Associazione Italiana delle Tecnologie Manifatturiere

PREMIO DI LAUREA “F. SOAVI” 2022

Scheda sintetica tesi

Titolo tesi
Development of an innovative solution for in-process monitoring tool and surface quality in milling operations.

Relatori
Prof. Paolo Albertelli

Autori della tesi
Ugo Malguzzi

Presenting author (chi esporrà il lavoro in Assemblea)
Ugo Malguzzi

Corso di Laurea Magistrale
Automation and control engineering

Università di appartenenza
Politecnico di Milano

Abstract del lavoro di tesi (massimo 1000 caratteri)
Milling is one of the most used industrial processes for machining custom parts, starting from raw workpieces and removing material approaching the desired final product shape. Increasing automation paired with demands from high speed and high performance cutting, leads to the need for **in-process monitoring methods** which gives real-time reliable status indicators, permitting to rise productivity while avoiding waste or faulty conditions. This research describes actual monitoring techniques which make use of sensory machine tools. Starting with the formalization of the milling model, followed by the experimental identification of linked parameters. Kalman Filter was developed and tuned on the identified model to estimate cutting forces and tooltip vibrations based on measurements coming from a sensorized spindle. The limitations of the approach and its robustness were also investigated. Starting from there, innovative methods for **online surface finish evaluation**, **tool load and wear conditions** are developed. In order to achieve this goal, an algorithm for in-process **engagement estimation** is proposed as well. Simulations and experimental results enhance the performances and possible usefulness of these new methods.

Immagini illustrative (massimo 3)

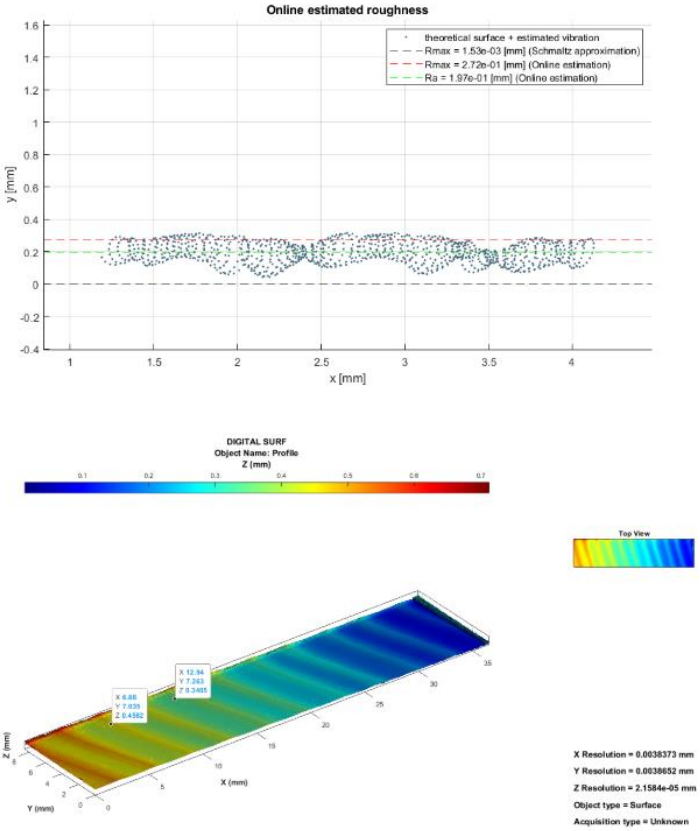

Figure 44: Comparison between estimated and measured roughness, unstable cut

```
%
N10 G90 G94 G17 G49 G40 G80
N15 G21
N20 T6 M06
N25 S1000 M03
N30 G54
N35 M08
N40 G00 X-54. Y99.
N45 G43 Z25. H06
N50 G00 Z17.
N55 G18 G02 X-44. Z7. I10. F400.
N60 G01 X0.
N65 X100.
N70 G17 G02 Y38.76 J-30.12
N75 G01 X0.
N80 G00 Z25.
N85 M09
N90 G49
N95 M30
%
```

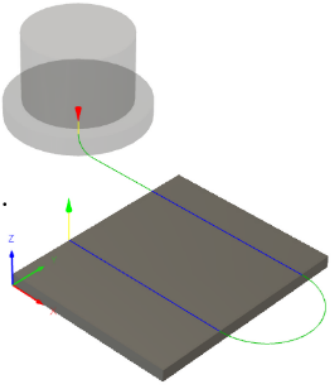

Figure 45: Tested toolpath and corresponding G-code

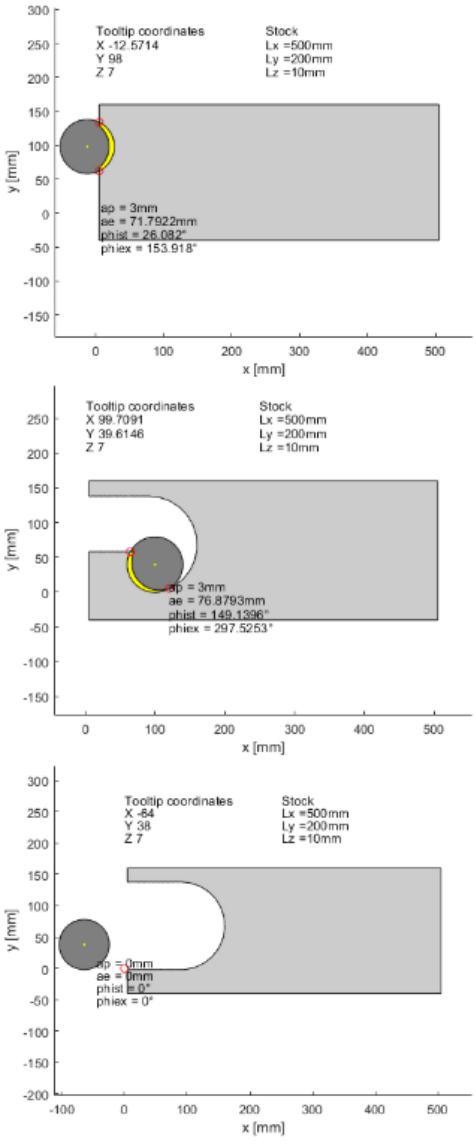

Figure 46: Simulation of engagement estimation algorithm