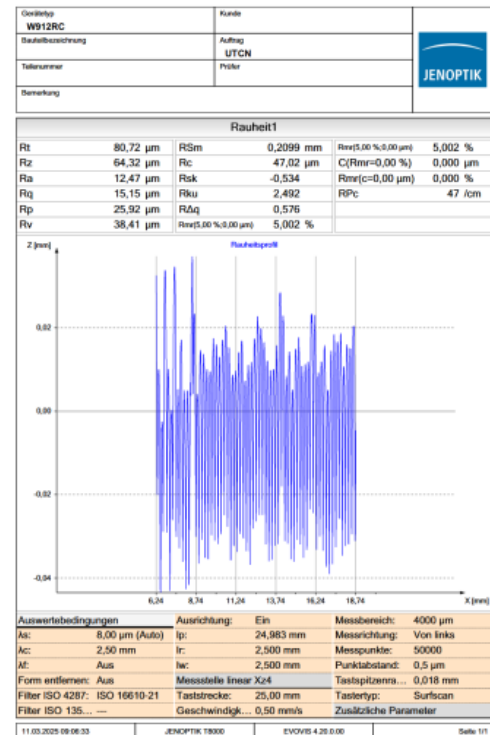


Fig. 14. Specific report

This surface roughness report shows a highly textured surface, with an average roughness (Ra) of 12.47 µm and a total height difference (Rt) of 80.72 µm, indicating deep peaks and valleys. The negative skewness (Rsk = -0.534) suggests more valleys than peaks, while the kurtosis (Rku = 2.492) points to a relatively flat texture. With a peak density of 47/cm, the surface is quite rough and would likely need further finishing for precision or sealing applications.

Regarding the last piece (see figure 15):



Fig. 15. Sample from group Y made with Prusa MK4

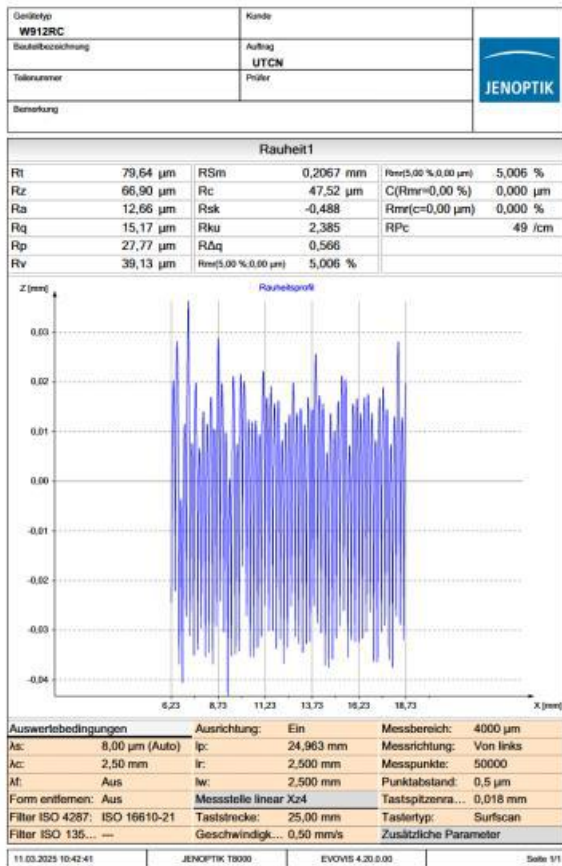


Fig. 16. Specific report

In this specific case, the surface shows high roughness with $R_a = 12.66 \mu\text{m}$ and $R_t = 79.64 \mu\text{m}$, indicating deep and uneven features. Negative skewness ($R_{sk} = -0.488$) suggests more valleys than peaks, and low kurtosis ($R_{ku} = 2.385$) points to a blunt surface texture. With 49 peaks/cm (R_{Pc}) and a spacing of 0.2067 mm (R_{Sm}), the surface is moderately dense. Overall, it's a coarse surface likely needing further finishing.

In the second part of this research, where the measurements were carried out under the microscope, we had the following parameters for the printing process as it can be noticed in Table 1, and the output results in Table 2.

The parts printed with smaller nozzle diameter and layer height (XR02) show the lowest surface roughness ($R_a = 5.39 \mu\text{m}$) but required the longest printing time (300 min). As nozzle diameter and layer height increase (XR04, XR061, XR062), the surface roughness increases significantly, but the printing time decreases. The Prusa PLA Galaxy Black (YGK) shows a balanced result with moderate surface

roughness ($R_a = 12.66 \mu\text{m}$) and a reasonable printing time (150 min).

Finer nozzle and layer settings yield better surface quality but require more time. For a good balance between quality and efficiency, the Prusa PLA Galaxy Black (YGK) seems to be more of a practical choice.

The next study aims to understand how printing parameters and material choice affect the surface quality of 3D printed PLA using FDM, with the goal of achieving good surface finish in the shortest time and allowing accurate prediction and adjustment of parameters during the printing process, providing the information's in Table 3. For Prusa PLA Galaxy Black measured with Alicona using λ_c once 2.5 mm and once 8 mm. In Table 3 can be seen that the test made with $\lambda_c=2.5$ conducted with Alicona is closer to the result obtained from Jenoptik.

Two sets of samples were tested:

- Set X: Same material (Bambulab PLA Matte Red), different nozzle and layer settings (XR02, XR04, XR061, XR062).
- Set Y: Same settings, different PLA manufacturers and colours (YGK – Prusa, YRD – Bambulab, YBK – F3D, YBE – Creality).

It's known that all samples were printed using consistent parameters: 0.4 mm nozzle, 0.2 mm layer height, 220°C, and 135 minutes for Bambulab A1 and 150 minutes for Prusa MK4. Group X used a monotonic line infill, and group Y used concentric infill.

The results indicate that the XR02 (Set X) sample achieved the best overall surface finish with $R_a = 5.39 \mu\text{m}$, while YBE (Creality) led in Set Y with $R_a = 11.59 \mu\text{m}$, highlighting that surface roughness is influenced by infill type, nozzle size, and material.

With Alicona measurements revealing higher R_a values due to greater detail, consistent printer performance confirmed by identical XR061/XR062 results, and Aksona microscope findings indicating that conventional FDM yields smoother surfaces under these conditions.

Table 1

Surface Roughness Comparison Results			
Com- parison	Parameters	Results	Insights
XR04 vs YRD	0.4 mm nozzle, 0.2 mm layer height, 220°C, 135 min	XR04 (Ra = 11.81 µm) < YRD (Ra = 12.47 µm)	Monotonic infill (XR04) produced slightly smoother surface than concentric (YRD).
XR061 vs XR062	0.6 mm nozzle, 0.3 mm layer height, 54 min	Both Ra = 18.67 µm	Confirms printer repeatability; other roughness variations may depend on profile length or method.
XR04 vs YBE	Same print settings, different materials	YBE (Ra = 11.59 µm) < XR04 (Ra = 11.81 µm)	Creality material (YBE) yielded the smoothest surface under identical conditions.
Alicona (YGK)	Surface scanned at 2.5 mm and 8 mm profile lengths	Ra = 15.65– 17.16 µm	Larger scan areas reveal increased roughness; detailed scanning detects more surface variation.

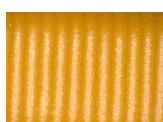
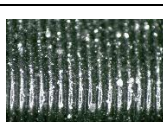
In conclusion this study proves that the same material can give significantly different results based on the input printing parameters and the manufacturer of the material. PLA is widely used in 3D printing, given his mechanical and printability properties, despite the challenges that are encountered during fabrication of semi-crystalline polymers. However this material allows a wide range of complex prototypes, reducing costs significantly. By testing on a cheaper material instead of the one used for the final product companies can reduce the amount of waste and rebuts. Testing to see which material's output properties gives the most similar surface quality as the one used for the final product are to be made once and then further prototyping is conceived using that material.

5. Conclusions

6. Anexes

Table 2

Printing Input parameters for set X

Material	Name	Microscope view	Input Parameters				Printer
			Nozzle diameter [mm]	Layer height [mm]	Nozzle temperature [°C]	Time [min]	
Bambulab PLA Matte Red	XR02		0.2	0.1	220	300	Bambulab A1 combo
	XR04		0.4	0.2		135	
	XR061/2		0.6	0.3		54	
Prusa PLA Galaxy Black	YGK		0.4	0.2		150	Prusa MK4

Material	Name	Microscope view	Output Parameters			
----------	------	-----------------	-------------------	--	--	--

Table 3

Printing Output parameters measured with Jenoptik

			Ra [μm]	Rz [μm]	Rt [μm]	Rq [μm]	Rsk	Rku
Bambulab PLA Matte Red	XR02		5.39	31.15	38.35	6.52	-0.310	2.453
	XR04		11.81	61.58	66.84	14.20	-0.689	2.557
	XR061		18.67	86.96	91.09	22.29	-0.866	2.611
	XR062		18.67	84.91	88.59	22.10	-0.784	2.499
Prusa PLA Galaxy Black	YGK		12.66	66.90	79.64	15.17	-0.488	2.385

Table 4

Comparison Prusa PLA Galaxy Black Alicona between $\lambda_c=2.5$ mm and $\lambda_c=8$ mm

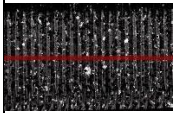
Material	Name	Alicona Microscopic view	Profile λ_c [mm]	Ra [μm]	Rz [μm]	Rt [μm]	Rq [μm]	Rsk	Rku
Prusa PLA Galaxy Black	YGK		2.5	15.6577	147.7017	138.0002	18.7117	0.0046	2.425
			8	17.1673	157.7083	152.7422	21.1148	- 0.2518	2.7061

Table 5

Printing Input parameters for set Y

Material	Name	Parts	Input Parameters				Printer
			Nozzle diameter [mm]	Layer height [mm]	Nozzle temperature [$^{\circ}\text{C}$]	Time [min]	
Bambulab PLA Matte Red	YRD		0.4	0.2	220	135	Bambulab A1 combo
F3D PLA+ Black	YBK						
Crealty Hyper PLA Blue	YBE						
Prusa PLA Galaxy Black	YGK						

Table 6

Printing Output parameters measured with Jenoptik for Y

Material	Name	Parts	Output Parameters					
			Ra [μm]	Rz [μm]	Rt [μm]	Rq [μm]	Rsk	Rku
Bambulab PLA Matte Red	YRD		12.47	64.32	80.72	15.15	-0.532	2.492
F3D PLA+ Black	YBK		12.22	63.76	75.80	14.59	-0.715	2.578
Creality Hyper PLA Blue	YBE		11.59	57.17	63.15	13.82	-0.661	2.425
Prusa PLA Galaxy Black	YGK		12.66	66.90	79.64	15.17	-0.488	2.385

7. References

- [1] K. V. Wong and A. Hernandez, 'A Review of Additive Manufacturing', *Int. Sch. Res. Not.*, vol. 2012, no. 1, p. 208760, 2012, doi: 10.5402/2012/208760.
- [2] I. Gibson, D. Rosen, B. Stucker, and M. Khorasani, *Additive Manufacturing Technologies*. Cham: Springer International Publishing, 2021. doi: 10.1007/978-3-030-56127-7.
- [3] C. Lu, 'Study on prediction of surface quality in machining process', *J. Mater. Process. Technol.*, vol. 205, no. 1–3, pp. 439–450, Aug. 2008, doi: 10.1016/j.jmatprotec.2007.11.270.
- [4] 'The Power of Light – changing the world with photonics!' Accessed: May 30, 2025. [Online]. Available: <https://www.jenoptik.com/>
- [5] R. B. Kristiawan, F. Imaduddin, D. Ariawan, Ubaidillah, and Z. Arifin, 'A review on the fused deposition modeling (FDM) 3D printing: Filament processing, materials, and printing parameters', *Open Eng.*, vol. 11, no. 1, pp. 639–649, Apr. 2021, doi: 10.1515/eng-2021-0063.
- [6] S. Stopp, T. Wolff, F. Irlinger, and T. Lueth, 'A new method for printer calibration and contour accuracy manufacturing with 3D-print technology', *Rapid Prototyp. J.*, vol. 14, no. 3, pp. 167–172, May 2008, doi: 10.1108/13552540810878030.
- [7] 'The Power of Light – changing the world with photonics!' Accessed: May 30, 2025. [Online]. Available: <https://www.jenoptik.com/>
- [8] Y. Wu, M. J. Leamy, and M. Varenberg, 'Minimizing self-oscillation in belt drives: Surface texturing', *Tribol. Int.*, vol. 145, p. 106157, May 2020, doi: 10.1016/j.triboint.2020.106157.
- [9] 'Optical 3D Metrology & Surface Roughness Measurement - Alicona'. Accessed: May 30, 2025. [Online]. Available: <https://www.alicon.com/>
- [10] 'Optical 3D Surface Roughness Measurement Instrument', Optical 3D Metrology & Surface Roughness Measurement. Accessed: May 30, 2025. [Online]. Available: <https://www.alicon.com/en/products/infinitefocus>

[11] 'FDM 3D Printing - Available Materials'. Accessed: May 30, 2025. [Online]. Available: https://www.weerg.com/fdm-3d-printing?utm_campaign=SPM250330007_LL:T OP-ENG_P:TCHS_T:0818_C:ALLC_OO:ROAS2000_K:BRAND-mix_N:noita&utm_medium=ppc&utm_source=adwords&utm_term=&hsa_mt=&hsa_net=adw

ords&hsa_ad=&hsa_src=x&hsa_cam=22384315608&hsa_kw=&hsa_grp=&hsa_tgt=&hsa_ver=3&hsa_acc=5333437716&gad_source=1&gad_campaignid=22390745498&gbraid=0AAAAADfIPzvaJ3TKQAdVZgOdMQq0jKA06&gclid=CjwKCAjwruXBBhArEiwACBRtHWwPO73xs1_2hAm4924ZkxaGFiXuW3wXrACgmrJ8k36UJTAq6AYrdxoCzMYQAvD_BwE

STUDIUL INTEGRAT AL PARAMETRILOR DE RUGOZITATE A SUPRAFEȚEI ȘI PRECIZIEI DIMENSIONALE ÎN IMPRIMAREA 3D FDM

Rezumat: Acest studiu se concentrează pe analiza modului în care calitatea suprafeței și precizia dimensională sunt afectate de procesele de măsurare și parametrii de imprimare ai unei roți de curea de distribuție imprimată 3D pentru un motor Dacia Logan. Acest proiect are ca scop investigarea modului în care diferiți parametri de imprimare 3D și mărci de filament PLA influențează calitatea suprafeței, testând în același timp consistența imprimărilor realizate cu setări identice. Piesele au fost produse folosind metoda FDM pe o imprimantă Bambu Lab A1 Combo, cunoscută pentru viteza sa mare, precizie și funcții de calibrare automată. Rugozitatea suprafeței, afectată de factori precum înălțimea stratului, temperatura patului de imprimare și viteza de răcire, a fost măsurată folosind un profilometru Jenoptik Waveline W912RC de înaltă precizie. Rezultatele au arătat că dimensiunile mai mici ale duzei și înălțimile mai fine ale stratului au permis obținerea unor suprafețe mai netede, cu dimensiuni variabile ale duzei de 0,2 mm, 0,4 mm și 0,6 mm. Măsurătorile perpendiculare au arătat valori consistente, confirmând stabilitatea profilului suprafeței.

Studiul a concluzionat că atât parametrii de imprimare, cât și marca filamentului au un impact măsurabil asupra rugozității suprafeței și că, chiar și în condiții identice, factorii de mediu pot provoca variații minore. Ajustarea și monitorizarea continuă a parametrilor au fost identificate ca fiind esențiale pentru optimizarea calității suprafeței, reducerea defectelor și respectarea standardelor ISO privind rugozitatea suprafeței și precizia măsurătorilor.

Patricia Gabriela Rakos, Technical University of Cluj-Napoca, rakospatricia95@gmail.com, Bulevardul Muncii 103-105, 400641 Cluj-Napoca

Ioana-Maria Dan, Technical University of Cluj-Napoca, m.d.toffoioana@gmail.com, Bulevardul Muncii 103-105, 400641 Cluj-Napoca

Eva Maria Walcher, Dipl.-Ing., TU Wien, Institute of Production Engineering and Photonic Technologies (IFT), eva.Walcher@tuwien.ac.at, Franz-Grill-Straße 4, 1030 Wien

Osman Bodur, Dr.techn., TU Wien, Institute of Production Engineering and Photonic Technologies (IFT), Osman.bodur@tuwien.ac.at, Franz-Grill-Straße 4, 1030 Wien

Günther Poszvek, Univ.Ass. Dipl.-Ing.(FH) Dr.techn. TU Wien, Institute of Production Engineering and Photonic Technologies (IFT), guenther.poszvek@tuwien.ac.at, +43 1 58801 31145, Franz-Grill-Straße 4, 1030 Wien