



Óbuda University  
Doctoral School of Material Sciences and Technology

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

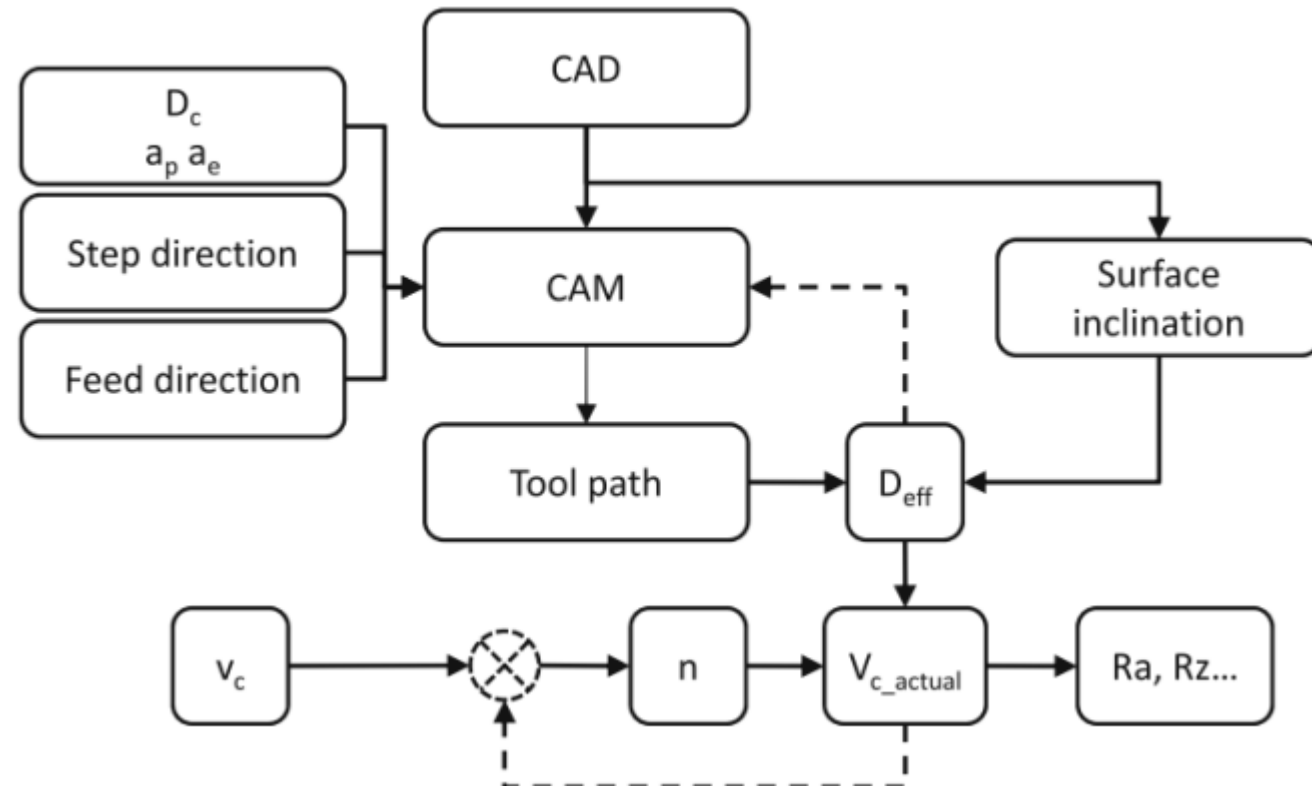
Student: Abdulwahab Mgherony

Supervisor: Dr. Balázs Mikó

# 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



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

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

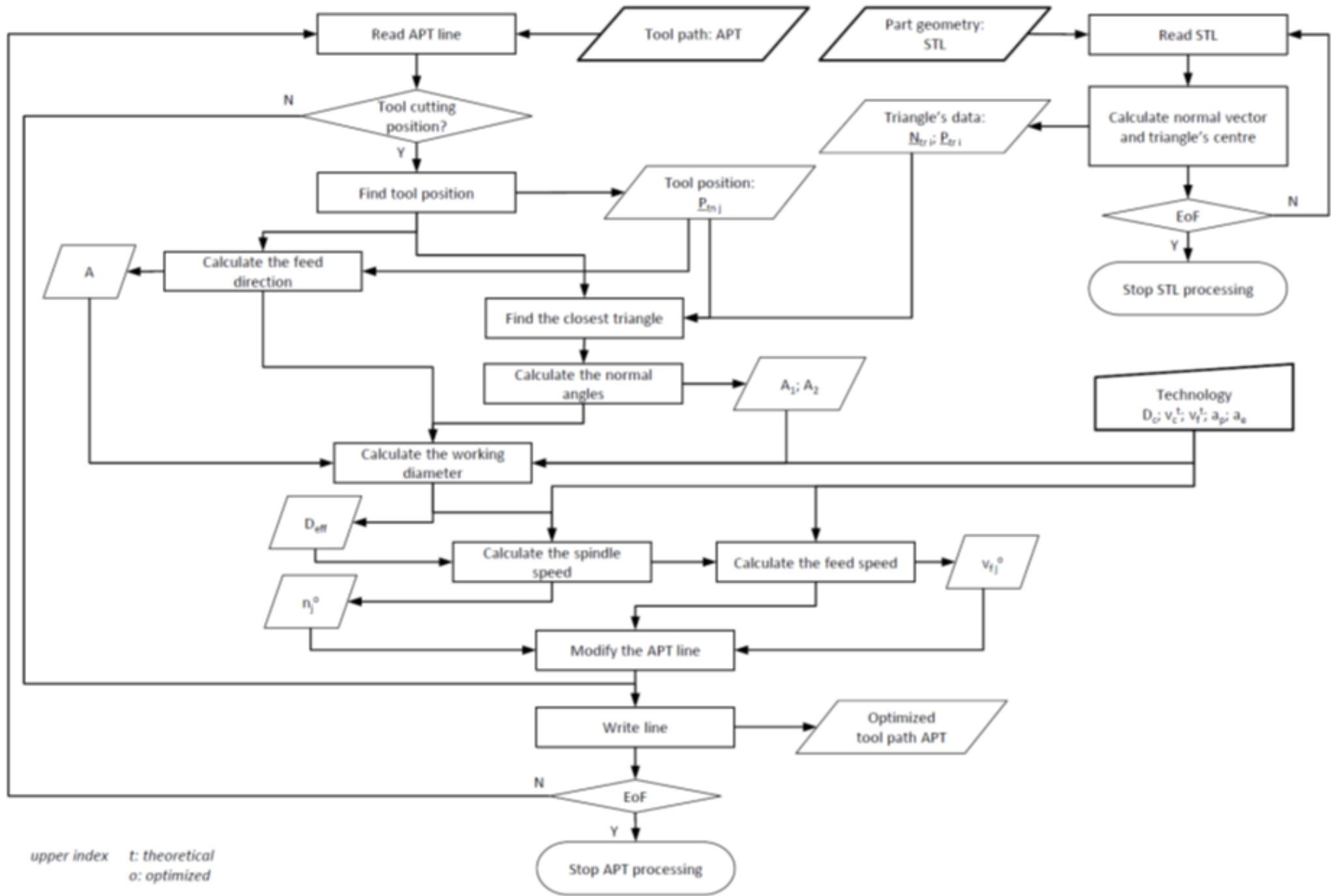
$$i\hbar \frac{\partial}{\partial t} \psi = \hat{H} \psi$$

$$F = E + V = 2$$

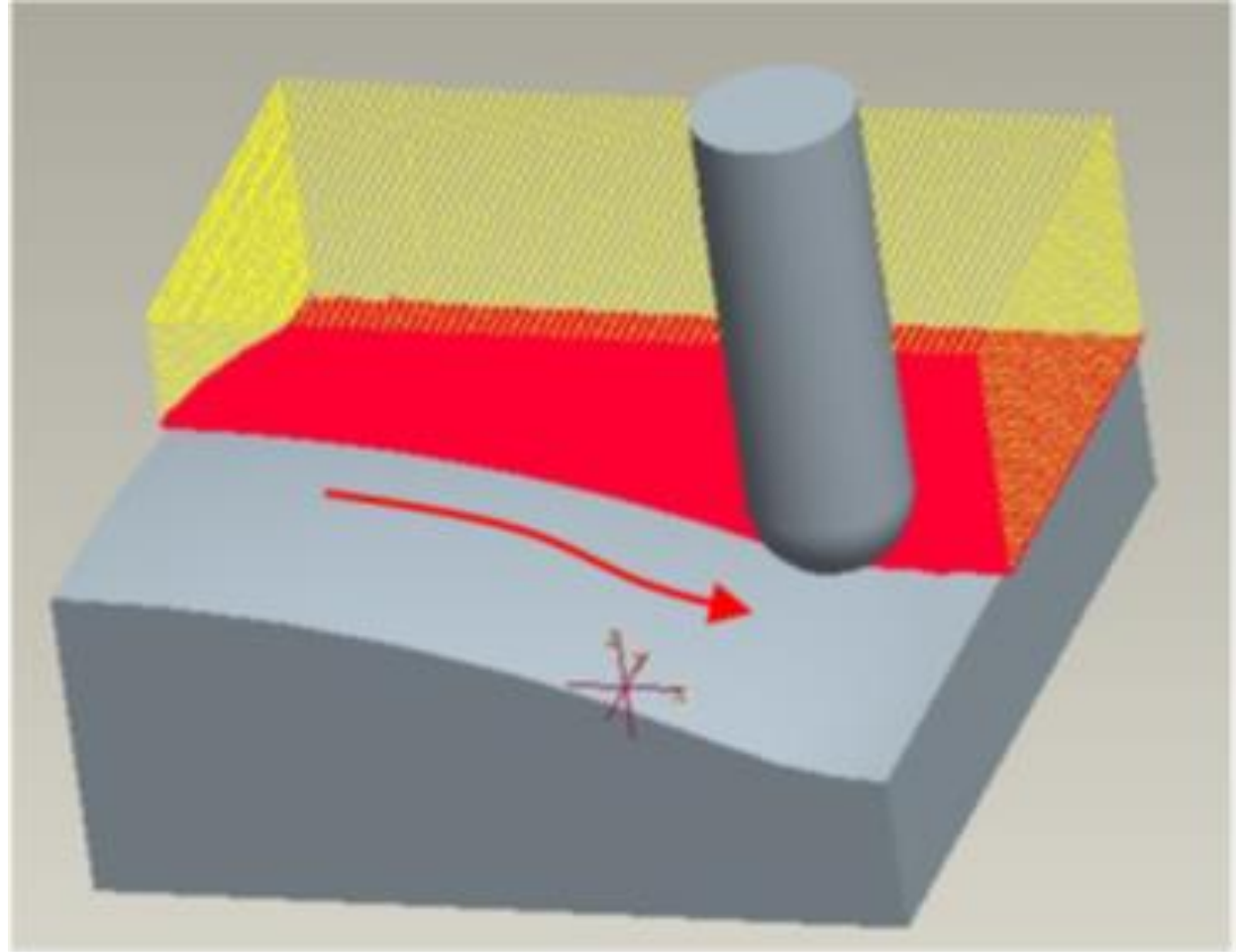
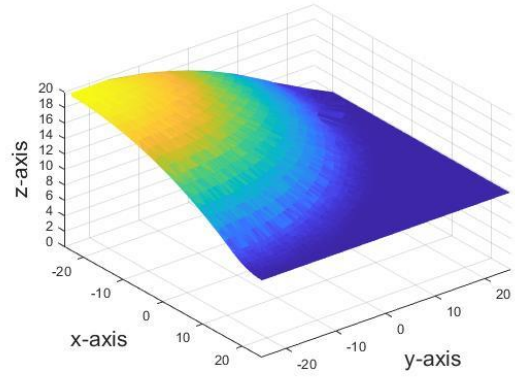
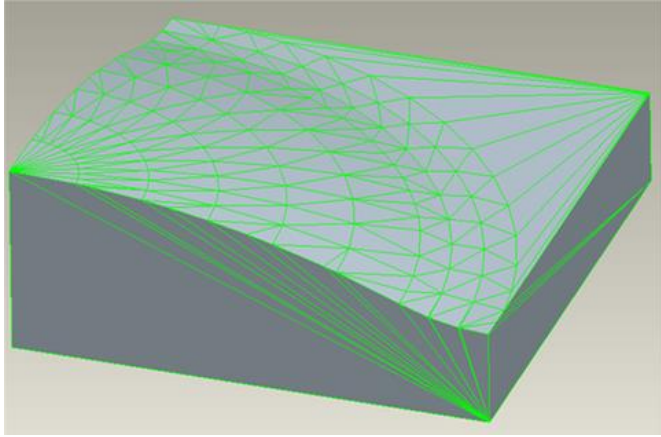
Results of the current semester

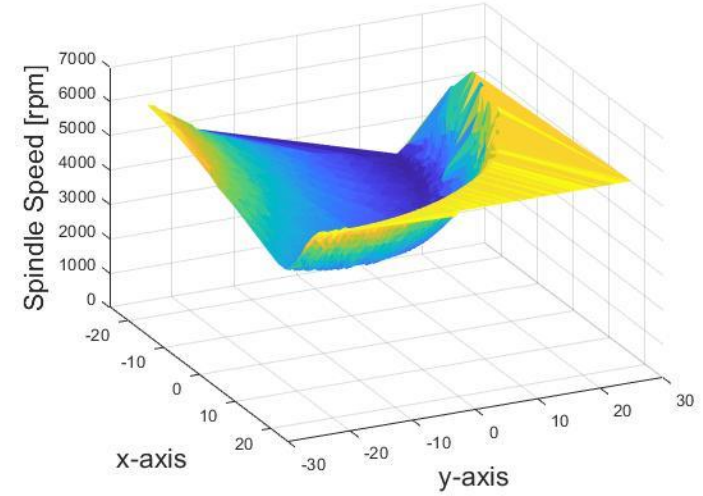
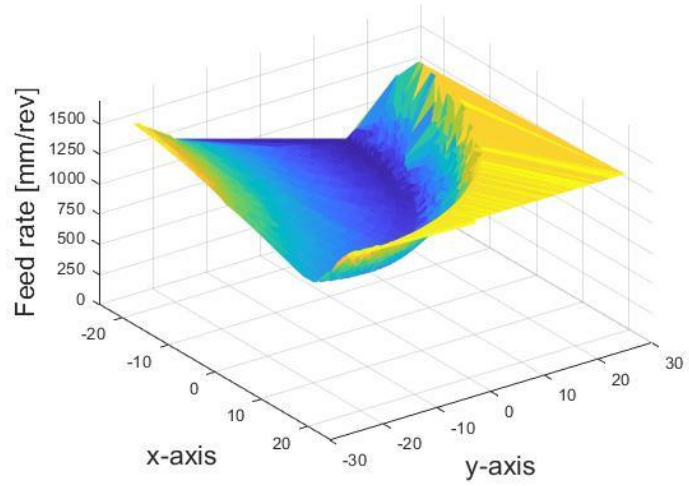
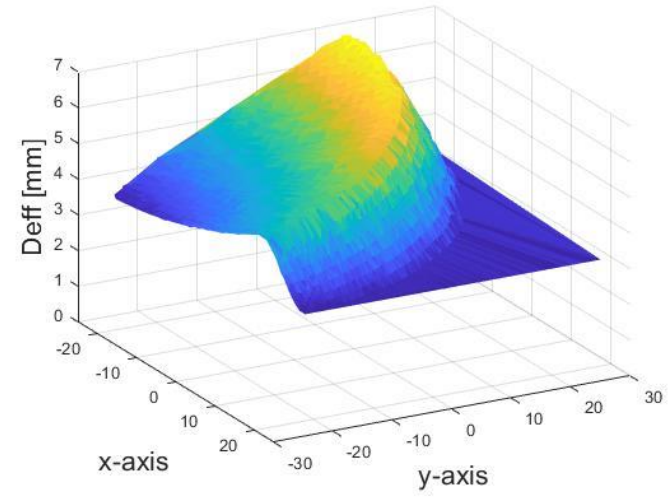
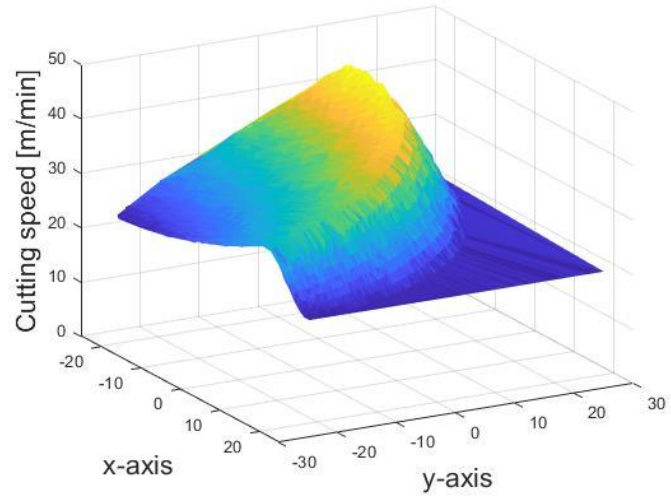
$$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$$

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



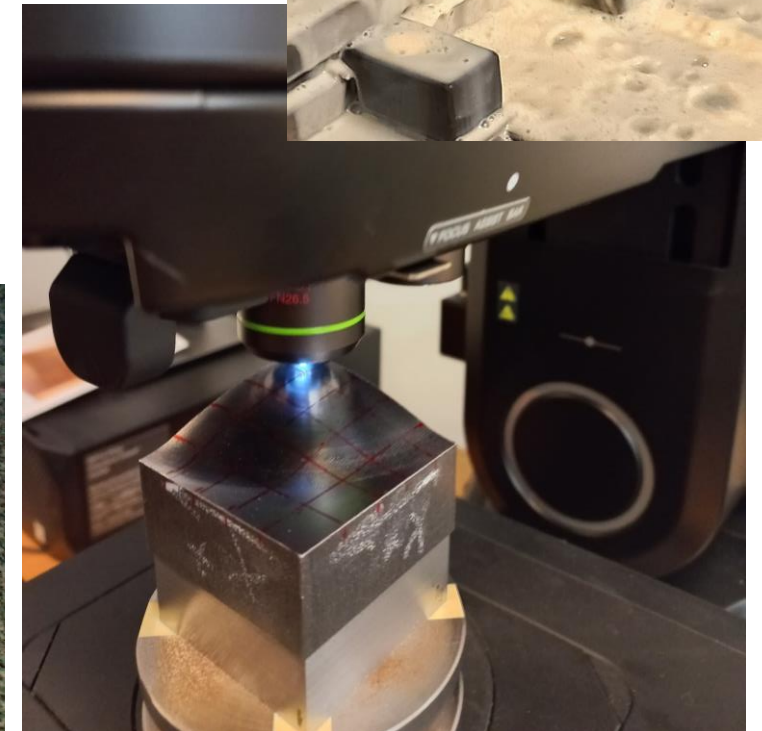
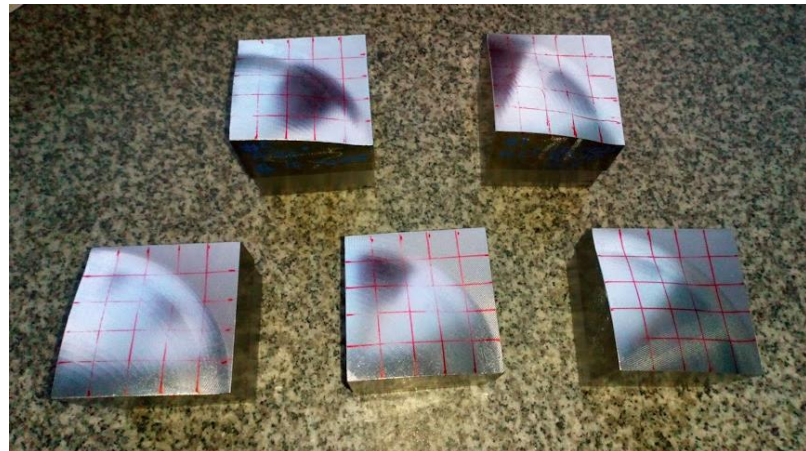
upper index t: theoretical  
o: optimized














# 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 roughness
  - 2D (Mahr)
  - 3D (Olympus)





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	
Measuring the surface roughness using Olympus	

# 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

# Publication

## Under publishing:

- 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)
- 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.

## Under review:

- 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