



Óbuda University
Doctoral School of Material Sciences and Technology

Optimization of ball end milling tool path in case of free form milling

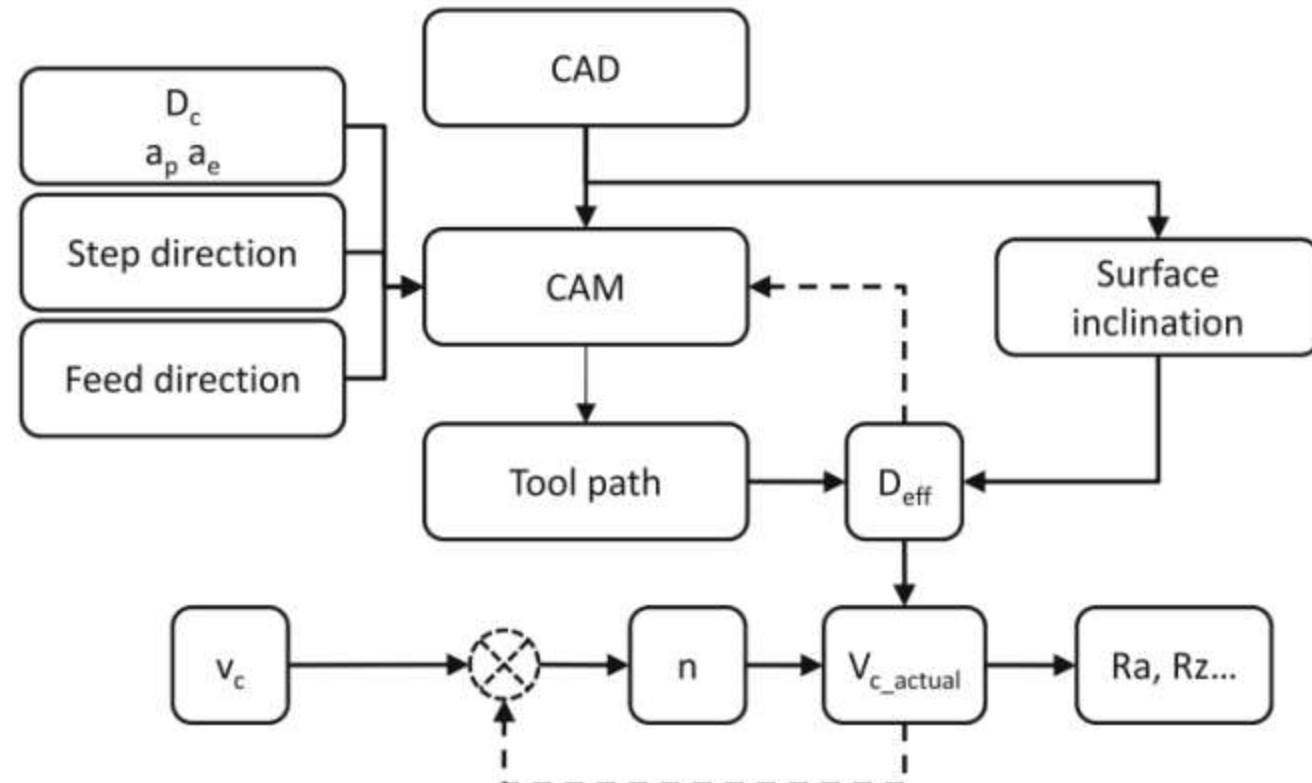
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The aim of the research

1. Investigate the effect of the cutting speed in case of 3D ball-end milling
2. Determine the working diameter of the cutting tool considering the surface inclination and the tool path
3. Develop an algorithm in order to control the cutting speed
4. Develop a new tool path concept

The suggested methods to solve the research problem



$$F = G \frac{m_1 m_2}{d^2}$$

$$\phi(x) = \frac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

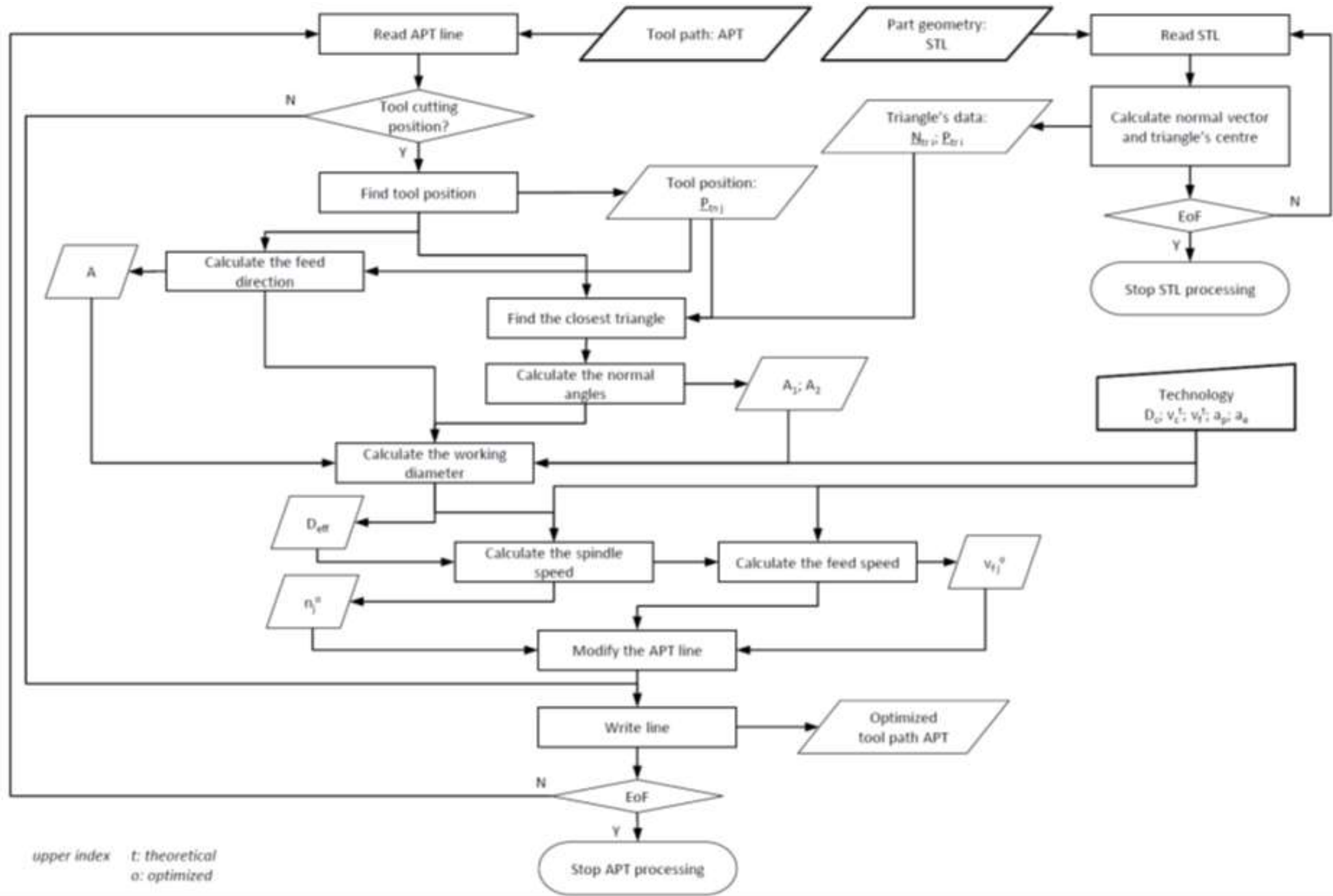
$$i\hbar \frac{\partial}{\partial t} \psi = \hat{H} \psi$$

$$F = E + V = 2$$

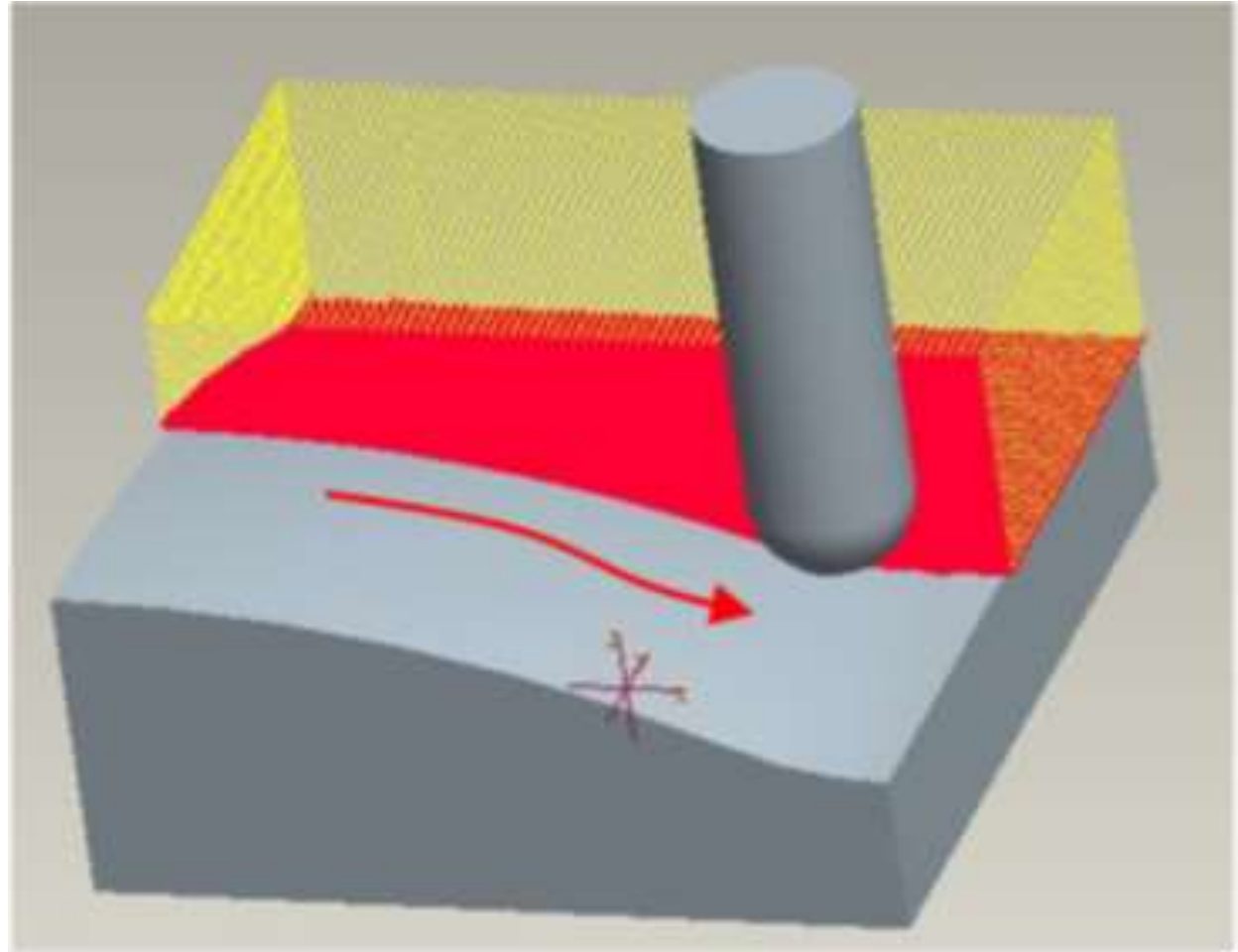
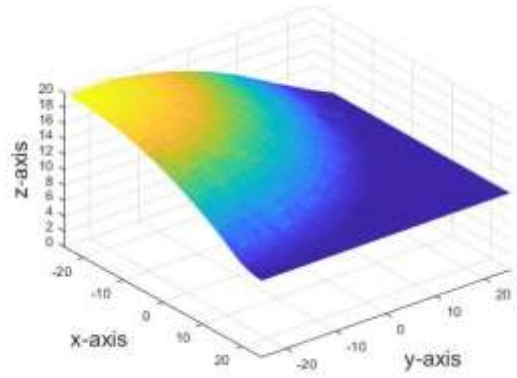
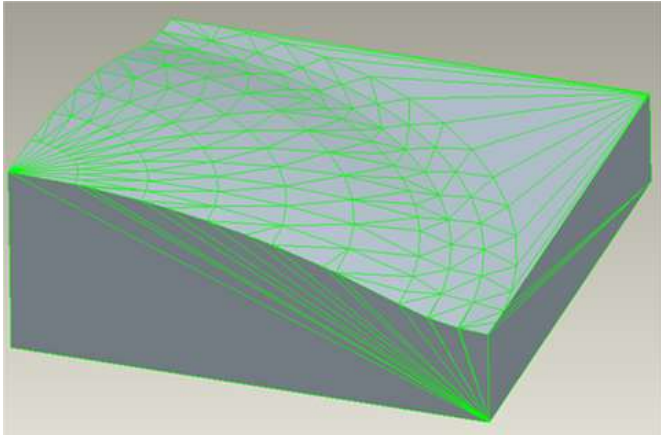
Results of the current semester

$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

$$\frac{df}{dt} = \lim_{h \rightarrow 0} \frac{f(t+h) - f(t)}{h}$$

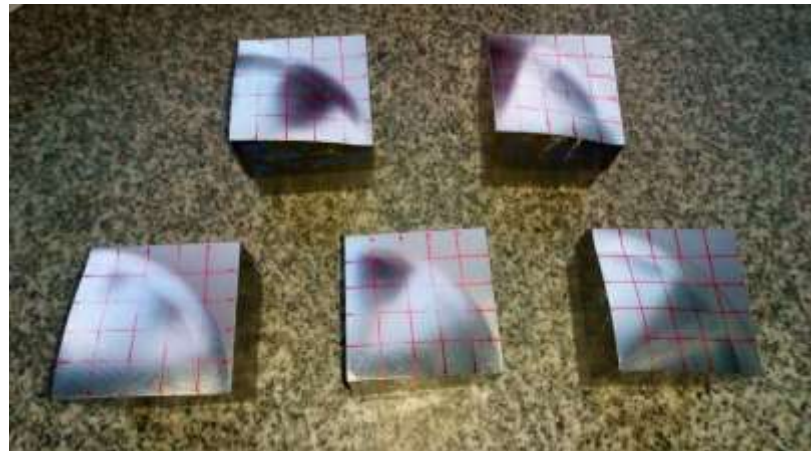


upper index t: theoretical
o: optimized



Milling test 1 & 2 - reference

- Tool: 10 mm ball end milling cutter
- Zig-zag milling (1) and down milling (2)
- Without spindle speed control
- Measure surface roughnes
 - 2D (Mahr)
 - 3D (Olympus)



Surface roughness in the case of a constant spindle speed

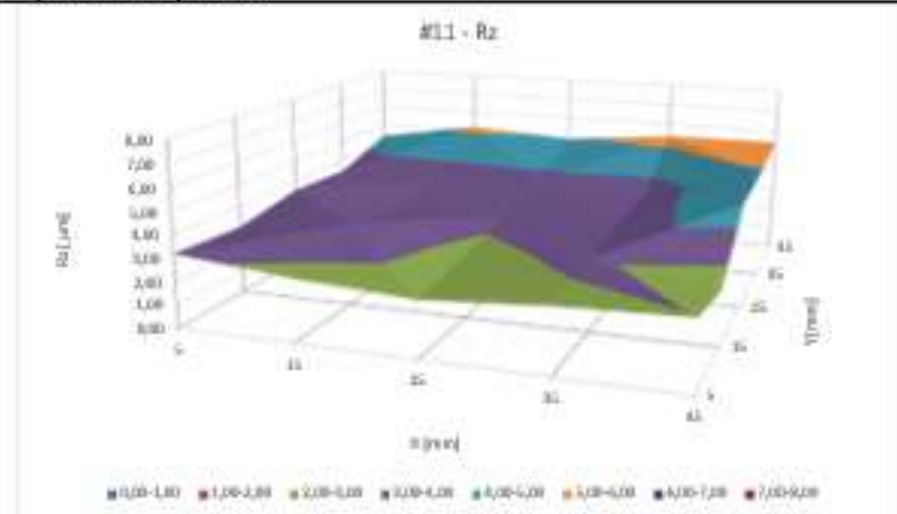


fig 6-a: in the case of milling Direction 0°

Surface roughness in the case of a controlled spindle speed

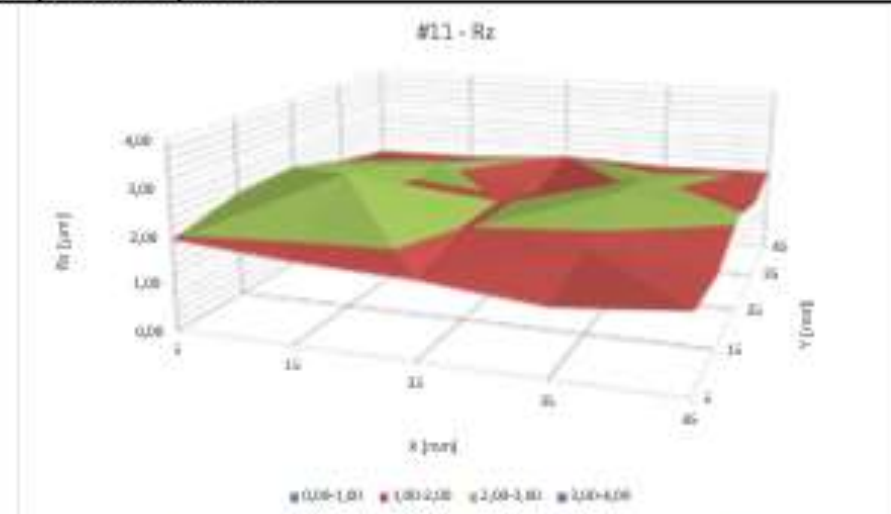


fig 6-b: in the case of milling Direction 0°

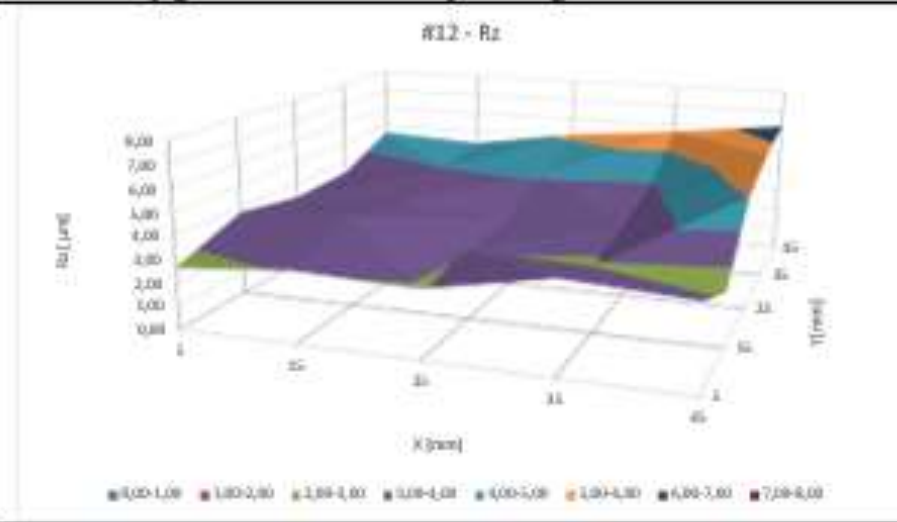


fig 7-a: in the case of milling Direction 22.5°

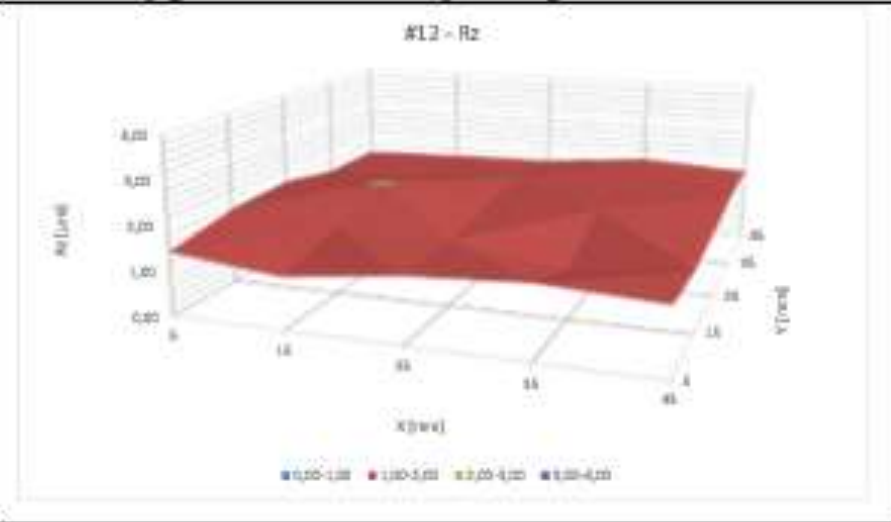


fig 7-b: in the case of milling Direction 22.5°

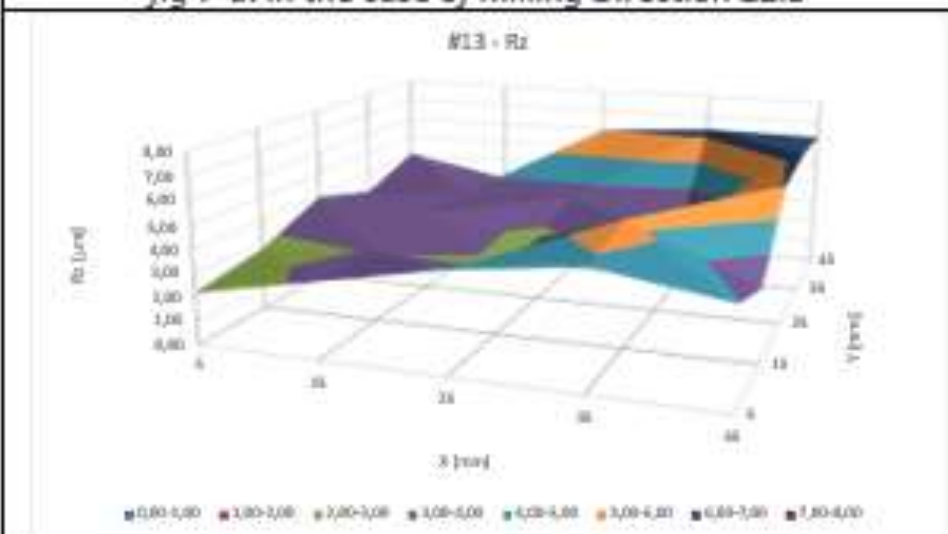


fig 8-a: in the case of milling Direction 45°

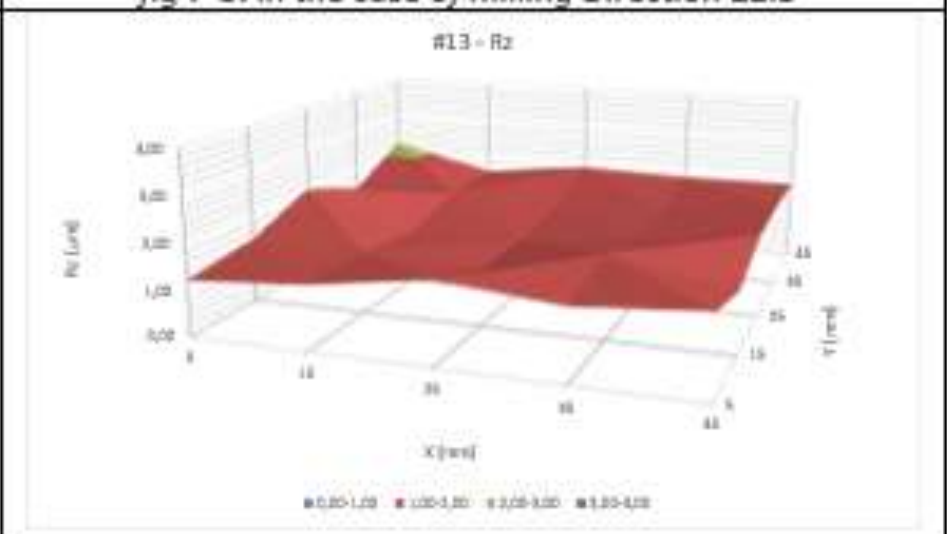


fig 8-b: in the case of milling Direction 45°

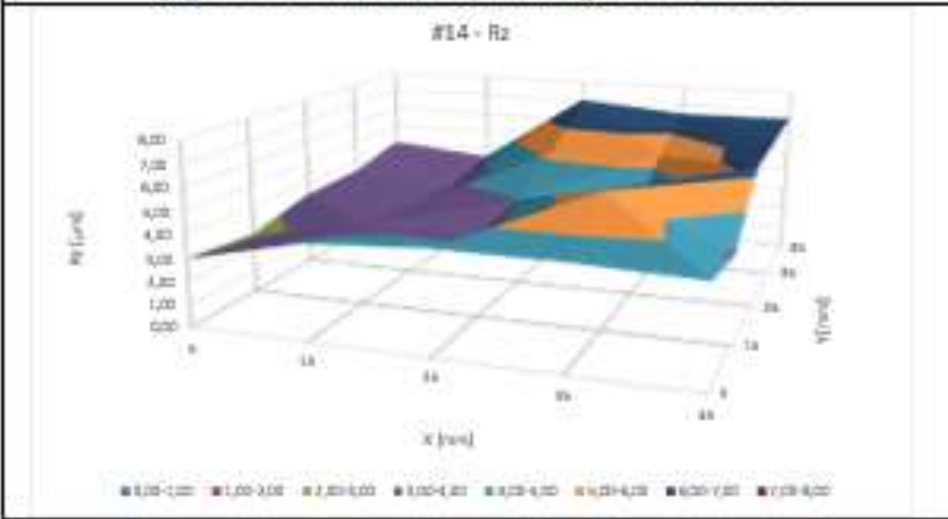


fig 9-a: in the case of milling Direction 67.5°

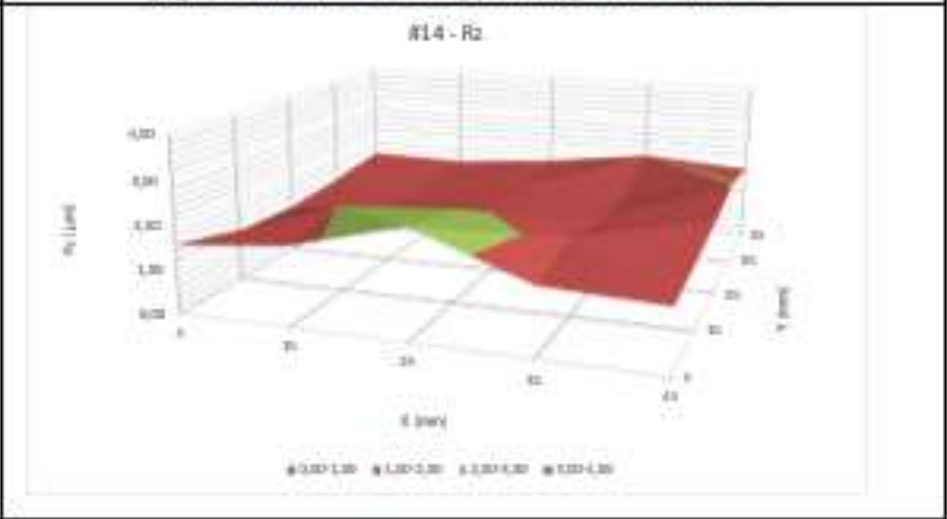


fig 9-b: in the case of milling Direction 67.5°

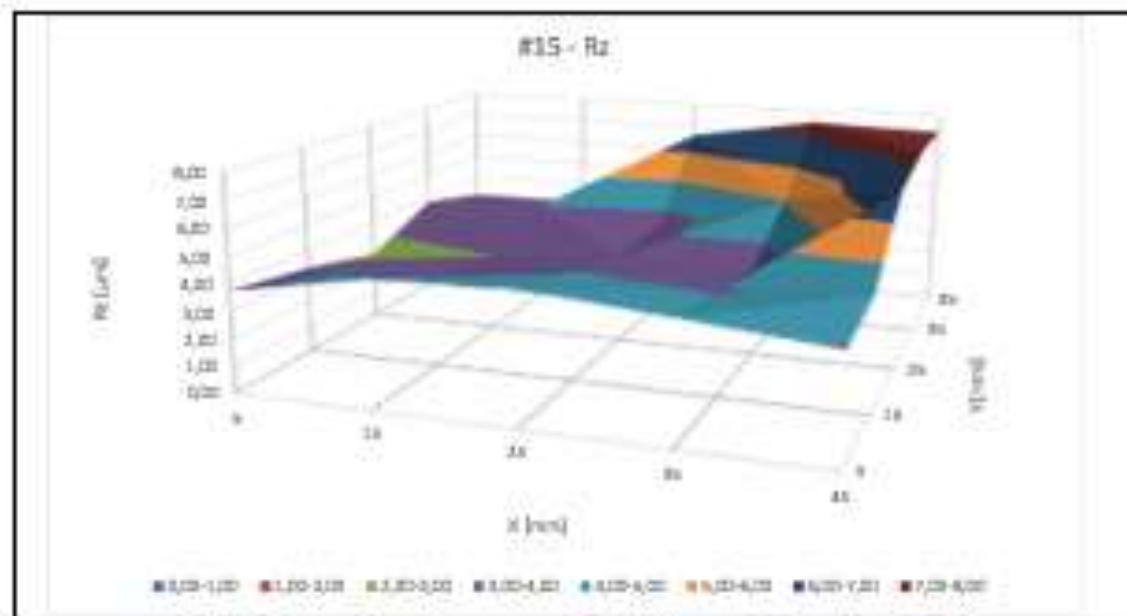


fig 10-a: in the case of milling Direction 90°

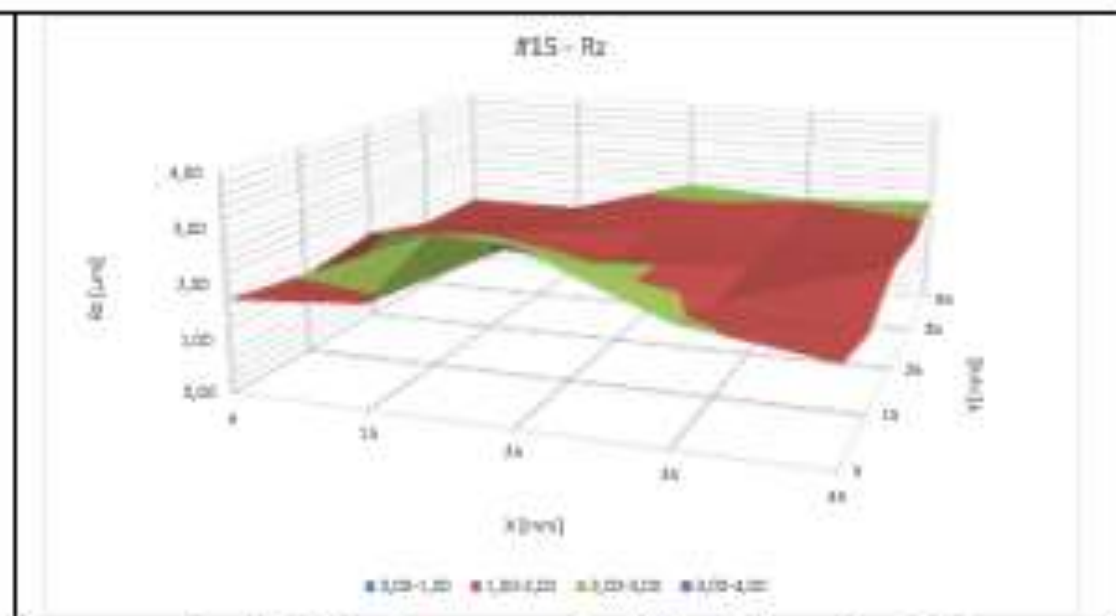
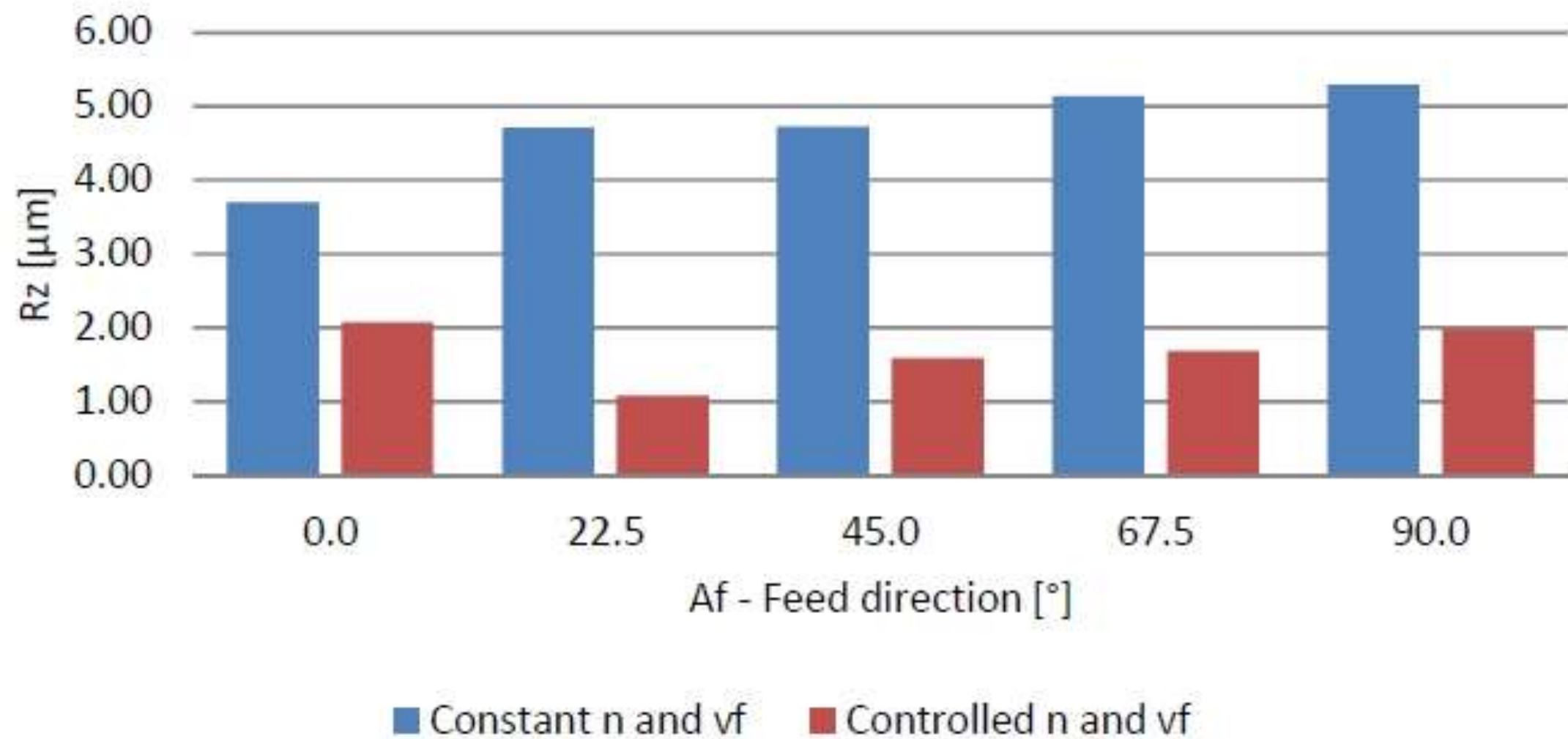
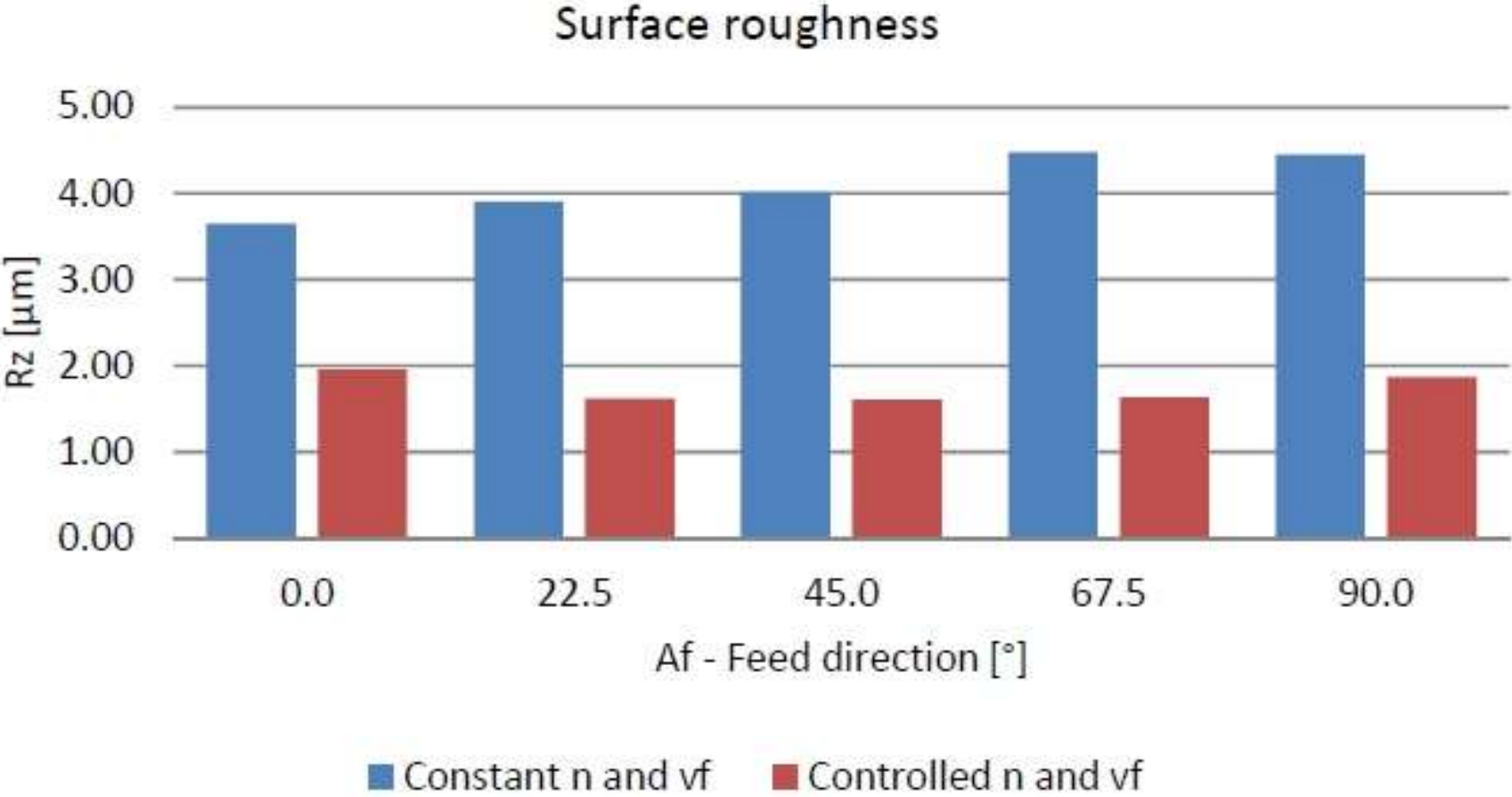


fig 10-b: in the case of milling Direction 90°

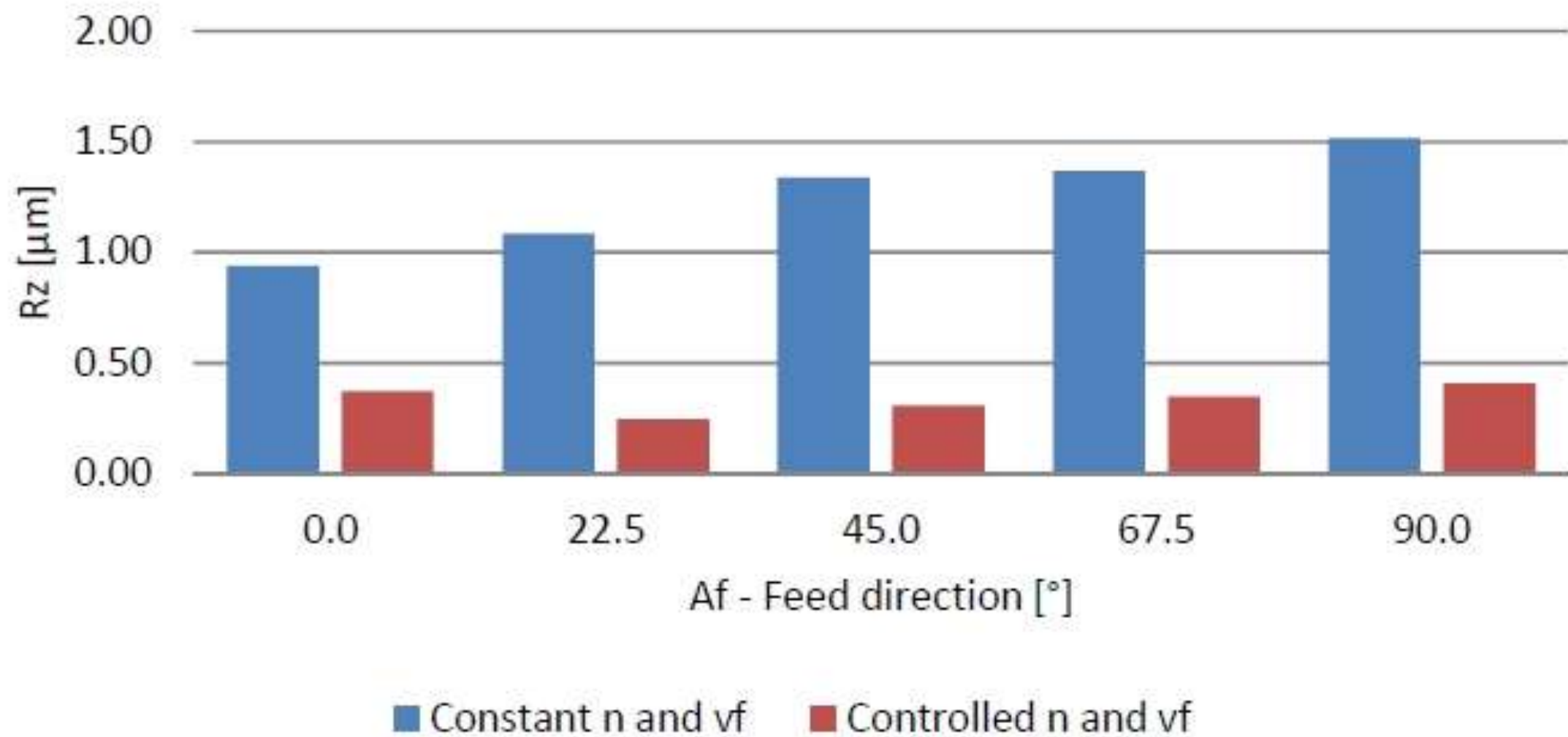
Range of the surface roughness












Average values of the surface roughness (Rz)



Standard deviation of the surface roughness



Milling workpieces using ball-end tool (5-parts with different milling direction) under a constant spindle speed	
Measuring the surface roughness using Mahr	
Measuring the surface roughness using Olympus	
Milling workpieces using ball-end tool (down milling) under a constant spindle speed	
Measuring the surface roughness using Mahr	
Measuring the surface roughness using Olympus	
Milling workpieces under adjusted spindle speed	
Measuring the surface roughness using Mahr	
Concept of the tool path planning and optimization considering the working diameter	

Publication

A. Published:

1. Abdulwahab Mgherony; Balázs Mikó; Ágota Drégelyi-Kiss (2020) Design of experiment in investigation regarding milling machinery. Cutting and tool in technological systems 0(92):68-84 ISSN 2078-7405 DOI: 10.20998/2078-7405.2020.92.09
2. Abdulwahab Mgherony; Balázs Mikó; Gabriella Farkas (2021) Comparison of surface roughness when turning and milling. Periodica Polytechnica - Mechanical engineering 65(4):337-344 ISSN 0324-6051 DOI: 10.3311/PPme.17898 (Q3)
3. Abdulwahab Mgherony; Balázs Mikó; (2021) The effect of the cutting speed on the surface roughness when ball-end milling. Hungarian Journal of Industry and Chemistry ISSN 2450-5102 3
4. Mgherony A; Mikó B; Balázs Mikó (2022) The change of the working diameter in 3-axis ball-end milling. Tehnički vjesnik (IF 0.783) ; ISSN 1330-3651(Print), ISSN 1848-6339 (Online) (Q3)
5. Mikó B.; Nagy J.; Mgherony A. (2022) Application of the regression method in case of the free form surface error. Proceedings of Development in Machining Conference - DiM 2022 ; Crakow, Poland 18-19.05.2022.

Publication

B. Under publishing:

- Mgherony A; Mikó B. (2022) Controlling the spindle speed when milling free-form surfaces using ball-end milling cutter. Acta Polytechnica Hungarica xx(x):xx ISSN 1785-8860 (IF) DOI

Publication plan

1. The result of controlling spindle speed point to point on the surface roughness when machining using ball-end tool
2. Concept of the tool path planning and optimization considering the working diameter.

Thanks for your attention