APEM journal

Advances in Production Engineering & Management
Volume 20 | Number 4 | December 2025 | pp 423–433
https://doi.org/10.14743/apem2025.4.549

ISSN 1854-6250
Journal home: apem-journal.org
Original scientific paper

Influence of cutting-edge tip geometry on the tool–workpiece electrical contact resistance

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A B S T R A C T

It is well established that the electrical resistance generated at the contact interface between dissimilar metals is strongly correlated with the actual contact area. By leveraging this phenomenon in cutting operations, we have successfully achieved in-process identification of flank wear width during machining. The method has shown particularly favourable performance under finishing conditions involving interrupted cutting, where tool monitoring is generally considered challenging. However, cutting operations employ a wide range of tool geometries, cutting parameters, and machining configurations, and it remains unclear whether the proposed approach is universally applicable across these variations. To address this issue, the present study focuses on turning, a process in which the tool–workpiece contact time is relatively long, and investigates the applicability of the method to diverse cutting geometries. Specifically, we examine how differences in tool geometry and the chip–rake-face contact area influence the electrical contact resistance between the tool and the workpiece. The results indicate that, for unused tools, variations in nose radius do not affect the electrical contact resistance measured at the tool–workpiece interface. In contrast, the contact between the flowing chip and the rake face is strongly dependent on rake angle. Consequently, for tools with negative rake angles, chip–rake-face interaction was found to have a pronounced influence on the electrical contact resistance at the tool–workpiece interface.

A R T I C L E   I N F O

Keywords:
Tool wear detection;
Contact resistance;
In-process monitoring;
Real time evaluation;
Rake angle;
Nose radius

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Article history:
Received 1 December 2025
Revised 6 December 2025
Accepted 13 December 2025

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APEM journal

Advances in Production Engineering & Management
Letnik 20 | Številka 4 | December 2025 | Strani 423–433
https://doi.org/10.14743/apem2025.4.549

ISSN 1854-6250
Spletna stran: apem-journal.org
Izvirni znanstveni članek

Vpliv geometrije konice rezalnega roba na električni kontaktni upor na stiku orodje–obdelovanec

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P O V Z E T E K

Električni upor na stiku med različnima kovinama je tesno povezan z dejansko kontaktno površino. Ta pojav smo pri odrezavanju uporabili za sprotno določanje širine obrabe na prosti ploskvi orodja. Metoda se je izkazala za posebej učinkovito pri fini obdelavi s prekinjenim rezanjem, kjer je spremljanje stanja obrabe orodja običajno zahtevno. Ker se pri odrezavanju uporablja širok nabor geometrij orodij, rezalnih parametrov in obdelovalnih nastavitev, ostaja odprto vprašanje, ali je predlagani pristop splošno uporaben pri vseh teh variacijah. Za obravnavo tega vprašanja se osredotočamo na struženje, postopek, pri katerem je čas stika med orodjem in obdelovancem razmeroma dolg, ter preučujemo uporabnost metode pri različnih rezalnih geometrijah. V nadaljevanju podrobneje analiziramo vpliv razlik v geometriji orodja ter v kontaktni površini med odrezkom in cepilno ploskvijo na električni kontaktni upor med orodjem in obdelovancem. Rezultati kažejo, da pri neobrabljenih orodjih spremembe polmera konice ne vplivajo na električni kontaktni upor, izmerjen na stiku orodje–obdelovanec. Nasprotno pa je vpliv interakcije med nastajajočim odrezkom in cepilno ploskvijo na električni kontaktni upor močno odvisen od cepilnega kota. Posledično ima pri orodjih z negativnim cepilnim kotom ta interakcija izrazit vpliv na električni kontaktni upor na stiku med orodjem in obdelovancem.

P O D A T K I   O   Č L A N K U

Ključne besede:
Obraba orodja;
Kontaktni električni upor;
Sprotno spremljanje procesa;
Sprotno vrednotenje;
Cepilni kot;
Polmer konice

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Zgodovina članka:
Prejet 1. decembra 2025
Popravljen 6. decembra 2025
Sprejet 13. decembra 2025