

Kratek opis usposabljanja mladega raziskovalca (*Short description of the Young Researcher's training*)

1. Raziskovalna organizacija (*Research organisation*):

Univerza v Ljubljani, Fakulteta za strojništvo
University of Ljubljana, Faculty of Mechanical Engineering

2. Ime, priimek in elektronski naslov mentorja (*Mentor's name, surname and email*):

Izr.prof.dr. Peter Krajnik (peter.krajnik@chalmers.se)

3. Šifra in naziv raziskovalnega področja (*Research field*):

2.10 *Proizvodne tehnologije in sistemi / Manufacturing technologies and systems*

4. Kratek opis usposabljanja mladega raziskovalca (*Short description of the Young Researcher's training*):

Navedite tudi morebitne druge zahteve, vezane na usposabljanje mladega raziskovalca (npr. znanje tujih jezikov, izkušnje z laboratorijskim delom, potrebne licence za usposabljanje...).

slo:

Mladi raziskovalec, bo po potrditvi vključen v raziskovalno skupino katedre za menedžment obdelovalnih tehnologij in laboratorija za odrezavanje. Poleg študijskih obveznosti, bo sodeloval na industrijskih, domačih, ter evropskih raziskovalnih projektih, na katerih sodeluje oz. jih koordinira raziskovalna skupina. Tu bo možnost aktivne sodelave/izmenjave s švedsko tehnično univerzo – Chalmers, kjer gostuje mentor prof. Krajnik.

Trenutno se v programski skupini aktivno odvijajo:

- P2-0266, Napredne izdelovalne tehnologije za visoko kakovostno in trajnostno proizvodnjo, raziskovalni program, 2015-2021.
- Raziskovalni projekt obdelave keramičnih izdelkov za elektro industrijo (elektrifikacija) (2019-2022)
- V fazi prijave:
 - a) razvoj naprednega kriogenega odrezavnaja na industrijski nivo (EU projekt)
 - b) razvoj namenskih površinsko teksturiranih rezalnih orodij (EU projekt)
 - c) raziskave na področju visokotlačnega odrezavnaja (EU projekt)
 - d) raziskave procesa poliranja z abrazivnim tokom (SLO industrijski projekt)
 - e) temeljne raziskave additivnih tehnologij za izdelavo rezalnih orodij (SLO projekt)
- Bilateralni projekti z industrijo

Trajnostni razvoj obdelovalnih procesov in koncept hibridnih obdelovalnih postopkov se oblikuje kot ključno raziskovalno področje, saj bo od razvoja visoko-zmogljivih obdelovalnih tehnologij in njihove praktične uporabe, odvisna bodoča konkurenčna prednost slovenskih proizvodnih podjetij.

Uspešna proizvodnja velikih in majhnih izdelkov mora vse pogosteje uporabiti high-tech materiale ter nove obdelovalne in proizvodne procese za krajše izdelovalne čase. Primeri takih

tehnologij so: kriogeno odrezavanje (patenti), pulzirajoče visokotlačno odrezavanje (patent), laserska asistenca odrezovalnih procesov, odrezavanje z minimalnim mazanje (t.i. MQL), čisti odrezovalni procesi, strojno poliranje, itd.

Raziskovalne vsebine in cilji skupine so tako usmerjeni v sprejemanje, prenos in raziskovalno podporo visoko-zmogljivih obdelovalnih tehnologij, med katere štejemo visoko-hitrostno obdelavo, visoko precizno mikro obdelavo in sodobne čiste načine obdelave, za katere je namenjen velik delež aktivnosti raziskovalne skupine. Program mladega raziskovalca bo tako usmerjen v tehnologije, inženirske metodologije, nova orodja, metode in delovno okolje, ki podpira sodelovanje, kreativnost ter učinkovito uporabo virov za hitro in visoko-zmogljivo proizvodnjo izdelkov v tesnem sodelovanju z industrijskimi partnerji.

Vsi ti problemi so izzivi za raziskovalno okolje, hkrati pa so osnova za oblikovanje bazičnih raziskav. Novi inovativni proizvodi zahtevajo obvladovanje lahkih materialov, materialov visokih trdnosti in materialov obstojnih pri visokih temperaturah, kot so npr. titanove zlitine, umetne snovi, keramike in kompoziti. Istočasno so velike zahteve industrije po ozkih tolerancah in izdelavi komponent s kompleksnimi geometrijskimi lastnostmi.

Mlademu raziskovalcu bo z vključitvijo v skupino omogočen dostop do uporabe strojev v laboratoriju ter inteligentnih naprednih senzorji za katetrizacijo odrezovalnih procesov (www.fs.uni-lj.si/labod). Dodatno bo kandidatu omogočena možnost nadgraditve dosežkov z možnostjo terminsko določenega dela v tujini pri naših partnerjih (kjer bo kandidatom na volja oprema, ki jo v Sloveniji ni), ter desiminacija rezultatov preko znanstvene in strokovne literature, ustreznih konferenc in predstavitev. Tako bo s statusom mladega raziskovalca, kandidatu zagotovljena sprejemljiva začetna plača, plačana šolnina za dr. študij, plačano delo v tujini. Sicer pa se dobro delo tudi dodatno nagrajuje.

Namen je, da bodo rezultati pomembni tako za MR kandidata, raziskovalno skupino kot za industrijo v obliki znanstvenega doprinosa in praktičnih aplikacij. Na podlagi teh smernic in individualnih želj/zanimanj kandidata, bo v začetni fazi kandidatu določena tema/smer raziskovanja, ustrezni podiplomski izpiti, seminarji in komisije za zagovore le teh.

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Young researcher will be, after confirmation, involved in the research group of the Department for Management of Manufacturing Technologies and Laboratory for Machining. In addition to PhD study obligations, he/she will be involved also in the industrial, national and European research projects that are coordinated by the research group or the research group is participating in. Additional possibility for the candidates would be in active collaboration/exchange with Swedish Technical University – Chalmers, where advisor is currently hosted.

Currently, the program/research group is actively involved in the following projects:

- P2-0266, Advanced manufacturing technologies for high-quality and sustainable production, research program, 2015-2021.
- Research on machining performance of ceramic materials for electro industry (electrification), 2019-2022
- In application phase:
 - f) Research on novel cryogenic machining for industrial environment (EU project)
 - g) Research on development of tailored surface structures of cutting tools (EU project)

- h) Research on high-pressure assisted machining (EU project)
- i) Research on polishing process with abrasive fluid flow (SLO industrial project)
- j) Basic research on additive technologies used in production of cutting tools (SLO project)
- Bilateral projects with industry

Sustainable development of manufacturing processes and the concept of hybrid machining processes are becoming a key research area, since the development of high-performance processing technologies and their practical application are directly related to future competitive advantage/position of Slovenian manufacturing companies.

Successful production of small and large products is increasingly facing with the need for using high-tech materials and new production/machining processes for assuring shorter cycle times. Examples of such technologies are cryogenic machining (patents), pulsating high pressure jet assisted machining (patent), laser assisted machining, machining with minimum quantity lubrication (MQL), clean machining processes, machine-based polishing, etc.

Research contents and goals of the research group are thus directed to the reception, transmission and research support for high-performance processing technologies, which include high-speed machining, high-precision micro-processing and clean modern manufacturing methods, for which a considerable proportion of the research group activities is dedicated. The program of the young researcher activities will be focused on technologies, engineering methodologies, new tools, methods and work environment that supports collaboration, creativity, and effective use of resources for fast and high-performance manufacturing products in close cooperation with industrial partners.

All these problems are challenging for the research environment and in the same time the basis for the creation of basic research. New innovative products require management of light materials, high strength materials and high temperature resistant materials, i.e. Titanium alloys, plastics, ceramics and composites. At the same time the high demands of industry are related to tight tolerances and production of components with complex geometrical properties.

Young researcher will have, with the work in research group, access to intelligent advance sensor equipment for characterization of machining processes (www.fs.uni-lj.si/labod). Additionally, the candidate will be provided the opportunity to upgrade his knowledge with the possibility for shorter exchange work abroad at with our partners (where the candidates will have the possibility to work on equipment that is not available in Slovenia), and dissemination of results through scientific and technical literature, relevant conferences and presentations. Thus, with the status of young researcher, to candidate provided will be base salary, PhD study tuition, payed exchange work by foreign laboratories. Additionally, good work is additionally awarded.

The overall intention is that the results will be important for MR (young researcher) candidate as well as for the research group and industry with the scientific contribution and practical applications. On the basis of these guidelines and individual desires / interests of the candidate, in the initial phase the topic / direction of research will be defined including defining the relevant postgraduate exams, seminars and committees for the defenses.