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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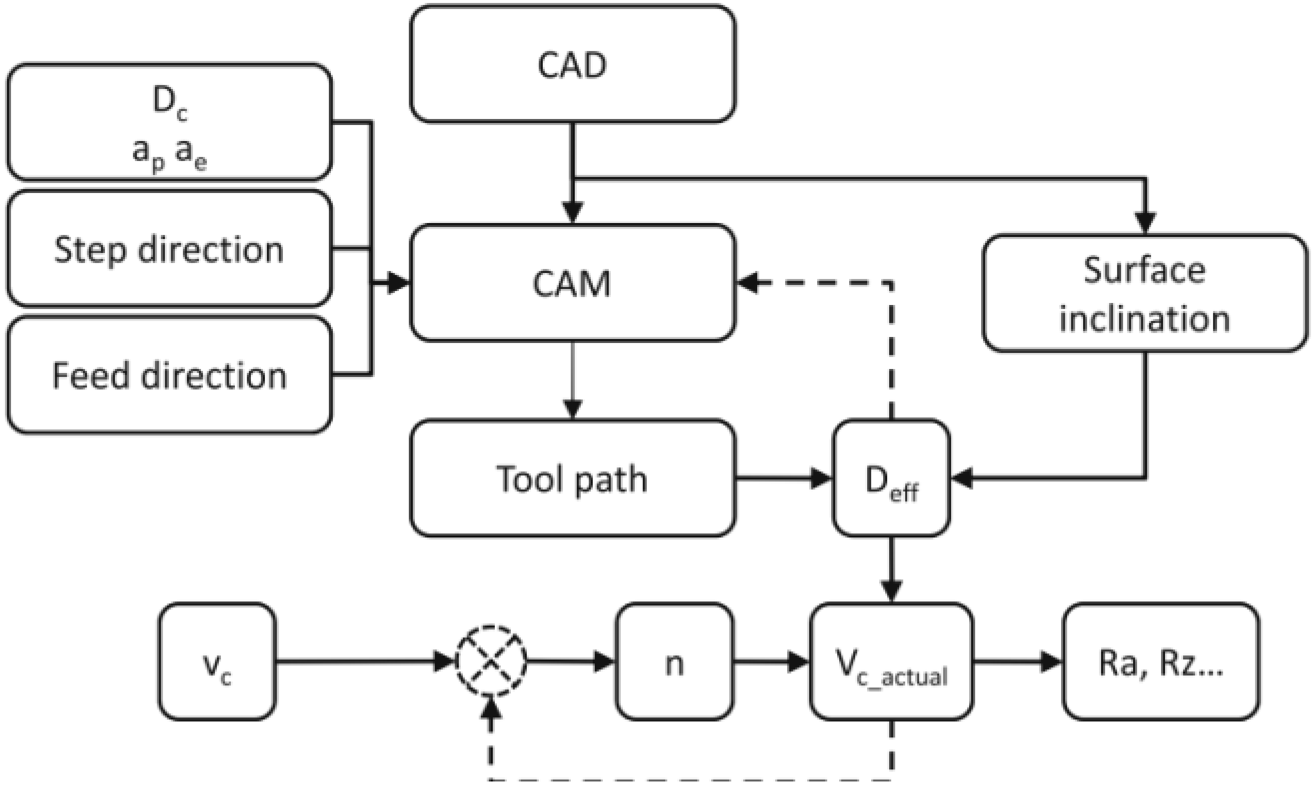
The aim of the research

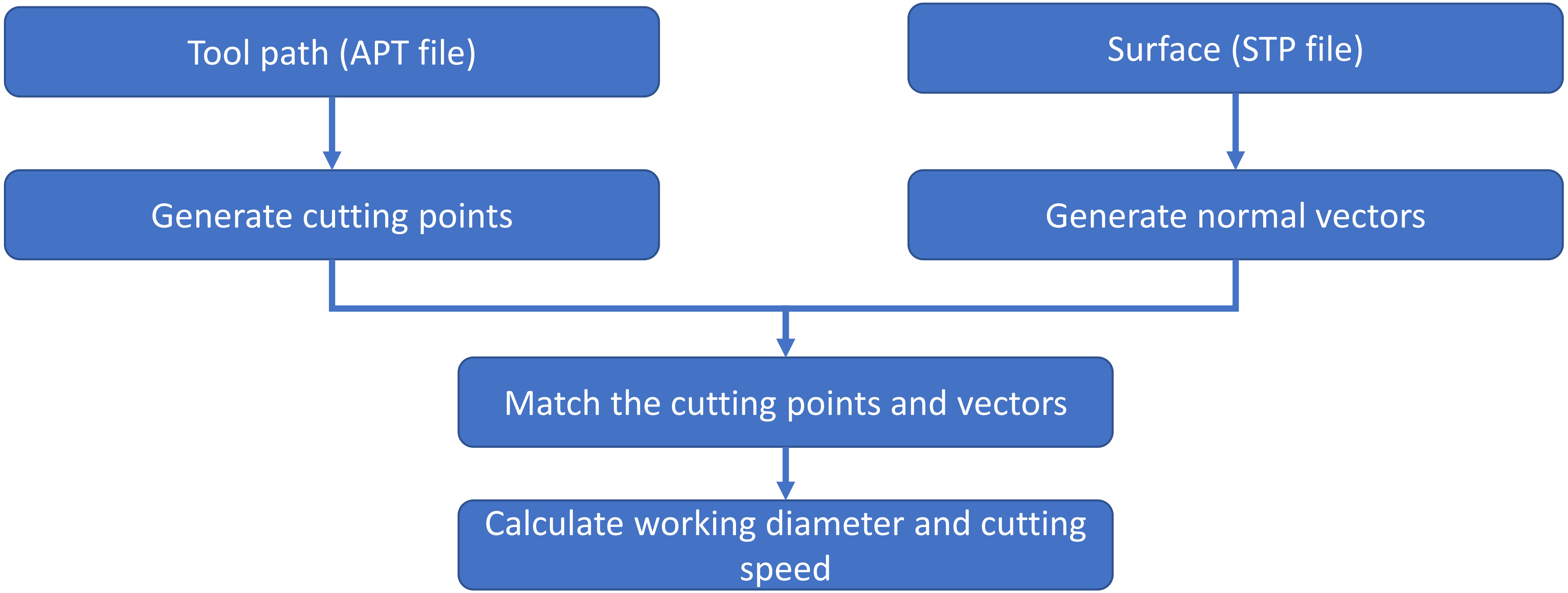
1. Investigate the effect of the cutting speed in case of 3D ball-end milling
2. Determine the working diameter of the cutting tool considering the surface inclination and the tool path
3. Develop and algorithm in order to control the cutting speed
4. Develop a new tool path concept

The suggested methods to solve the research problem



Results of the current semester

The concept of the algorithm



Stl file

facet normal 0.000000e+00 0.000000e+00 -1.000000e+00

outer loop

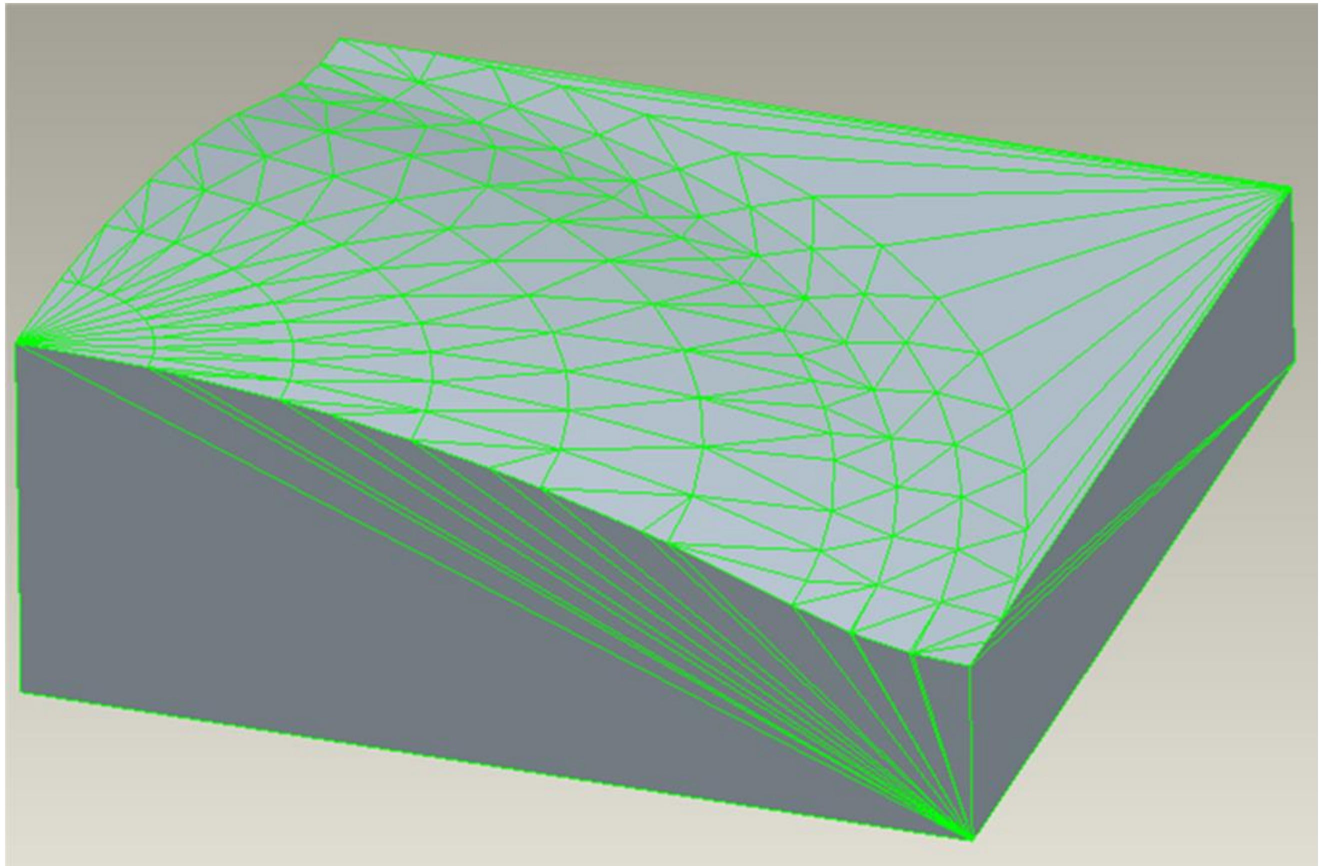
vertex 0.000000e+00 5.000000e+01 0.000000e+00

vertex 5.000000e+01 0.000000e+00 0.000000e+00

vertex 0.000000e+00 0.000000e+00 0.000000e+00

endloop

endfacet



NCL (APT) – Stadard description of the tool path

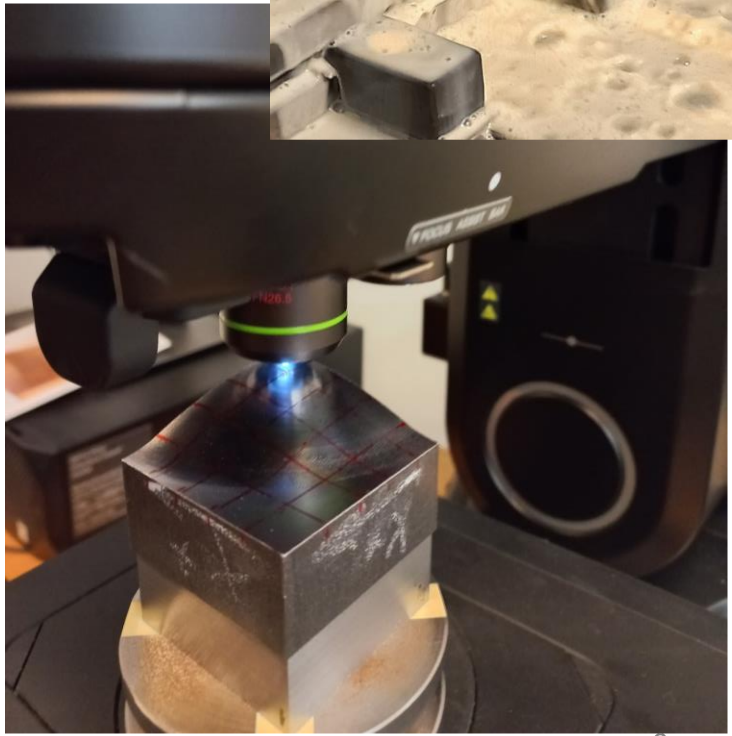
- SPINDL / RPM, 2000.000000, CLW
- GOTO / -0.496, -0.000, 22.002
- FEDRAT / 500.000000, MMPM
- GOTO / -0.496, -0.000, 20.002
- FEDRAT / 1000.000000, MMPM
- GOTO / 0.004, -0.000, 20.000
- GOTO / 1.826, -0.000, 19.985

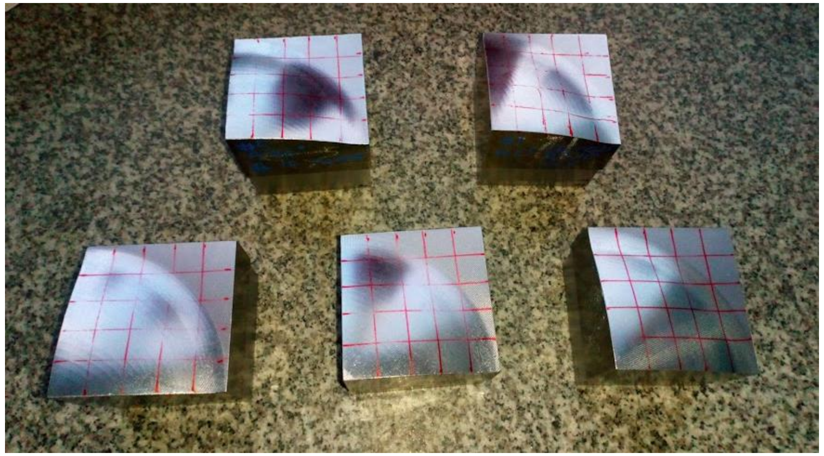
The pseudo-code of the Python program

- Read the stl file
- represent each triangle with the center point
- Read the ncl file
- Find the closest center
- Calculate the surface inclination AN1, AN2
- Calculate the milling direction
- Calculate the effective diameter
- Calculate the required spindle speed

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)





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. Abdul Whab 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. Abdul Whab 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)

Publication

Accepted:

- Abdul Whab 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-

Under review:

- Abdul Whab Mgherony; Balázs Mikó (2021) 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)

Publication plan

1. Concept of the active spindle speed control based on simulation
2. The result of controlling spindle speed point to point on the surface roughness whenmachining using ball-end tool
3. Concept of the tool path planning and optimization considering the working diameter.

Thanks for your attention