UNIVERZITET CRNE GORE
Mašinski fakultet Podgorica
Broj: 1311
Podgorica, 28. 06. 2019. godine

UNIVERZITET CRNE GORE

- Centru za doktorske studije –

OVDJE

U prilogu dostavljamo Predlog odluke Vijeća Mašinskog fakulteta, sa sjednice održane dana 25. 06. 2019. godine, o predlogu formiranja Komisije za odbranu polaznih istraživanja i ocjenu podobnosti doktorske teme i kandidata, Mr Radislava Brđanina.

DEKAN

Prof. dr Igor Vušanović

UNIVERZITET CRNE GORE
Mašinski fakultet Podgorica
Broj: 1311/1
Podgorica, 28. 06. 2019. godine

Na osnovu člana 64 Statuta Univerziteta Crne Gore, u vezi sa članom 34, stav 1 Pravila doktorskih studija, Vijeće Mašinskog fakuteta u Podgorici, na sjednici održanoj dana 25. 06. 2019. godine, utvrdilo je predlog

ODLUKE

Član 1

Komisiju za odbranu polaznih istraživanja i ocjenu podobnosti teme pod nazivom: „Eksperimentalna i numerička analiza parametara koji utiču na slabljenje, oblik i fazu talasa pritiska kod hidrauličkog udara“, kandidata, Mr Radislava Brđanina čine:

1. Prof. dr Igor Vušanović, predsjednik

2. Prof. dr Uroš Karadžić, mentor – član i

3. Doc. dr Esad Tombarević, član.

Član 2

Odluka stupa na snagu kada je verifikuje Senat Univerziteta Crne Gore.

DEKAN

Prof. dr Igor Vušanović

UNIVERZITET CRNE GORE
Mašinski fakultet
Komisija za doktorske studije
Podgorica, 25. 06. 2019.

- VIJEĆE MAŠINSKOG FAKULTETA –

Poštovani,

U skladu sa Pravilima doktorskih studija i Vodičem za doktorske studije, u prilogu dostavljamo prijavu kolege **Radislava Brđanina** na predviđenom **obrascu PD**, kao i prateću dokumentaciju.

Komisija za doktorske studije na Mašinskom fakultetu je na sjednici održanoj dana 25. 06. 2019. godine, razmatrala formalne uslove dostavljene prijave, sa stanovišta neophodnih podataka i ispunjavanju uslova za prijavu teze, i poštujući princip kompetentnosti, imajući u vidu dostavljenu prijavu i prateći materijal, inicira sledeći sastav komisije za odbranu polaznih istraživanja i ocjenu podobnosti teme i kandidata:

1. Prof. dr Igor Vušanović, predsjednik,

2. Prof. dr Uroš Karadžić, mentor – član i

3. Doc. dr Esad Tombarević, član.

Predlažemo Vijeću Mašinskog fakulteta da na bazi ovog inicijalnog predloga, utvrdi predlog sastava komisije i isti dostavi Odboru za doktorske studije na dalje postupanje.

Srdačno,

Crna Gora
UNIVERZITET CRNE GORE
MAŠINSKI FAKULTET
25. 06. 2019.
1248

PREDSJEDNIK KOMISIJE ZA DOKTORSKE STUDIJE

Prof. dr Aleksandar Vujović

13.06.2019

1148

PRIJAVA TEME DOKTORSKE DISERTACIJE

OPŠTI PODACI O DOKTORANTU	
Titula, ime i prezime	Magistar, Radislav Brđanin
Fakultet	Mašinski fakultet
Studijski program	Mašinstvo
Broj indeksa	1/16
Ime i prezime roditelja	Neđeljko Brđanin
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BIOGRAFIJA I BIBLIOGRAFIJA	
Obrazovanje	1. II ciklus studija, Univerzitet u Istočnom Sarajevu, Fakultet za proizvodnju i menadžment Trebinje, 18.07.2013, 10 2. I ciklus studija, Univerzitet u Istočnom Sarajevu, Fakultet za proizvodnju i menadžment Trebinje, 24.09.2010, 9,24
Radno iskustvo	1. 15.07.2014. – danas, Viši asistent, Univerzitet u Istočnom Sarajevu, Fakultet za proizvodnju i menadžment Trebinje, Trebinje 2. 01.03.2011. – 14.07.2014, Asistent, Univerzitet u Istočnom Sarajevu, Fakultet za proizvodnju i menadžment Trebinje, Trebinje
Popis radova	1. **Radislav Brđanin**, Jovan Ilić, Uroš Karadžić, Ivan Božić: *Comparison of dynamic pressure transducers on experimental water hammer setup*, VII Regionalna konferencija: Industrijska energetika i zaštita životne sredine u zemljama jugoistočne Evrope - IEEP '19, 19. - 22. jun 2019., Zlatibor 2. **Radislav Brđanin**, Jovan Ilić, Uroš Karadžić, Ivan Božić: *Experimental water hammer setup at University of Montenegro – description and possibilities*, 14. Međunarodna konferencija o dostignućima u mašinstvu i industrijskom inženjerstvu – DEMI 2019, 24. - 25. maj 2019., Banja Luka 3. Jovan Ilić, Ivan Božić, **Radislav Brđanin**, Uroš Karadžić: *Comparative analysis of the hydropower plant transient processes for various surge tank types and improved guide vanes closing law*, 14. Međunarodna konferencija o dostignućima u mašinstvu i industrijskom inženjerstvu – DEMI 2019, 24. - 25. maj 2019., Banja Luka 4. Radoslav Vučurević, Zdravko Krivokapić, Radislav Brđanin, „Comparative Analysis of Surface Quality Prediction Models", International Journal of Engineering and Technology (IJET), ISSN 0975-4024, Vol. 10, No. 2, pp. 441-449, 2018 5. Radoslav Vučurević, Zdravko Krivokapić, **Radislav Brđanin**, „Surface Quality Prediction Using Artificial Neural Networks",

	Annals of the University of Oradea, Fascicle of Management and Tehnological Engineering, No. 1, pp. 174-177, 2018. 6. B. Marinović, R. **Brđanin**, B. Urošević Gvozenac, Ž. Đurić, "Application of Promethee method as suport in the planning process of small hydropower plants", 8th INTERNATIONAL SCIENTIFIC CONFERENCE "Research and development of mechanical elements and systems" IRMES 2017, ISBN 978-9940-527-53-2, 2017. 7. Radoslav Vučurević, Zdravko Krivokapić, Petar Ivanković, Željko Đurić, **Radislav Brđanin**: Uticaj veličine prečnika zavojne burgije na sposobnost procesa brušenja prečnika, časopis Kvalitet i izvrsnost, ISSN 2217-852X, br. 7-8, str. 82-84, 2016. 8. O. Spaić, **R. Brđanin**, B. Marinović: *Razvoj neuronskih modela za istovremeno direktno i indirektno praćenje habanja reznih alata*, XII međunarodni naučno-stručni simpozijum INFOTEH JAHORINA 2013, 20. mart - 22. mart 2013., Jahorina, ISBN 978-99955-763-1-8, COBISS.BH-ID 3707928. 9. Radoslav Vučurević, Petar Ivanković, **Radislav Brđanin**: *Uticaj sposobnosti procesa brušenja zaleđa na kvalitet zavojne burgije*, časopis Kvalitet i izvrsnost, ISSN 2217-852X, br. 7-8, str. 90-92, 2012.

NASLOV PREDLOŽENE TEME	
Na maternjem jeziku	Eksperimentalna i numerička analiza parametara koji utiču na slabljenje, oblik i fazu talasa pritiska kod hidrauličkog udara
Na engleskom jeziku	Experimental and numerical analysis of parameters that affect water hammer wave attenuation, shape and timing

Obrazloženje teme

Hidraulički udar i nestacionarni strujni procesi su izuzetno složena oblast mehanike fluida kojom se istraživači bave širom svijeta. On predstavlja veoma složenu pojavu koja se javlja prilikom promjene režima strujanja u cjevovodima hidroelektrana i vodovodnih sistema. Obično je uzrokovan promjenom režima rada hidrauličkih turbomašina kao i otvaranjem i zatvaranjem regulacionih i sigurnosnih zatvarača. Hidraulički udar izaziva stvaranje talasa povećanog i smanjenog pritiska koji, ako se ne drže pod kontrolom na adekvatan način, mogu da izazovu smetnje u radu pa čak i havariju hidrauličkog sistema. Poznavanje i opisivanje fenomena koji prate hidraulički udar (interakcija fluida i strukture cjevovoda, razdvajanje strujnog toka i nestacionarno trenje) od izuzetnog je značaja za pouzdan i siguran rad postrojenja. Pravi put za razumijevanje ovog složenog fenomena je istraživanje u kontrolisanim laboratorijskim uslovima na eksperimentalnim instalacijama i provjera pretpostavki usvojenih u numeričkim modelima. U radu će biti razvijen numerički kod za proračun hidrauličkog udara koji uključuje sve navedene efekte što do sada nije urađeno.

Pregled dosadašnjih istraživanja

Izučavanje prelaznih procesa u hidrauličkim sistemima počelo je još u XIX vijeku kada su izvedene osnovne jednačine kojima se opisuje strujanje nestišljivog fluida u krutim i elastičnim cijevima, kao i izraz za brzinu prostiranja poremećajnog talasa. Osnove prelaznih procesa u hidrauličkim sistemima date su u **Wylie i Streeter** (1993) i **Chaudhry** (2014) gdje je izložen detaljan pregled istorijskog razvoja istraživanja prelaznih procesa u hidrauličkim sistemima.
U novije doba pravci istraživanja u oblasti prelaznih pojava kreću se u oblasti modeliranja sistema zaštite od hidrauličkog udara i istraživanja njegovih specijalnih efekata:

- modeliranje pojave parne i gasne kavitacije i razdvajanja toka prilikom prelaznih procesa
- uzimanje u obzir nestacionarnosti koeficijenta trenja,
- istraživanja interakcije fluida i fizičkog sistema (FSI efekat), kroz koji fluid struji, izazvane prelaznim procesom,
- viskoelastično ponašanje zida cijevi kod cjevovoda od plastičnih materijala (nije predmet istraživanja, pa neće biti razmatrano).

Bergant i dr. (2008) dali su prikaz matematičkih modela i studija slučaja specijalnih efekata hidrauličkog udara, odnosno parametara koji mogu značajno uticati na slabljenje, oblik i fazu talasa pritiska. Utvrđeno je da posmatrani fenomeni mogu uticati kako na slabljenje, tako i na jačanje talasa pritiska.

Raspad parnih i gasnih mjehurova tokom trajanja prelaznog procesa izaziva dodatne fluktuacije pritiska u sistemu koje mogu da izazovu oštećenje sistema, pa čak i njegovu havariju. Zbog toga je na pojavu kavitacije i na njeno pravilno modeliranje obraćena posebna pažnja. Pregled istraživanja u oblasti kavitacije u XX vijeku dali su **Bergant i dr.** (2006). Za opisivanje parne kavitacije u cjevovodima najviše je korišten DVCM (Discrete Vapour Cavity Model) model, a za opisivanje parne i gasne kavitacije DGCM (Discrete Gas Cavity Model) model. **Adamkowski i Lewandowski** (2012) uporedili su eksperimentalne rezultate sa DVCM modelom, dali vizuelni prikaz kavitacije i ukazali na pojavu distributivne kavitacije duž cjevovoda, a ne samo u blizini ventila. **Karadžić i dr.** (2014) uporedili su eksperimentalne rezultate sa rezultatima DGCM modela koji su pokazali dobro slaganje. **Traudt i dr.** (2015) eksperimentalno su ispitivali kavitaciju snimanjem kamerom visoke brzine i istražili uticaj kavitacionih mjehurova na prostiranje talasa pritiska. **Warda i Elashry** (2010) uporedili su eksperimentalne rezultate sa DVCM i DGCM modelom, dali vizuelni prikaz i objašnjenje procesa formiranja i raspada kavitacionih mjehurova. **Karadžić i dr.** (2018) numerički i eksperimentalno su analizirali hidraulički udar i kavitaciju i dali novu teorijsku analizu prostiranja talasa pritiska izazvanih istovremenim i odloženim zatvaranjem ventila na krajevima cjevovoda.

Problem nestacionarnosti trenja tokom trajanja prelaznih procesa zaokupio je pažnju naučnika u drugoj polovini prošlog vijeka. Nestacionarni koeficijent trenja može se izraziti kao zbir dva člana, kvazistacionarnog i nestacionarnog, pri čemu se kvazistacionarni član računa na konvencionalan način, a nestacionarni nekom od razvijenih metoda (Vardy 1980). Dva najviše korištena modela su konvolucijski model (**Zielke** 1968), gdje koeficijent trenja zavisi od trenutne srednje brzine strujanja i težinske funkcije i model za određivanje nestacionarnog člana u izrazu za koeficijent trenja prema kojem je on funkcija trenutne srednje vrijednosti brzine strujanja fluida, vrijednosti trenutnog lokalnog ubrzanja i vrijednosti trenutnog konvektivnog ubrzanja koji su razvili **Brunone i dr.** (1991). **Vitkovsky i dr.** (2004) predstavili su model nestacionarnog trenja u kome je težinska funkcija aproksimirana sumom eksponencijalnih članova unapređujući konvolucijski Zielke-ov i Vardy-Brown-ov metod. **Vardy i Brown** (2010) ispitivali su Zielke-ov metod određivanja nestacionarnog trenja i predložili poboljšanje. **Adamkowski i Lewandowski** (2012) uporedili su više modela nestacionarnog trenja i izvršili njihovu validaciju dobijenim eksperimentalnim rezultatima. **Duan i dr.** (2017) istražili su relevantnost i važnost nestacionarnog trenja i njegovog modeliranja kroz laboratorijske i testove na realnom sistemu uz numeričko modeliranje konvolucijskog i modela trenutnog ubrzanja. **Urbanowicz** (2018) je predstavio poboljšan model za izračunavanje nestacionarnog trenja koji je pokazao dobre rezultate.

U konvencionalnoj analizi hidrauličkog udara elastičnost cjevovoda je uzeta u obzir preko brzine prostiranja poremećajnog talasa. Inercija cjevovoda i njegovo aksijalno pomjeranje nije uzeto u obzir. Ovaj pristup je prihvatljiv za potpuno učvršćene cijevi. Za cjevovode koji se mogu pomjerati interakcija između fluida i strukture cjevovoda kroz koji fluid struji tokom trajanja prelaznog procesa mora se uzeti u obzir. Interakcija između fluida i strukture može se odigrati

kroz tri mehanizma: sprezanje trenja na zidu cijevi (*friction coupling*), Poasonovo sprezanje (*Poisson coupling*) i sprezanje u čvorovima sistema, na pozicijama ventila, koljena i sl. (*junction coupling*) (**Tijsseling** 1993, 1996). Detaljan pregled stanja istraživanja u ovoj oblasti dao je **Tijsseling** (1996). **Tijsseling** (1993) je istraživao različite mehanizme interakcije fluida i strukture cjevovoda za slučaj hidrauličkog udara sa kavitacijom. **Wiggert i dr.** (1985) ispitivali su uticaj koljena na talase pritiska u cjevovodu. **Lavooij i Tijsseling** (1991) predstavili su model sa četiri jednačine za opisivanje aksijalnog pomjeranja cjevovoda za koji je **Tijsseling** (1996) istakao da je dovoljan za opis ponašanja većine realnih cjevovoda. **Tijsseling** (2016) je dao pregled eksperimentalnih istraživanja interakcije fluida i strukture kod cjevovoda sa jednim koljenom. **Ferras i dr.** (2016) eksperimentalno su ispitivali različite mehanizme slabljenja talasa pritiska kod hidrauličkog udara. **Adamkowski i Lewandowski** (2012) istražuju eksperimentalno i numerički uticaj *Poisson coupling* efekta, kod interakcije fluida i strukture, na parametre cjevovoda. **Ferras i dr.** (2016) daju prikaz i poređenje sa eksperimentalnim rezultatima *friction coupling* mehanizma kod interakcije fluida i strukture. **Riedelmeier i dr.** (2017) vrše identifikaciju snage *junction coupling* mehanizma kod interakcije fluida i strukture. **Ferras i dr.** (2018) daju detaljan pregled jednodimenzionih modela interakcije fluida i strukture u cjevovodima pod pritiskom.

Na osnovu pregleda dosadašnjih istraživanja uočena je potreba za eksperimentalnim ispitivanjima i rezultatima za verifikaciju razvijenih numeričkih modela i proučavanje pojava koje prate hidraulički udar, u prvom redu interakcije fluida i strukture (FSI). FSI efekat obično se ne uključuje u proračune hidrauličkog udara iako može biti od velikog značaja. Takođe, u literaturi ne postoji numerički model koji obuhvata hidraulički udar i sve njegove specijalne efekte (interakcija fluida i strukture, razdvajanje toka, nestacionarno trenje) verifikovan adekvatnim eksperimentalnim rezultatima.

Cilj istraživanja

Cilj istraživanja u radu je bolje razumijevanje hidrauličkog udara, interakcije fluida i strukture (FSI), razdvajanja strujnog toka i nestacionarnog trenja kako bi se poboljšao dizajn cjevovoda i smanjila mogućnost havarija hidrauličkog sistema, što će se postići kroz:

- Otkrivanje koji od efekata dominantno utiču na intenzitet i trajanje poremećajnih talasa pritiska izazvanih hidrauličkim udarom pri različitim uslovima u sistemu;
- Izvođenje eksperimenata sa FSI efektom u kombinaciji sa drugim pojavama i analiza uticaja FSI efekta na ponašanje sistema;
- Razvoj numeričkih kodova za proračun hidrauličkog udara koji bi bili verifikovani eksperimentalnim rezultatima, a imali bi primjenu na realnim energetskim postrojenjima.

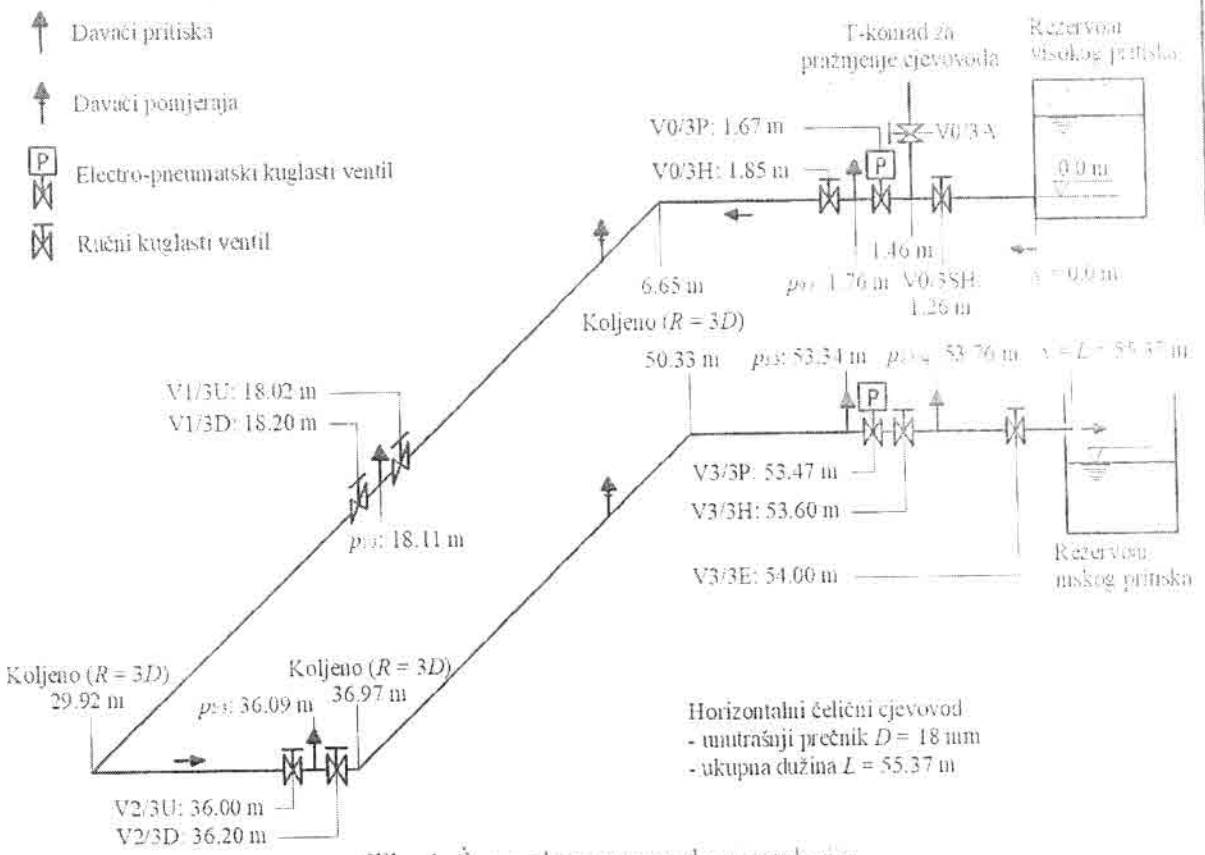
Materijali, metode i plan istraživanja

U radu će biti korištene analitičke, numeričke i eksperimentalne metode. Na osnovu dosadašnjih istraživanja u oblasti, biće dati numerički modeli ispitivanih pojava koji će biti korišteni prilikom izrade numeričkog koda. Eksperimentalna istraživanja vršiće se na instalaciji za ispitivanje hidrauličkog udara i njegovih pratećih efekata na Mašinskom fakultetu u Podgorici, dok će prilikom izrade numeričkog koda biti korišten softverski paket Matlab.

Istraživanje u radu odnosi se na eksperimentalno ispitivanje i numeričko modeliranje i ispitivanje hidrauličkog udara i njegovih pratećih efekata u vremenskom domenu. Biće razvijeni numerički modeli na bazi metode karakteristika, a njihova validacija izvršena poređenjem sa rezultatima dobijenim ispitivanjem na eksperimentalnoj instalaciji čiji su opis i šema dati u nastavku. Rezultati dobijeni eksperimentima, kao i numeričkim modelom, biće analizirani sa aspekta uticaja svakog od fenomena na talas pritiska.

Eksperimentalna instalacija za ispitivanje fenomena hidrauličkog udara, kavitacije i razdvajanja strujnog toka, interakcije fluida i strukture cjevovoda (FSI - fluid structure interaction), pumpnja i

pražnjenja cjevovoda, kao i nestacionarnog trenja je projektovana i napravljena na Mašinskom fakultetu u Podgorici u Laboratoriji za energetiku 2011 godine, a 2018 godine uradena su odredena unapređenja u cilju povećavanja njenih istraživačkih mogucnosti. Instalacija se sastoji od cjevovoda koji povezuje rezervoar visokog pritiska uzvodno sa rezervoarom niskog pritiska na nizvodnoj strani (čelični cjevovod ukupne dužine L=55.37 m; unutrašnjeg prečnika d=18 mm; debljine zida cjevovoda e=2 mm; najveći dozvoljeni pritisak u cjevovodu je p_{max_all} = 25 MPa) – Slika. 1. Četiri grupe ventila postavljene su duž cjevovoda uključujući početnu i krajnju tačku. Grupa ventila ispred uzvodnog rezervoara (pozicija 0/3) sastoji se od elektro-pneumatskog i ručnog kuglastog ventila, a ventilske grupe duž cjevovoda (pozicije 1/3 i 2/3), koje se nalaze na istoj međusobnoj udaljenosti, sastoje se od dva ručna kuglasta ventila (ventili V0/iU i V0/iD; i = 1, 2). U svakoj ventilskoj grupi se nalazi blok sa senzorima dinamičkog i apsolutnog pritiska. Na instalaciji postoji i T-komad sa dva ventila na uzvodnoj ventilskoj grupi koji služi za izvođenje eksperimenata punjenja i pražnjenja cjevovoda. Na instalaciji se nalaze 4 koljena (90°) sa poluprečnikom R=3D. Cjevovod je učvršćen protiv aksijalnih pomjeranja u 37 tačaka (blizu ventilskih grupa i koljena). Oslonci se opuštaju prilikom izvođenja eksperimenata koji uključuju FSI efekte. Vazdušni pritisak u uzvodnom rezervoaru (ukupne zapremine $\forall_{HPV}$ = 2 m^3; maksimalni dozvoljeni pritisak u rezervoaru $p_{HPV\,max\,all}$ = 2.2 MPa) može se podešavati do 800 kPa. Pritisak u rezervoaru prilikom svakog eksperimenta je konstantan zahvaljujući visoko preciznom regulatoru pritiska koji pripada grupi za snabdijevanje komprimovanim vazduhom. Duž cjevovoda pod pritiskom postavljena su četiri davača dinamičkog pritiska i četiri davača apsolutnog pritiska, koji se nalaze u ventilskim grupama (Slika 1.). Dinamički pritisci na pozicijama $p_{0/3}$, $p_{1/3}$, $p_{2/3}$ i $p_{3/3}$ se mjere pomoću Dytran 2300V4 visokofrekventnog pijezoelektričnog davača (mjerenje pritiska u opsegu 0÷69 bar, osjetljivost 5 mV/ 0.069 bar, preciznost ±0.1%), a apsolutni pritisci pomoću Keller PAA-M5 HB davača pritiska (mjerenje pritiska u opsegu 0÷30 bar, osjetljivost 10 mV/ 0.03 bar, preciznost ±0.1%). Referentni nivo za sve pritiske mjerene u cjevovodu i rezervoaru je na početku horizontalnog čeličnog cjevovoda (visina 0 m na Slici 1). Dva davača za mjerenje pomjeranja cjevovoda (HBM K WA-L010W 32K, mjerenje pomjeranja u opsegu 0-10 mm, preciznost ±0.2%) postavljena su na sopstvene nosače, pa mogu da se pomjeraju na različite pozicije duž cjevovoda. Temperatura vode se neprekidno mjeri pomoću termometra koji je montiran u posudi za skupljanje vode. Elektro-pneumatski ventili (V3/3P and V0/3P) su upravljani filtriranim komprimovanim vazduhom, dovedenim plastičnim crijevom od regulatora pritiska, čiji je pritisak nezavisan u odnosu na pritisak u sistemu. Prelazni proces može se izazvati brzim zatvaranjem ili otvaranjem ventila na nizvodnom kraju, koristeći ili V3/3P ili V3/3H ili pomoću ventila na uzvodnom kraju V0/3P. Ventili V3/3P i V3/3H opremljeni su senzorom (opseg mjerenja: 0° do 90°, frekventni odziv: > 10 kHz) koji mjeri promjenu ugla ventila (α) tokom zatvaranja ili otvaranja. Pored toga, prelazni procesi se mogu izazvati zatvaranjem ili otvaranjem ručnih ventila duž cjevovoda (ventili V0/3U; Vi/3U i Vi/3D; i =1, 2). Na rezervoaru visokog pritiska i na nizvodnom kraju cjevovoda, postavljena su dva davača statičkog pritiska ($p_{0/3\text{-}sg}$ i $p_{3/3\text{-}sg}$; opseg pritiska: od 0 MPa do 1 MPa, preciznost: ±0.5 %). Ovi davači se koriste za procjenu početnih uslova u sistemu. Za podešavanje protoka kroz instalaciju koristi se ručni kuglasti ventil (V3/3E). Protok (brzine vece od 0.3 m/s) se mjeri pomoću elektromagnetnog mjerača protoka (preciznost: ± 0.2%). Svi izmjereni podaci prikupljaju se pomoću mjerno-upravljačkog sistema (compact DAQ platforma proizvođača National Instruments) koji je povezan sa računarom, odakle se ujedno upravlja elektro-pneumatskim ventilima.



Slika 1. Šema eksperimentalne instalacije

Na eksperimentalnoj instalaciji planirano je izvođenje eksperimenata koji obuhvataju:

a) klasični hidraulički udar,
b) hidraulički udar sa kavitacijom i razdvajanjem strujnog toka,
c) hidraulički udar bez kavitacije sa uključenim FSI efektima – Poisson coupling,
d) hidraulički udar bez kavitacije sa uključenim FSI efektima – junction coupling,
e) hidraulički udar sa pojavom kavitacije i razdvajanja strujnog toka i sa uključenim FSI efektima – Poisson coupling,
f) hidraulički udar sa pojavom kavitacije i razdvajanja strujnog toka i sa uključenim FSI efektima – junction coupling,
g) istovremeno zatvaranje ventila na početku i kraju cjevovoda.
h) istovremeno otvaranje ventila na početku i kraju cjevovoda.
i vremenski odloženo zatvaranje ventila na početku i kraju cjevovoda.
j) vremenski odloženo otvaranje ventila na početku i kraju cjevovoda.

Svaki eksperiment će se izvoditi po tri puta za iste početne (protok, pritisak u rezervoaru visokog pritiska, vrijeme zatvaranja ventila) i granične uslove kako bi se obezbijedila ponovljivost eksperimenata. Natpritisak u rezevoaru visokog pritiska će se varirati od 0 do 4 bara. Početni pritisci u rezervoaru visokog pritiska će biti određeni tako da se na osnovu njihove vrijednosti zna da li će hidraulički udar biti praćen kavitacijom ili ne. Eksperimenti sa FSI efektima će se izvoditi nakon olabavljivanja cjevovoda na prethodno definisanim pozicijama, na koljenu, elektropneumatskom ventilu (junction coupling) i na dovoljno dugoj pravoj dionici cjevovoda (Poisson coupling). Senzori za mjerenje pomjeranja biće postavljani na pozicije u blizini ili na samom koljenu, te u blizini ventila (junction coupling) i na različite pozicije na pravoj dionici cjevovoda (Poisson coupling), kako bi na najbolji način bili snimljeni FSI efekti.

Očekivani naučni doprinos

Izvođenje eksperimenata sa FSI efektom u kombinaciji sa razdvajanjem strujnog toka i nestacionarnim trenjem koji su rijetki u poznatoj literaturi i razvoj numeričkog koda za proračun hidrauličkog udara koji uključuje sve navedene efekte što do sada nije urađeno.
Eksperimenti sa istovremenim i precizno vremenski odloženim zatvaranjem i otvaranjem dva ventila na početku i kraju sistema i odgovarajuće numeričke simulacije će omogućiti pravilnu teorijsku analizu prostiranja talasa pritiska izazvanog na ovaj način što je nešto što se ne može pronaći u poznatoj literaturi.

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SAGLASNOST PREDLOŽENOG/IH MENTORA I DOKTORANTA SA PRIJAVOM

Odgovorno potvrđujem da sam saglasan sa temom koja se prijavljuje.

Mentor	Prof. dr Uroš Karadžić	
Doktorant	Mr Radislav Brđanin	

IZJAVA

Odgovorno izjavljujem da doktorsku disertaciju sa istom temom nisam prijavio/la ni na jednom drugom Univerzitetu.

U Podgorici,
12.06.2019.

Radislav Brđanin

MP

BIOGRAFIJA

Radislav (Neđeljko) Brđanin, magistar industrijskog inženjerstva i menadžmenta, rođen je 4.7.1987. godine u Foči, Republika Srpska, Bosna i Hercegovina. Osnovnu školu završio je 2002. godine, a Gimnaziju 2006. godine u Bileći sa odličnim uspjehom. Diplomirao je 2010. godine odbranivši diplomski rad pod nazivom Faktor rizika pri izboru investicionih projekata u nestabilnim uslovima privređivanja (recesija i kriza) na Fakultetu za proizvodnju i menadžment Trebinje Univerziteta u Istočnom Sarajevu, Smjer industrijski menadžment, kao prvi diplomac generacije. Za školsku 2006/07, kao najbolji student Fakulteta, dobitnik je plakete Univerziteta u Istočnom Sarajevu. Studije II ciklusa završio je 2013. godine na Fakultetu za proizvodnju i menadžment Trebinje odbranivši završni/master rad, iz naučne oblasti Inženjerstvo i tehnologija, pod nazivom Razvoj neuronskih modela sa višestrukim izlazom. 2010. godine izabran je za asistenta Univerziteta u Istočnom Sarajevu na Fakultetu za proizvodnju i menadžment Trebinje. U zvanje višeg asistenta na Fakultetu za proizvodnju i menadžment Trebinje izabran je 2014. Godine. Od 2011. godine zaposlen je kao asistent na Fakultetu za proizvodnju i menadžment Trebinje Univerziteta u Istočnom Sarajevu gdje izvodi nastavu (vježbe) na predmetima iz oblasti Mašinstvo (Proizvodno mašinstvo i Energetika). Kao član projektnog tima učestvovao je i učestvuje na tri nacionalna i jednom bilateralnom projektu. Bio je član komisije za odbranu dva diplomska rada. Tokom 2017. godine bio je član Upravnog odbora JU Dom učenika Trebinje. Govori engleski jezik.

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NAUČNO-ISTRAŽIVAČKI PROJEKTI

1. Naučno-istraživački projekat "Istraživanje i razvoj poboljšanih mera zaštite hidroenergetskih postrojenja pri prelaznim procesima u cilju povećanja njihove pouzdanosti i energetske efikasnosti". Univerzitet Crne Gore, Mašinski fakultet i Univerzitet u Beogradu, Mašinski fakultet. Projekat sufinansiran od strane Ministarstva nauke Crne Gore i Ministarstva obrazovanja, nauke i tehnološkog razvoja Republike Srbije, 2019.-2020., (član radnog tima)

2. Naučno-istraživački projekat "Izrada žljeba zavojnih burgija kombinacijom postupaka valjanja i brušenja – I faza". Fakultet za proizvodnju i menadžment Trebinje. Projekat finansiran od strane Ministarstva za naučnotehnološki razvoj, visoko obrazovanje i informaciono društvo Republike Srpske, 2018.-2019., (član radnog tima)

3. Naučno-istraživački projekat "Razvoj CAD sistema za projektovanje alata za izradu žljeba zavojnih burgija". Fakultet za proizvodnju i menadžment Trebinje. Projekat finansiran od strane Ministarstva nauke i tehnologije Republike Srpske, 2013.-2014., (član radnog tima)

4. Naučno-istraživački projekat "Modeliranje stanja alata (zavojnih burgija) primjenom vještačke inteligencije". Fakultet za proizvodnju i menadžment Trebinje. Projekat finansiran od strane Ministarstva nauke i tehnologije Republike Srpske, 2013.-2014., (član radnog tima)

UCG
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MAŠINSKI FAKULTET UNIVERZITETA CRNE GORE
KOMISIJA ZA DOKTORSKE STUDIJE

PREDLOG KOMISIJE ZA ODBRANU POLAZNIH ISTRAŽIVANJA
kandidata mr Radislava Brđanina

Odlukom Senata Univerziteta Crne Gore br. 03-1066/2-1 od 06.06.2018 imenovan sam za mentora na izradi doktorske disertacije kandidatu mr Radislavu Brđaninu.

Pošto su se stekli uslovi za odbranu polaznih istraživanja, na osnovu razgovora sa kandidatom predlažem **Komisiju za odbranu polaznih istraživanja** za izradu doktorske disertacije **mr Radislava Brđanina** pod nazivom *„Eksperimentalna i numerička analiza parametara koji utiču na slabljenje, oblik i fazu talasa pritiska kod hidrauličkog udara"* u sledećem sastavu:

1. **Prof. Dr Igor Vušanović, predsjednik,**
2. **Prof. Dr Uroš Karadžić, mentor-član,**
3. **Doc. Dr Esad Tombarević, član.**

U Podgorici 12. 06. 2019.

MENTOR

Prof. Dr Uroš Karadžić

UNIVERZITET CRNE GORE
MAŠINSKI FAKULTET
MAŠINSTVO
Broj dosijea: 1/2016

Na osnovu člana 165 stava 1 Zakona o opštem upravnom postupku ("Službeni list RCG", broj 60/03.), člana 115 stava 2 Zakona o visokom obrazovanju ("Službeni list CG", broj 44/14.) i službene evidencije, a po zahtjevu studenta Brđanin Nedeljko Radislav, izdaje se

UVJERENJE O POLOŽENIM ISPITIMA

Student **Brđanin Neđeljko Radislav**, rođen **04-07-1987** godine u mjestu **Foča**, Republika **Bosna i Hercegovina**, upisan je studijske **2016/2017** godine, u I godinu studija, kao student koji se **samofinansira** na **doktorske akademske studije**, studijski program **MAŠINSTVO**, koji realizuje **MAŠINSKI FAKULTET** - Podgorica Univerziteta Crne Gore u trajanju od **3 (tri)** godine sa obimom **180** ECTS kredita.

Student je položio ispite iz sljedećih predmeta:

Redni broj	Semestar	Naziv predmeta	Ocjena	Uspjeh	Broj ECTS kredita
1.	1	DVOFAZNI TOK	"A"	(odličan)	6.00
2.	1	ENERGETSKA I EKSERGETSKA ANALIZA	"C"	(dobar)	6.00
3.	1	ODABRANA POGLAVLJA IZ TURBINA	"A"	(odličan)	6.00
4.	1	ODABRANA POGLAVLJA NUMERIČKIH METODA	"C"	(dobar)	6.00
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Ostvareni uspjeh u toku dosadašnjih studija je:
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Uvjerenje se izdaje na osnovu službene evidencije, a u svrhu ostvarivanja prava na: (dječji dodatak, porodičnu penziju, invalidski dodatak, zdravstvenu legitimaciju, povlašćenu vožnju za gradski saobraćaj, studentski dom, studentski kredit, stipendiju, regulisanje vojne obaveze i slično).

Broj: 1135
Podgorica, 13.06.2019 godine

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Date.

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O D L U K U
O IZBORU U ZVANJE

Dr IGOR VUŠANOVIĆ bira se u akademsko zvanje **redovni profesor** Univerziteta Crne Gore za predmete: Termodinamika, Energetika u saobraćaju, Kompjuterske metode u energetici i Mjerenje i simulacija energetskih procesa, na Mašinskom fakultetu.

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O D L U K U
O IZBORU U ZVANJE

Dr UROŠ KARADŽIĆ bira se u akademsko zvanje **vanredni profesor Univerziteta Crne Gore** za predmete: Pumpe, ventilatori i turbokompresori, Turbine, Projektovanje energetskih postrojenja i Hidroelektrane, na Mašinskom fakultetu., na period od 5 godina.

REKTOR

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Broj / Ref 03 - 547
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Na osnovu člana 72 stav 2 Zakona o visokom obrazovanju („Službeni list Crne Gore" br. 44/14, 47/15,40/16,42/17,71/17 i 55/18) i člana 32 stav 1 tačka 9 Statuta Univerziteta Crne Gore, Senat Univerziteta Crne Gore, na sjednici održanoj 12.02. 2019.godine, donio je

O D L U K U
O IZBORU U ZVANJE

Dr ESAD TOMBAREVIĆ bira se u akademsko zvanje **docent Univerziteta Crne Gore za oblast Termotehnika** (Energija i životna okolina – osnovne studije, studijski program Mašinstvo; Osnove tehnike hlađenja – osnovne studije, studijski program Mašinstvo; Klimatizacija – master studije, studijski program Mašinstvo; Energetska efikasnost u zgradarstvu – master studije, studijski program Energetska efikasnost) **na Mašinskom fakultetu Univerziteta Crne Gore, na period od pet godina.**

SENAT UNIVERZITETA CRNE GORE
PREDSJEDNIK

Prof.dr Danilo Nikolić, rektor

CURRICULUM VITAE

Igor Vušanović

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Education

2002	Ph.D. Degree, Mechanical Engineering, University of Montenegro;
1996	M.S. Degree, Mechanical Engineering, University of Montenegro;
1992	B.S. Mechanical Engineering Degree, University of Belgrade;

Employment

2016 –
Dean of Mechanical Engineering, University of Montenegro
2012 -
Full Professor, University of Montenegro, Faculty of Mechanical Engineering;
2008 – 2012
Associate Professor, University of Montenegro, Faculty of Mechanical Engineering;
2003-2008
Assistant Professor, University of Montenegro, Faculty of Mechanical Engineering;
1996-2002
Assistant (Second Level), University of Montenegro, Faculty of Mechanical Engineering;
1992-1996
Assistant (First Level), University of Montenegro, Faculty of Mechanical Engineering

Honors

Purdue University, School of Materials Engineering, USA, Visiting Scholar, Fellowship of Ministry of Science of Montenegro, 1999

Ministry of Science and Education Scholarship, 1989/90, 1990/91, and 1991/92. (granted to students with high scholastic record)

Grants

University of Belgrade, Best student of generation 1992

Professional Societies

ASHRAE, Associate Member, USA

Research Interests

The main thrust of my research is the mathematical and numerical modeling of macrosegregation and microsegregation during the solidification of multicomponent alloys. Macrosegregation phenomenon has been successfully described with standard set of conservation equations (mass, momentum, energy and compositions). Additional pressure drop due to the solidification usually describes with Darcy-law for pseudo porous media. Microsegregation phenomenon has been successfully described with different sets of equations, depending on phase that precipitates during the solidification process. Generic ternary phase diagram is described with equations that represent liquid's and solid's surface and binary troughs as well. Partition coefficient equations have been used in order to describe solid's surface. Mass ratio between phases for secondary and ternary solidification has been calculated using the well-known tie triangle rule. A limitation on predicting final material properties as a function of processing is the fact that the phenomena, which govern the final structure and properties, occur over a wide range of length scales, from the microscopic (micron to millimeter) to the macroscopic (millimeters to meters). We are interested in developing predictive capabilities to model the final multiscale structure of metal alloys during and after solidification. From a microscopic point of view, a solidification problem is one of understanding the growth of several solid phases from a liquid, which most often occurs, by the growth of microscopic dendritic structures. The morphology, the crystal structure, and the freezing/melting behavior of those dendrites and the mass diffusion fields around them have significant influence on the properties of the final cast part. These phenomena interact with the heat and mass transfer and fluid flow occurring at macroscopic length scales. A careful integration of predictive models that describe the multiscale development of microstructure and properties is necessary to advance the fundamental science of materials processing.

Ph.D. Thesis: "Analysis of Phase Change Phenomena in Multicomponent Systems with Aspects of Technical Applying"

M.S. Thesis: "Analysis of ice making and melting processes by using modify "enthalpy method", in ice storage systems"

References

USA

1. Vaughan R. Voller, Professor, Department of Civil, Enviromental and Geo – Engineering University of Minnesota, Minnesota, USA

2. Matthew J. M. Krane, Associate Professor, Materials Engineering, Purdue University, West Lafayette, IN, USA
3. Velimir Radmilović, Professor, National Center for Electron Microscopy, Lawrenc Berk ley National Laboratory, Berkeley, CA, USA
4. Vaughan R. Voller, Professor, Department of Civil, Environmental, and Geo Engineering, University of Minnesota, Minneapolis, MN 55455, USA

SLOVENIA

1. Dr Božidar Šarler, Professor, University of Nova Gorica, Laboratory for Multiphase Processes, Slovenia (http://www.p-ng.si/en/research/multiphase-processes/)

SERBIA

1. Dr Dimitrije Voronjec, Professor, Faculty of Mechanical Engineering, University of Belgrade, Belgrade, Yugoslavia
2. Dr Milovan Studović, Professor, Faculty of Mechanical Engineering, University of Belgrade, Belgrade, Yugoslavia

MONTENEGRO

1. Dr Petar Vukoslavčević, Professor, Faculty of Mechanical Engineering, University of Montenegro, Podgorica, Yugoslavia
2. Dr Nenad Kažić, Professor, Faculty of Mechanical Engineering, University of Montenegro, Podgorica, Yugoslavia

Research Activity

Over the past fifth ten years, I have studied:

- Modeling of two-phase flow (water-steam) in evaporator channels with couple of different mathematical models
- Phase change phenomena in ice water system using modify "enthalpy" method for describing energy balance equation
- Phase change phenomena during the solidification of two and three component alloys with special attention on Al-Cu-Mg alloy

During the undergraduate study and for graduate work I have developed different mathematical models for predicting heat and mass transfer in evaporator channels. The most simply model treat two phase mixture as homogenous, but it can be successfully used for calculating the pressure drop and temperature profiles in 1-D channels trough the time. Most advanced model of characteristics has been developed also, and it can be successfully used for predicting fast heat and mass transfer processes in evaporator channels. Those phenomena occur in many technical systems (stream generators, heat exchangers, and steam boilers) during the accident, which happens under the undesirable conditions.

During the Master degree study I made efforts to developing mathematical and numerical models for describing phase change phenomena in ice water system. Transport phenomena

during the phase change in ice water system are important in many systems of latent energy storage, which is commonly used for energy saving in processes that demand low energy consumption. Mathematical model for describing phase changes phenomena in ice water that's developed treat problem as 2-D unsteady. An energy balance equation is written with enthalpy instead of temperature, and special algorithm is developed for calculating local temperature and fraction of solid and liquid, knowing mixture enthalpy. Isothermal character of phase change phenomena was a main difficulty in order to get temperature and mass fraction of solid phase field from mixture enthalpy, known from governing equations.

During my Ph.D. study, I worked on mathematical and numerical modeling of transport phenomena in ternary Al-Cu-Mg alloy as multi-component system. Macrosegregation i.e. redistribution of alloying elements which occurs in ingot scale is usually induced by a relative movement of both solid and liquid phase during the casting process, and can be successfully described with standard set of transport equations (mass, momentum, energy and concentration). As a constitutive correlation for macroscopic set of equations, generic ternary phase diagram of ternary Al-Cu-Mg alloy and appropriate microsegregation model has been implemented. This microscopic model was used to compute local temperatures, solid and liquid fractions and compositions of both alloying elements. The different sets of equations were used for primary and subsequent solidifications. The non-equilibrium in primary phase is enforced as well as diffusion that is modeled 1-D planar model. Compositional profiles of Cu and Mg in primary, secondary and ternary phase can be calculated with represented model, as well as ratio between phases and diffusion of Cu and Mg in primary phase.

After finishing of my Ph.D. dissertation the main research is focused on experimental validation of macro and micro modeling of ternary Al alloys. Experimental installation is composed from metal mold, electrical heaters and water-cooled heat exchanger for heat removal during the casting. Temperature measurements have been performed at the all six sides of mold, while the measurements inside the mold are taken too. Aluminum based *Al-4wt%Cu-1wt%Mg* alloy was cast couple of times and temperature and compositional measurements have been cut and compared with predicted values. Also, alloy *Al-32wt%Cu-2wt%Mg* is also cast with similar conditions as previous mentioned. The purpose of those experiments is to evaluate model that was developed during my PhD study. Some of these results have been published at EUROTHERM 69 Conference, held in Slovenia 2003.

During the period 2004 – 2008 I participated in two separate projects in the frame of scientific cooperation with Slovenian institutions (University of Nova Gorica), and we successfully worked on developing of microsegregation codes for ternary commercial alloys (Al-Cu-Mg, Al-Mg-Si, Al-Fe-Si) which are of interest of company IMPOL d.d (www.impol.si) from Slovenska Bistrica. The all developed codes were successfully implemented in well known macroscopic mixture models and codes for vertical (VDC) and horizontal (HDC) casting of ternary aluminum alloys.

Teaching Experience

At the Faculty of Mechanical Engineering and Faculty of Metallurgy and Technology at University of Montenegro I have taught as an Assistant the following graduate courses:

- Thermodynamics

- Refrigeration systems,
- Steam Boilers,
- Heating and Ventilation,
- Fluid Mechanics.

After finishing my Ph.D. work after I was promoted in Assistant Professor I started teach two new established courses:

- Numerical Heat Transfer and Fluid Flow;
- Measuring and Simulations of Energy Processes;

These courses were performed for a first time at the Faculty of Mechanical Engineering in school year 2003/2004.

After 2006 I started teach

- Air conditioning at the Faculty of Mechanical Engineering;
- Thermodynamics at Maritime faculty in Kotor.

Igor Vušanović - Publications

A. Paper published or submitted for publishing in international review journals

1. E. Tombarević, I. Vušanović, "Numerical Analysis of Unsteady Heat Transfer in U-tube Geothermal Heat Exchanger", *ANNALS of Faculty Engineering Hudenoara – International Journal of Engineering*, Vol. 16(2), (2018) pp. 141-144. (ISSN 1584-2665)
2. I. Vušanović, V. R. Voller, "Best practice for measuring grid convergence in numerical models of alloy solidification", *International Journal of Numerical Methods for Heat and Fluid Flow*, Vol. 26 No. 2, (2016) pp. 1-14
3. I. Vušanović, V. R. Voller, "Simple metrics for verification and validation of macrosegregation model predictions", *IOP Conference Series: Materials Science and Engineering 117* (2016) 012062.
4. I. Vušanović, "Transient permeability in macrosegregation of static casting in binary alloys: Use of CDF statistical model for analysis ", *IOP Conference Series: Materials Science and Engineering 84* (2015) 012008.
5. V. R. Voller, I. Vušanović "Frequency Analysis of Macrosegregation Measurements and Simulations", *International Journal of Heat and Mass Transfer* 79 (2014) 468–471.
6. I. Vušanović, V. R. Voller, "Understanding channel segregates in numerical models of alloy solidification: A case of converge first and ask questions later ", *Materials Science Forum*, Vols. 790-791, pp. 73-78, (2014), Trans Tech Publications, Switzerland (doi:10.4028/www.scientific.net/MSF.790-791.732013).
7. E. Tombarević, V.R. Voller, I. Vušanović, "Detailed CVFEM Algorithm for Three Dimensional Advection-diffusion Problems ", (2013), *Computer Modeling in Engineering and Science* CMES, Vol. 96, no.1, pp. 1 – 29.
8. B. Šarler, R. Vertnik, A.Z. Lorbiecka, I. Vušanović, B. Senčič. Application of continuous casting simulation at Štore Steel, II. *BHM Berg Huettenmaennische Monatshefte, (2013)*, str. 1-9, doi: 10.1007/s0050101301477.
9. B. Šarler, R. Vertnik, A. Z. Lorbiecka, I. Vušanović, B. Senčič, "A multiscale slice model for continuous casting of steel", *IOP Conference Series: Materials Science and Engineering 33 (2012) 012021.*

10. J. D. Jovanović, E. M. Tombarević, I. C. Vušanović, "Control volume finite element method for modeling of spur gear frictional heat", (2013), *Technics Technologies Education Management – TTEM*, Vol. 8, No 2. 5/6.
11. I. Vušanović, M. J. M. Krane, "Macrosegregation in horizontal direct chill casting of ternary Al alloys: Investigation of solid motion", *IOP Conference Series: Materials Science and Engineering 27* (2011) 012069.
12. I. Vušanović, R. Vertnik, B. Šarler, "A simple slice model for prediction of macrosegregation in continuously cast billets", *IOP Conference Series: Materials Science and Engi-neering 27* (2011) 012056.
13. E. Tombarević, I. Vušanović, "Modeling of ice-water phase change in horizontal annulus using modified enthalpy method", (2011), *Advances in Applied Mathematics and Mechanics*, Vol. 3, No 3, pp. 354 – 369.
14. I. Vušanović, "Macrosegregation of ternary Al – 4.5Cu – 1.0Mg alloy in horizontal direct chill casting: implementation of non-equilibrium microsegregation model", (2009), *International Journal of Cast Metal Research*, Vol. 22, No 1 – 4, pp. 314 – 317.
15. M. J. M. Krane, I. Vušanović "Macrosegregation in horizontal direct chill casting of aluminum slabs", (2009), *Materials Science & Technology*, Vol. 25, No. 1, pp. 102 – 107.
16. I. Vušanović, B. Šarler, M.J.M. Krane, "Microsegregation during the solidification of an Al–Mg–Si alloy in the presence of back diffusion and macrosegregation", (2005), *Materials Science Engineering (A)*, Vol. 413 – 414, pp. 217 – 222.
17. A. Bergant, U. Karadžić, J. Vitkovsky, I. Vušanović, A. R. Simpson, " A Discrete Gas-Cavity Model that Considers the Frictional Effects of Unsteady Pipe Flow", (2005), *Strojniški vestnik – Journal of Mechanical Engineering*, Vol. 51(11), pp. 692 – 710.
18. I. Vušanović, M. J. M. Krane, "Microsegregation during solidification of Al-Cu-Mg alloys with varying composition". (2002), *International Communications in Heat and Mass Transfer*, Vol. 29, N° 1, (2002), pp. 1037-1046.
19. I. Vušanović, D. Voronjec, M.J.M. Krane, "Microsegregation phenomena in Al-Cu-Mg alloy with considering of diffusion phenomena in primary phase" *Facta Universitatis*, Vol. 1, N° 8, (2001), pp. 965 - 980.
20. V. Asanovic, B. Perovic, Z. Markovic, I. Vušanović, A. Kostov, "The influence of heat treatment on shape memory effect, *Materials Science Forum*, Vol. 352. (2000) pp. 165-170.
21. V. Asanović, B. Perović, Z. Marković-Leka, A. Kostov, I. Vušanović, "Thermoelastic Martensitic Transformation and Shape Memory Effect in Cu-Zn-Al Alloys," *Acta periodica technologica*, Vol. 31, (2000), Issue B, pp. 515-523.

B. Papers published in national Yugoslav journals (in Serbian; abstract in English)

1. M. Šekularac, I. Vušanović, "Dinamika sistema toplotne pumpe sa klima – komorom u rashladnom režimu rada", *KGH*, No. 3/2008, pp. 27 – 44, (2008).
2. I. Vušanović, M.J.M. Krane, "Matematički model mikrosegregacije u u Al-Cu-Mg leguri sa promjenljivim koncentracijama tokom očvršćavanja", *Termotehnika*, No. 1–4 Vol. 27 (2001), pp. 25–36.
3. V. Asanovic, B. Perovic, Z. Markovic, I. Vušanović, A. Kostov, "The influence of heat treatment on shape memory effect, *Journal of Technique*, No. 3/1999, Belgrade, 1999.

4. I. Vušanović, "Numerical modeling of phase change phenomena in ice – water system by using modify entalphy method", *Thermal Science – Journal of Heat Transfer Engineers*, No. 1-4/1998, Belgrade, 1998.
5. I. Vušanović, "Mathematical modeling of phase change phenomena in two component system, based on enthalpy approach", *Journal - Process Technique*, No. 2-3/1998, Belgrade, 1998.
6. N. Kazic, I.Vušanović, "The Phenomena of ice making process in ice storage systems", *KGH*, No. 2/1995, Belgrade, 1995.

C. **Papers published in the proceedings or international conferences (in English)**

1. M. Đekić, E. Tombarević and I. Vušanović, "Long term performance of building with vertical ground coupled heat pump system, *In P. Gvero (Ed.) Book of Abstracts of the 14th International Conference on Accomplishments in Mechanical and Industrial Engineering DEMI, May 24 – 25th, 2019, Banja Luka, Bosnia and Herzegovina.*
2. I. Vušanović, VR Voller, "Numerical Modeling of Solid Movement in Phase Change Processes", *ICCES: International Conference on Computational & Experimental Engineering and Sciences, March 25 – 28th, 2019, Tokyo, Japan.*
3. E. Tombarević, I. Vušanović "Experimental validation of a quasy-3D CVFEM model of borehole heat exchangers", *Fourth International Conference on Computational Methods for Thermal Problems, THERMACOMP 2016, July 6-8, 2016, Georgia Tech, Atlanta, USA, N. Massarotti, P. Nithiarasu and Y. Joshi (Eds.)*
4. I. Vušanović, "Transient permeability in macrosegregation of static casting in binary alloys: Use of CDF statistical model for analysis ",*Modeling of Casting, Welding and Advanced Solidification Processes (MCWASP XV 2015)* Awaji Island, Japan, *June* 2015.
5. I. Vušanović, V. R. Voller, "Simple metrics for verification and validation of macrosegregation model predictions", *4th International Conference on Advances in Solidification Processes*, Beaumont Estates, Old Windsor, UK, 2014.
6. I. Vušanović, V. R. Voller, "Effect of domain size on grid convergence in numerical models of alloy solidification", *Third International Conference on Computational Methods for Thermal Problems, THERMACOMP 2014, June2-4, 2014, Lake Bled, Slovenia, (N. Massarotti, P.Nithiarasu and B. Šarler (Eds.)*
7. E. Tombarević, I. Vušanović, "Numerical Model of Heat flow in a Geothermal borehole heat exchanger ", *Third International Conference on Computational Methods for Thermal Problems, THERMACOMP 2014, June2-4, 2014, Lake Bled, Slovenia, (N. Massarotti, P.Nithiarasu and B. Šarler (Eds.)*
8. B. Šarler, A. Z. Lorbiecka, U. Hanoglu, R. Vertnik, I. Vušanović, "A meshless slice model for continuous casting and hot rolling of steel. " V: LIU, Gui-Rong (ur.), LIU, Z. S. (ur.). Proceedings of the 5th Asia Pacific Congress on Computational Mechanics (APCOM2013) and 4th International Symposium on Computational Mechanics (ISCM2013), 11th -14th December 2013, Singapore.
9. I. Vušanović, V. R. Voller, "Understanding channel segregates in numerical models of alloy solidification: A case of converge first and ask questions later ", *The 6th International Conference on Solidification and Gravity,* Miskolc Lillafured, Hungary, *2 – 6th September 2013.*
10. B. Šarler, R. Vertnik, A. Z. Lorbiecka, U. Hanoglu, I. Vušanović, " An Extended Heat and Mass Transfer Slice Model for Continuous Casting of Steel", *ECCOMAS Special Interest*

Conference Numerical Heat Transfer , Gliwice-Wroclaw, Poland , *4-6 September 2012*. Eds.: A. Nowak, R.A. Białecki

11. E. Tombarević, I. Vušanović, "Control Volume Finite Element Method for two and three dimensional advection-diffusion problems", *ICCES Special Symposium on Meshless & Other Novel Computational Methods*, Budva, Montenegro, *September 2012.*
12. B. Šarler, R. Vertnik, A. Z. Lorbiecka, I. Vušanović, B. Senčič, "A multiscale slice model for continuous casting of steel", *Modeling of Casting, Welding and Advanced Solidification Processes (MCWASP XIII 2012)*, Schladming, Austria, *June 2012*
13. I. Vušanović, R. Vertnik, B. Šarler, "A simple slice model for prediction of macrosegregation in continuously cast billets: influence of different solid diffusion models", *International symposium on liquid metal processing and casting, LMPC*, Nancy, France, *September, 2011*
14. I. Vušanović, R. Vertnik, B. Šarler, "A simple slice model for prediction of macrosegregation in continuously cast billets",*3rd International Conference on Advances in Solidification Processes*, Rolduc Abbey/Aachen, Germany, *June 2011*
15. I. Vušanović, M. J. M. Krane, "Macrosegregation in horizontal direct chill casting of ternary Al alloys: Investigation of solid motion", *3rd International Conference on Advances in Solidification Processes*, Rolduc Abbey/Aachen, Germany, *June 2011*
16. E. Tombarević, I. Vušanović, "3D Numerical model of the borehole heat exchanger", *Slovenian-Italian Conference on Materials and Technologies for Sustainable Growth*, University of Nova Gorica, Ajdovščina, Slovenia, *May 2011*
17. I. Vušanović, "Energy efficiency in building sector: solutions for heating and air conditioning in Montenegro", *Third International Conference GNP 2010*, Žabljak, Montenegro, 2010.
18. E. Tombarević, I. Vušanović, "Modelling of ice melting in horizontal annulus using enthalpy method", *First International Conference on Computational Methods for Thermal Problems*, ThermaComp 2009, Naples, Italy, 2009.
19. E. Tombarević, I. Vušanović, "Influence of inner pipe wall temperature on freezing of water in a horizontal cylindrical annulus", *EUROTHERM Nr. 84 Thermodynamics of phase change*, Namur, Belgium, 2009.
20. I. Vušanović, "Macrosegregation of ternary Al – 4.5wt%Cu – 1.0wt% Mg alloy in horizontal direct chill casting – implementation of non-equilibrium microsegregation model" *Proceedings of the Second International Conference on Advances in Solidification Processing*, Graz/Seggau, Austria, *June 2008*.
21. M. Šekularac, I. Vušanović, "Mathematical modeling of HVAC instalations", *Klima Forum 2007*, Godovič, Slovenia, *September 2007*
22. I. Vušanović, I. Vujošević, "Energy efficiency strategy in Montenegro – implementation and challenges", *Klima Forum 2007*, Godovič, Slovenia, *September 2007.*
23. I. Vušanović, B. Šarler, "Modeling of micro and macro segregation in DC casting of ternary Al based alloys", *EUROMAT 2007*, Nurnberg, Germany, *September 2007.*
24. I. Vušanović, M. J. M. Krane, "Macrosegregation in horizontal direct chill casting (HDC) of aluminium binary alloys billets- influence of casting parameters," *in Solidification Processing 07*, H. Jones et al. (eds.), pp 428-432 (2007).
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26. U. Karadžić, A. Bergant, I. Vušanović, "Influence of unsteady friction on transients in hydraulic pipeline systems", 12th *Symposium on thermal science*, Sokobanja, Serbia, *October 2005*.
27. N. Kažić, I. Vušanović, "Exergy and HVAC", *Klima forum 2006*, Godovič, Slovenia, *September 2006*.
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30. I. Vušanović, M.J.M. Krane, "Mathematical model for microsegregation of Al rich Al-Cu-Mg alloys with considering of diffusion in primary phase", *II International Symposium LIGHT METALS AND COMPOSITE MATERIALS*, Belgrade, Serbia & Montenegro, 2004.
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34. V.D. Asanovic, B. Perovic, Z. Markovic, A. Kostov, I. Vušanović, "Thermoelastic martensitic transformation and shape memory effect in Cu-Zn-Al alloys", *YUCFPCE (Yugoslav Congress of food, pharmaceutical and Chemical engineering)*, Novi Sad, 1999.
35. I. Vušanović, "Numerical modeling of phase change in ice-water system by using modify entalphy method", 10th *Symposium YU - TERM '97*, Zlatibor, 1997.
36. I. Vušanović, N. Kažić, "One numerical approach to the process in the ice storage device", 12th *International Congress of Chemical and Process Engineering - CHISA '96*, Prague, 1996.
37. I. Vušanović, V. Stevanovic, M. Studovic, "Transferring of waves in evaporator channel with disturbances of intake fluid flow", 24th *Congress KGH*, Belgrade, 1993.
38. I. Vušanović, V. Stevanovic, M. Studovic, "Mathematical model of forced and natural circulation – Modular approach", 23rd *Congress KGH*, Belgrade, 1992.

D. **Papers published in the proceedings of domestic conferences (in Serbian)**

1. Karadžić, U., Bergant, A., Vušanović, I. "Validacija konvolucijskog modela nestacionarnog trenja za prelazne procese u hidrauličkim cijevnim sistemima", *30. HIPNEF sa međunarodnim učešćem 24-26 maj*, Vrnjačka Banja, Srbija, 2006.
2. V.D. Asanovic, B. Perovic, Z. Markovic, I. Vušanović, "Aging effect on shape memory in Cu-25.38Zn-3.3Al", *XXXIX Meeting of Serbs Chemical Society*, Belgrade, 1999.
3. V. Asanovic, B. Perovic, Z. Markovic, I. Vušanović, A. Kostov, "The influence of heat treatment on shape memory effect", *YUCOMAT '99*, Herceg Novi, 1999.

4. I. Vušanović, N. Kazic, "Analysis of ice making process with various regimes of work of ice storage and their influence on efficiency of system", *Industrial Energetics '96*, Herceg Novi, 1996.
5. I. Vušanović, "Model simulation of thermohydraulic instabilities in two phase flow", *Symposium "Thermohydraulics '94"*, Belgrade, 1994.
6. N. Kazic, I. Vušanović, "Processes of making and melting of ice in ice storage systems", *Industrial Energy '94*, Belgrade, 1994.
7. I. Vušanović, N. Kazic, "Numerical Modeling of natural convection in Thermal Cavity", *Industrial Energy '94*, Belgrade, 1994.

E. International & National Scientific Projects on which I. Vušanović participated

1. I. Vušanović, V. R. Voller, M. Valant, E. Tombarević, "Numeričko i eksperimentalno istraživanje mogućnosti korišćenja geotermalne energije za potrebe rada geotermalnih toplotnih pumpi", Ministarstvo nauke Crne Gore, 2012 – 2015.
2. I. Vušanović, B. Šarler, " Modelling of industrial solidification processes under influence of electromagnetic fields", *Financed and supported by Ministry of Science of Montenegro and Ministry of Science, Education and sport of Slovenia, BI – SCG/2014 – 2015.*
3. V. Novaković, M. Vukčević, I. Vušanović, "HERD QIMSEE – Higher Education Research & Development – Quality Improvement in Science, Engineering and Education, Financed by Norwegian Ministry of foreign affairs with NTNU University, Trondheim, 2014 – 2016.
4. I. Vušanović, W. Chen, "Implementation of fast meshless simulations methods on solid mechanics and heat transfer problems in large scale structures", Financed and supported by Ministry of Science of Montenegro and Ministry of Science of China, in the frame of Montenegrin - Chinese Science & Technology cooperation BI – CHN/2014 – 2016.
5. I. Vušanović, B. Šarler, " Advanced modeling of continuous casting of steel", Financed and supported by Ministry of Science of Montenegro and Ministry of Science, Education and sport of Slovenia, BI – SCG/2012 – 2013.
6. I. Vušanović, B. Šarler, "Multiscale modeling of continuous casting of steel", Financed and supported by Ministry of Science of Montenegro and Ministry of Science, Education and sport of Slovenia, BI – SCG/2010 – 2011.
7. I. Vušanović, B. Šarler, " Modeling of micro and macrosegregation of ternary aluminium alloys obtained through DC casting and twinroll casting", Financed and supported by Ministry of Science of Montenegro and Ministry of Science, Education and sport of Slovenia, BI – SCG/06-07.
8. I. Vušanović, B. Šarler, "Modeling of phase change phenomena in Al alloys", Financed and supported by Ministry of Science of Montenegro and Ministry of Science, Education and sport of Slovenia, BI – SCG/04-05.
9. D. Gobin, B. Šarler, I. Vušanović, " Advances in simulation capabilities for solidification systems", Programme ECO-NET 2005.
10. I. Vušanović, "Development of ternary microsegregation models for direct-chill casting and twin-roll strip casting of Al based alloys, *IMPOL d.d., 2004.*

11. I. Vušanović, "Measuring and Simulation of Energetic Processes", *CDP+ Project No. 011 (2) supported and financed by WUS Austria, 2005.*

F. Graduate students supervisions

F.1 Master thesis – Advisor (A) and Committee member (M)

1. Marko Đekić, "Energy use analysis of residential building equipped with heat pumps in Montenegro", University of Montenegro, Faculty of Mechanical Engineering, October 2017. (A).
2. Esad Tombarević, " Modelling of phase change in ice storage with horizontal pipe", University of Montenegro, Faculty of Mechanical Engineering, March 2009. (A).
3. Milan Šekularac, "Analysis of dynamic of operation of a HVC system heat pump – air conditioning unit", University of Montenegro, Faculty of Mechanical Engineering, July 2008. (A)
4. Uroš Karadžić, "Analysis fluid transients phenomena in hydraulic systems", University of Montenegro, Faculty of Mechanical Engineering, October 2004. (A)
5. Sanja Radović, "Investigation of controlled cooling in continuous rolling of iron bars", University of Montenegro, Faculty of Metallurgy and Technology, University of Montenegro, December 2004. (M)

F.2 Ph.D thesis – Advisor (A) and Committee member (M)

6. Esad Tombarević, "Analysis of unsteady heat transfer in the geothermal u-tube borehole heat exchangers" PhD thesis, University of Montenegro, Faculty of Mechanical Engineering, July 2016. (A)
7. Uroš Karadžić, "Modelling of complex boundary conditions for transients in hydraulic systems", University of Montenegro, Faculty of Mechanical Engineering, November 2008. (M)

G. Lectures

1. I. Vušanović, "Current Challenges in Modeling Solidification Processes", Warren Lecture Series at Department of Civil, Enviromental and Geo – Engineering, University of Minnesota, September 2017 (invited lecture).
2. I. Vušanović, "Modeling issues in transport phenomena with phase change in multicomponent systems ", Nanjing University, February 2014 (invited lecture)
3. I. Vušanović, " Micro and Macrosegregation during the DC casting in ternary Al", University Pierre & Marie CURIE, Fast Laboratory, September 2006, (seminar);
4. I. Vušanović, " Micro-macrosegregation in ternary alloys - review of previous work and future challenges", University of Birmingham, School of Engineering, June 2006, (invited lecture);
5. I. Vušanović, "Numerical and experimental modeling of macrosegregation in ternary aluminum alloys, Nova Gorica Polytechnic, March, 2004 (invited lecture)

H. Strategies Expertise on which I. Vušanović participated as an author or co – author (on serbo-croatian)

1. N. Kažić, P. Vukoslavčević, D. Ivanović, I. Vušanović, U. Karadžić, V. Ivanović, E. Tombarević, M. Šekularac, "Elaborat za rješavanje problema zagadjenosti u Pljevljima, Centar za Energetiku, Mašinski fakultet UCG, Jun 2015.
2. I. Vušanović, "Crna Gora u XXI stoljeću u eri kompetitivnosti, Podprojekat ENERGIJA, *Crnogorska Akademija Nauka i Umjetnosti (CANU)*, Podgorica, April 2010 (u izradi).
3. H. Birkeland, K. O. Nerland, V. Rodić Igor Vušanović, "Montenegro - Prestudy Energy Efficiency and Renewable Energy Agency in Montenegro", *NORSK ENERGY*, Project No. 04 – 28499, *April 2008.*
4. I. Vujošević, I. Vušanović, F. Daganaud, "Energy Efficiency Strategy for Montenegro with action plan for 2005 – 2006", *Technical assistance to the Ministry of Economy and EPCG*, Podgorica, *April 2005.*
5. I. Vušanović, V. Ćulafić, R. Bulatović, D. Bajić, M. Janjić, "Elaborat Stručne Komisije u Vezi havarije na Autoklavu Ra15 u Fabrici Glinica u KAP-u", *Mašinski fakultet Univerziteta Crne Gore*, Podgorica, *Novembar 2004.*

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	Name	*Years Attended*	*Degree Obtained*	*Major Subject of Study*
	University of Montenegro, Faculty of Mechanical Engineering	**2005 – 2008**	**PhD ME**	**Research on Fluid Transients Phenomena on Perućica HPP, Montenegro**
	University of Montenegro, Faculty of Mechanical Engineering	**2000 – 2004**	**MSc ME**	**Fluid Transients, Water Hammer, Unsteady Friction**
	University of Montenegro, Faculty of Mechanical Engineering	**1992 - 1999**	**BSc ME**	**Air Conditioning**

7.	**Additional Education Information**	
	Scholarships or Academic Distinctions:	1. Scholarship from The Ministry of the Republic of Slovenia for Education, Science and Sport for two months (January 2005 – February 2005)
	Publications:	***1. Books*** 1. Vukoslavčević P., **Karadžić U.** (2010). Fundamentals of Fluid Mechanics. *Textbook, University of Montenegro, Faculty of Mechanical Engineering,* Podgorica, Montenegro. (in Serbian) ***2. Disertations*** 1. **Karadžić U.** (2008). Modelling of complex boundary conditions for transients in hydraulic systems. *PhD thesis, Faculty of Mechanical Engineering, University of Montenegro,* Podgorica, Montenegro.(in Serbian) 2. **Karadžić, U.** (2004). Analysis fluid transients phenomena in hydraulic systems. *Master thesis, Faculty of Mechanical Engineering, University of Montenegro,* Podgorica, Montenegro.(in Serbian) ***3. Monographs*** *3.1. Part of scientific monograph* 1. **Karadžić, U.** (2005). Fluid transients and unsteady friction in hydraulic pipeline systems. *Monograph 35 years of mechanical engineering studies in Montenegro, University of Montenegro, Faculty of Mechanical Engineering,* Podgorica, Montenegro. (in Serbian) ***4. Journal papers*** *4.1. Journal with impact factor* 1. **Karadžić U.**, Janković M., Strunjaš F., Bergant A. (2018). Water hammer and column separation induced by simultaneous and delayed closure of two valves. *Strojniški Vestnik-Journal of Mechanical Engineering,*

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2. Bergant A., Tijsseling A. Kim Y., **Karadžić U.**, Zhou L., Lambert M.F., Simpson A.R. (2018). Unsteady pressures influenced by trapped air pockets in water-filled pipelines. *Strojniški Vestnik-Journal of Mechanical Engineering*, 64(9), 501-512. DOI:10.5545/sv-jme.2018.5238

3. Vujadinović R., Tombarević E., **Karadžić U.** (2017). Valorization of potentials of wind energy in Montenegro. *Thermal Science*, 21(5), 1893-1903. doi:10.2298/TSCI161201016V

4. **Karadžić U.**, Bulatović V., Bergant A. (2014). Valve induced water hammer and column separation in pipeline apparatus. *Strojniški Vestnik-Journal of Mechanical Engineering*, 60(11), 742-754.

5. **Karadžić U.**, Kovijanić V., Vujadinović R. (2014). Possibility for hydro energetic utilization of relatively researched water streams. *Water Resources*, 41(6), 774-781.

6. **Karadžić U.**, Bergant A., Vukoslavčević P. (2009). A novel Pelton turbine model for water hammer analysis. *Strojniški Vestnik-Journal of Mechanical Engineering*, 55(6), 369-380.

7. Bergant, A., **Karadžić, U.**, Vitkovsky, J., Vušanović, I., and Simpson, A.R. (2005). A Discrete Gas-Cavity Model that Considers the Frictional Effects of Unsteady Pipe Flow. *Strojniški Vestnik-Journal of Mechanical Engineering*. 51(11), 692-710.

4.2. Journal without impact factor

1. **Karadžić U.**, Bergant A.(2018). Experimental investigations of pipeline filling and emptying in a small scale apparatus. *JET Journal of Energy Technology*, Vol.11, Issue 2, pp 11-22, ISSN 1855-5748.
2. Bergant A., Mazij J., **Karadžić U.** (2018). Design of water hammer control strategies in hydropower plants. *Applied engineering letters*, Vol.3, No.1, pp 27-33, e-ISSN 2466-4847, https://doi.org/10.18485/aletters.2018.3.1.5
3. Kuljić S., **Karadžić U.** (2017). Hydraulic analysis of water supply system in town Nevesinje. *Machine design*, Vol.9, No.4, pp 155-160, ISSN

1821-1259, DOI: 10.24867/MD.9.2017.4.155-160.
4. Bergant A., **Karadžić U.**, Tijsseling A. (2017). Developments in multiple-valve pipeline column separation control. *IOP Conf. Series:* Journal of Physics: Conf. Series, 813, doi:10.1088/1742-6596/813/1/012015.
5. Bergant A., **Karadžić U.**, Tijsseling A. (2016). Dynamic water behavior due to one trapped air pocket in a laboratory pipeline apparatus. *IOP Conf. Series: Earth and Environmental Science*, Vol.49, doi:10.1088/1755-1315/49/5/052007.
6. Vujadinović R., **Karadžić U.** (2016). Techno-economic analysis of the project Možura wind park with installed capacity of 46 MW, *Energetika-Ekonomija-Ekologija,* ISSN 0354-8651, god. XVIII, (in Montenegrin)
7. Vujadinović R., **Karadžić U.** (2015). Education of local governments as a way towards sustainable development of the countries of the Western Balkans – case study of Montenegro. *EJSDR European Journal of Sustainable Development Research,* Vol.1, Issue 1, pp 63-71.
8. Bergant A., **Karadžić U.** (2015). Numerical and experimental investigations of transient cavitating pipe flow. *JET Journal of Energy Technology,* Vol.8, Issue 2, pp 31-42.
9. **Karadžić U.**, Vujadinović R. (2013). Hydro potential of Montenegro – status, perspective of utilization and legislative framework. *Energetika-Ekonomija-Ekologija,* ISSN 0354-8651, god. XV, (in Serbian)
10. **Karadžić U.**, Bergant A., Vukoslavčević P., Sijamhodžić E., Fabijan D. (2011). Water hammer caused by shut-off valves in hydropower plants. *JET Journal of Energy Technology,* Vol.4, Issue 2, pp 47-54.
11. Vujadinović R., Bošković Lj., **Karadžić U.** (2011). Renewable energy sources as alternative to diesel generators in telecommunications companies. *Energetika-Ekonomija-Ekologija,* ISSN 0354-8651, god. XIII, br.2, pp 178-184. (in Serbian)
12. **Karadžić U.**, Bergant A., Vukoslavčević P. (2010). Water hammer caused by closure of turbine safety spherical valves. *IOP Conf. Series: Earth and Environmental Science*, Vol.12, pp 1-8.

5. Publications on conferences, symposiums and seminars

5.1. International conferences

1. Brđanin R., Ilić J. **Karadžić U.**, Bergant A. (2019). Experimental water hammer setup at University of Montenegro – description and possibilities. *DEMI 2019 - 14th International Conference on Accomplishments in Mechanical and Industrial Engineering*, Banja Luka, Republic of Srpska, BiH, 24-25 May, pp 195-200.

2. Vilotijević V., **Karadžić U.**, Božić I., Ilić J. (2019). Design discharge determination for SHPPs with capacity below 1 MW. *DEMI 2019 - 14th International Conference on Accomplishments in Mechanical and Industrial Engineering*, Banja Luka, Republic of Srpska, BiH, 24-25 May, pp 297-302.

3. Ilić J., Božić I., **Karadžić U.**, Brđanin R. (2019). Comparative analysis of the hydro power plant transient processes for various surge tank types and improved guide vanes closing law. *DEMI 2019 - 14th International Conference on Accomplishments in Mechanical and Industrial Engineering*, Banja Luka, Republic of Srpska, BiH, 24-25 May, pp 215-222.

4. **Karadžić U.**, Iliev V., Bergant A. (2018). Fluid structure interaction effects in small-scale pipeline apparatus. *International Conference Energy and Ecology Industry*. Belgrade, Serbia, 10-13 October.

5. Vilotijević V., **Karadžić U.**, Vušanović I. (2018). Determination of the degree of installed flow in small hydropower plants. *International Conference Energy and Ecology Industry*. Belgrade, Serbia, 10-13 October.

6. **Karadžić U.**, Janković M., Strunjaš F. (2017). Influence of the initial conditions on water hammer in reservoir-pipeline-valve system. *DEMI 2017 - 13th International Conference on Accomplishments in Mechanical and Industrial Engineering*, Banja Luka, Republic of Srpska, BiH, 26-27 May.

7. Vuković D., Vilotijević V., **Karadžić U.** (2017). Hydraulic transients calculations on Komarnica HPP.

DEMI 2017 - 13th International Conference on Accomplishments in Mechanical and Industrial Engineering, Banja Luka, Republic of Srpska, BiH, 26-27 May.

8. Bergant A., **Karadžić U.** (2015). Developments in valve-induced water hammer experimentation in a small-scale pipeline apparatus. *12th International Conference on Pressure Surges, BHR Group*, Dublin, Ireland, 18-20 November.

9. **Karadžić U.**, Bergant A., Mavrič R., Strunjaš F., Buckstein S. (2015). Developments in pipeline filling and emptying experimentation in a laboratory pipeline apparatus. *6th IAHR International Meeting of the Workgroup on Cavitation and Dynamic Problems in Hydraulic Machinery and Systems*, Ljubljana, Slovenia, September 09-11.

10. Bulatović V., **Karadžić U.**, Bergant A. (2013). Investigation of water hammer and column separation in unsteady friction dominated pipeline apparatus. *5th IAHR International Workshop on Cavitation and Dynamic Problems in Hydraulic Machinery, EPFL*, Lausanne, Switzerland, September 08-11.

11. Bergant A., Mazij, J., **Karadžić U.**, Gale, J. (2013). Assessment and mitigation of water hammer effects in hydropower plants on environment. *ENRE 3rd International Conference Energy Technology*, Velenje, Slovenia, 20-21 June.

12. Prvulović S., **Karadžić U.** (2012). Application of analytical hierarchy process in the selection of optimal technological solutions. II *International Conference Industrial Engineering and Environmental Protection IIZS*, University of Novi Sad, Technical faculty of Mihajlo Pupin, Zrenjanin, Serbia, 31st October.

13. Vujadinović R., **Karadžić U.** (2012). Use of aluminium in the production of cars. II *International Conference Industrial Engineering and Environmental Protection IIZS*, University of Novi Sad, Technical faculty of Mihajlo Pupin, Zrenjanin, Serbia, 31st October.

14. Bergant A., Anderson A., Nicolet C, **Karadžić U.** Mazij J. (2012). Issues related to fluid transients in refurbished and upgraded hydropower schemes. *11th International Conference on Pressure Surges, BHR*

Group, Lisbon, Portugal, 24-26 October.

15. **Karadžić U.** Bergant A. (2012). Pipeline apparatus for investigation of water hammer and column separation phenomena at the University of Montenegro. 2nd *IAHR Europe Congress*, TUM, Munich, Germany, 27-29 June.

16. Kovijanić V., **Karadžić U.** Vujadinović R. (2012). Assessment of possibility for hydro energetic utilization of small water streams. *Hidroenergia 2012*, Wroclaw, Poland, 23-26 May.

17. **Karadžić U.**, Bergant A., Vukoslavčević P. (2011). Influence of unsteady friction on hydraulic transients in a high-head hydropower plant. *4th IAHR International Meeting of the Work Group on Cavitation and Dynamic Problems in Hydraulic Machinery and Systems, Faculty of Mechanical Engineering, University of Belgrade*, Belgrade, Serbia, October 26-28, pp 313-320.

18. **Karadžić U.**, Bergant A., Vukoslavčević P. (2009). Water hammer effects during Pelton turbine load rejection. *3rd IAHR International Meeting of the Work Group on Cavitation and Dynamic Problems in Hydraulic Machinery and Systems, Brno University of Technology, Brno, Czech Republic October* 14-16, pp 443-452.

19. **Karadžić U.**, Bergant A., Vukoslavčević P. (2008). Parameters affecting water hammer in a high-head hydropower plant with Pelton turbines. *10th International Conference on Pressure Surges, BHR Group*, Edinburgh UK, 14-16 May, pp 351-364.

5.2. National and local conferences

1. Brđanin R., **Karadžić U.**, Ilić J. Božić I. (2019). Comparison of dynamic pressure transducers on experimental water hammer setup. 7th *Regional Conference Industrial Energy and Environmental Protection in South-Eastern Europe, IEEP 2019*. Zlatibor, Serbia, 19-22 June.

2. **Karadžić U.** (2019). Hydraulic transient calculation in case of Vrelo SHPP. *VI Symposium CG KO CIGRE*,

Bečići, Montenegro, 14-17 May. (in Montenegrin)

3. Radonjić N., Perišić V., **Karadžić U.**, Vujadinović R. (2017). The analysis of investments in renewable energy. *V Symposium CG KO CIGRE*. Bečići, Montenegro, 09-12 May. (in Montenegrin)

4. Janković M., Strunjaš F., Bergant A., **Karadžić U.** (2017). Hydraulic transients due to gradual valve closure. *V Symposium CG KO CIGRE*. Bečići, Montenegro, 09-12 May. (in Montenegrin)

5. Rakočević S., Mićanović M., Bošković Lj., **Karadžić U.**, Vujadinović R. (2017). Criteria for the selection of the installed flow of small hydropower plants. *V Symposium CG KO CIGRE*. Bečići, Montenegro, 09-12 May. (in Montenegrin)

6. Ćipranić I., Sekulić G., Bošković Lj., **Karadžić U.** (2016). Design principles of small hydropower plants and their integration into the environment. 6th International conference GNP, Žabljak, Montenegro, 07-11 March. (in Montenegrin)

7. Mazij, J., Bergant, A., **Karadžić, U.** (2015). Critical parameters of hydraulic transient regimes in hydropower plants with complex water conveyance systems. *IV Symposium CG KO CIGRE*. Herceg Novi, Montenegro, 11-14 May.

8. Bošković, Lj., **Karadžić, U.**, Drašković, I., Mičeta, G., Stanojević, M., Vujadinović, R. (2015). Experience in the process of development of idea, design and realization of SHPP Vrelo. *IV Symposium CG KO CIGRE*, Herceg Novi, Montenegro, 11-14 May, (in Serbian).

9. Bulatović, V., **Karadžić, U.** (2013). Experimental apparatus for investigation of hydraulic transients. *8th International meeting „Renewable Energy Sources and Energy Efficiency"*, The Montenegrin Academy of Sciences and Arts, Podgorica, Montenegro, 7 Oktober, (in Serbian).

10. Giljen Z., **Karadžić, U.** (2013). Analysis of hydraulic transients on „Piva" HPP for the case of emergency shut-down of the Francis turbine unit. *III Symposium CG KO CIGRE*, Budva, Montenegro, 13-16 May, (in Serbian).

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12. **Karadžić U.**, Bergant A., Vukoslavčević P. (2011). Numerical modeling of extreme hydraulic transients on „Perućica" HPP. *II Symposium CG KO CIGRE,Budva,* Montenegro, 16-19 May, (in Serbian).

13. Giljen Z., **Karadžić, U.** (2011). Analysis of hydraulic transients on „Piva" HPP. *II Symposium CG KO CIGRE,* Budva, Montenegro, 16-19 May, (in Serbian).

14. Vujadinović R., Bošković Lj., **Karadžić U.** (2011). Application of renewable energy sources in the telecomunication sector. *II International Symposium „Engineering, Ecology And Materials in Process Industry*, Jahorina, Bosnia and Hercegovina, 09-11 March (in Serbian).

15. **Karadžić U.**, Bergant A., Vukoslavčević P. (2009). Hydraulic transients on „Perućica" HPP with their influence on EES. *I Symposium CG KO CIGRE, Budva,* Crna Gora, 12-16 October, (in Serbian).

16. Jokić S., Nikolić Z., **Karadžić U.** (2009). Start-up and stop of renewed turbine units during the first phase of „Perućica" HPP modernisation. *I Symposium CG KO CIGRE,Budva,* Crna Gora, 12-16 October, (in Serbian).

17. **Karadžić U.**, Bergant A., Vukoslavčević P. (2009). Hydraulic transients in penstocks after load rejection of Pelton turbine unit. *14th Symposium on Thermal Science and Engineering of Serbia,* Sokobanja, Serbia, 13-16 October (in Serbian).

18. **Karadžić U.**, Vukoslavčević, P (2009). Water turbines for small hydro power plants. *Renewable Energy and Future of its Application, The Montenegrin Academy of Sciences and Arts,* Budva, Montenegro, 07-09 October, (in Serbian).

19. Vukoslavčević P., **Karadžić U.** (2007). Heat energy transfer in supercritical conditions. *Renewable Energy and Future of its Application, The*

	Montenegrin Academy of Sciences and Arts, Budva, Montenegro, (in Serbian). 20. **Karadžić U.**, Bergant A., Vukoslavčević P. (2007). Influence of unsteady friction on hydraulic transients in case of industrial hydropower system. *13th Symposium on Thermal Science and Engineering of Serbia*, Sokobanja, Serbia, 16-19 October, (in Serbian). 21. **Karadžić U.**, Bergant A., Vušanović I. (2006). Validation of convolution unsteady friction model for transients in hydraulic pipeline systems, *30. HIPNEF with international contribution*, Vrnjačka Banja, Serbia, 24-26 May, (in Serbian).
Mentoring:	22. **Karadžić, U.**, Bergant, A., Vušanović, I. (2005). Influence of unsteady friction on transients in hydraulic pipeline systems. *12th Symposium on Thermal Science and Engineering of Serbia*, Sokobanja, Serbia. 22-25 October, (in Serbian). ***6. Invited and plenary lectures*** *6.1. With international contribution* 1. Bergant, A., **Karadžić, U.**, Vitkovsky, J., Vušanović, I., and Simpson, A.R. (2008). Discrete Gas Cavity Model with Convolution Based Unsteady Friction Model. *Meeting of the Advisory Group on Unsteady Friction*, Edinburgh, United Kingdom, 16 May 2008. *6.2. Invited lectures* 1. **Karadžić, U.** (2016). Hydraulic transients investigations at University of Montenegro, *Hohai University, College of Mechanics and Materials*, Nanjing, China, 08.12.2016. 2. **Karadžić, U.** (2013). Developments in water hammer and column separation experimentation in a newly built apparatus at the University of Montenegro. *Litostroj Power doo, Ljubljana*, Slovenia, 15.12.2013. 3. **Karadžić, U.** (2010). Hydraulic transients investigations on Perućica HPP. *Litostroj Power doo, Ljubljana*, Slovenia, 15.12.2010.

1. PhD Thesis

2. Master Thesis

1. Vilotijević, V. (2018). Determination of the installed flow in small hydro power plants. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
2. Janković, M. (2016). The influence of closing and opening of the valve at the end of pipeline on hydraulic transients. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
3. Strunjaš, F. (2016). Hydraulic transients as result of simultaneous closure of the valves at the beginning and the end of pipeline. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
4. Bulatović, V. (2014). Experimental and numerical investigations of water hammer effects. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
5. Kuljić, S. (2012). Numerical calculation of water supply system Nevesinje. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
6. Giljen, Z. (2011). Hydraulic transients modelling on Piva HPP. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
7. Jokić, S. (2011). Development of the experimental installation for water hammer investigation. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)
8. Nikolić, Z. (2011). Verification of water hammer numerical model by comparison with results of measurement obtained on the experimental facility. *UCG, Faculty of Mechanical Engineering*, Podgorica, Montenegro. (in Serbian)

8. Knowledge of Languages

	Read		*Write*		*Speak*		*Understand*	
	Easily	*Not*	*Easily*	*Not*	*Easily*	*Not*	*Easily*	*Not*

	Easily		*Easily*		*Easily*		*easily*	
English	X		X		X		X	
Others: Russian	X			X		X	X	

9.	Computer Literacy	
	Basic:	**Microsoft Office, Internet and Email, Corel Draw, Auto Cad**
	Programming:	**Fortran, Visual Basic**
	Hydraulic:	**Wanda 3.0 (Deltares), AFT Fathom 6.0 (Applied Flow Technology), AFT Impulse 4.0 (Applied Flow Technology)**

10.	Work Experience
	January 2015 by now **Associate Professor at Faculty of Mechanical Engineering on the following subjects: Pumps and Fans, Hydraulic turbines, Design of Power Plants, Hydropower Plants** **October 2009 – January 2015** **Assistant Professor at Faculty of Mechanical Engineering on the following subjects: Pumps and Fans, Hydraulic turbines, Design of Power Plants, Hydropower Plants** **May 2000 – October 2009** **Assistant at Faculty of Mechanical Engineering on the following subjects: Fluid Mechanics, Heat and Mass Transfer, Hydraulic turbines, Pumps and Fans**

11.	References

	1. Dr Anton Bergant, Litostroj Power d.o.o., Ljubljana, Slovenia, anton.bergant@litostrojpower.eu 2. Dr Petar Vukoslavčević, Professor, Faculty of Mechanical Engineering, University of Montenegro, Podgorica, Montenegro, petarvuk@ucg.ac.me 3. Dr Igor Vušanović, Professor, Faculty of Mechanical Engineering, University of Montenegro, Podgorica, Montenegro, igorvus@ucg.ac.me 4.

12.	International projects

2006 – 2008
"Measurements of the flow fields characteristics in high pressure conditions". Scientific and technological cooperation between Governments of Republic Slovenia and Montenegro. (member of working team)

2009-2010
Conecting Energy NCPs: A proactive network of National Contact Points in the Seventh Framework Programme under the Energy Theme, C-ENERGY financed by European Commission contract number 226548-2. (Energy NCP in Montengro)

2010 – 2011
"Measurements of turbulent flow characteristics in pipes and channels". Scientific and technological cooperation between Governments of Republic Slovenia and Montenegro. (member of working team)

2011-2012
Development of a small hydropower registry for Northern Montenegro, financed by EBRD. (member of working team)

2012-2013
Technical Monitoring and Evaluation Consultant for the Clinic Center in Podgorica", MNE-EE-P107992-CQ-S-09-C.1., financed by World Bank. (member of working team)

2012-2013
"Investigations of water hammer effects in a test facility". Scientific and technological cooperation between Governments of Republic Slovenia and Montenegro. (leader of working team)

2012-2014
"Training courses for public services in sustainable infrastructure development in Western Balkans- SDTRAIN" 530530-TEMPUS-1-2012-1-SE-TEMPUS-JPHES. (member of working team at the University of Montenegro)

2013-2014
"Western Balkans regional energy efficiency programme (REEP), Policy dialogue – Supporting ESCO projects in the public sector, Legal assistance for an ESCO project enabling legal framework, financed by EBRD. (technical expert for Montenegro)

	2014-2015 "Investigations of hydraulic transients during filling and emptying of pipelines". Scientific and technological cooperation between Governments of Republic Slovenia and Montenegro. (leader of working team) 2015 "Western Balkans regional energy efficiency programme (REEP), Scoping study for Street Lighting Modernization Programme using ESCO approach in Montenegro, financed by EBRD. (technical expert for Montenegro) 2016 - 2017 „Investigation of the turbulent swirl flow influence on the energy parameters of the axial fans by using contemporary measurement techniques". Scientific and technological cooperation between Governments of Republic Serbia and Montenegro. (leader of working team) 2016 – 2018 Enhancement of Registry of Small Rivers for Small Hydropower Projects Potential of up to 10 MW in Montenegro, financed by EBRD. (Expert for hydraulic engineering and technical solutions for SHPPs) 2016 – 2019 REady for BUSiness, Integrating and validating practical entrepreneurship skills in engineering and ICT studies – REBUS, 573664-EPP-1-2016-BA-EPPKA2-CBHE-JP, ERASMUS+. (meamber of working team) 2019 – 2020 "Research and development of improved measures for protection of hydropower plants during hydraulic transients in order to increase their reliability and energy efficiency". Scientific and technological cooperation between Governments of Republic Serbia and Montenegro. (leader of working team)

13.	National projects
	2006 – 2008 "Mjerenje karakteristika strujnih polja u uslovima visokog pritiska". Projekat finansiran od strane Ministarstva prosvjete i nauke Crne Gore. (member of working team) 2008 – 2011 "Mjerenje karakteristika turbulentnih strujnih polja u cijevima i kanalima". Projekat finansiran od strane Ministarstva prosvjete i nauke Crne Gore. (member of working team) 2012 – 2014 "Investigations of transients phenomena in hydraulic and aeromechanical systems". Ministry of Science Montenegro. (member of working team)

14.	Professional engagement

1. „Hydraulic transients in Perucica HPP: Water hammer analysis in system under pressure before commisioning tests – load rejection of turbine unit A1", Perućica HPP EPCG, Litostroj EI Slovenija, May 2006, (member of working team).
2. Energy NCP (National Contact Point) in Montenegro in Seventh Framework Programe EU (FP7) from May 2007 till June 2012
3. „Investigations of the stress state in characteristics intersection of penstock C3 in Perućica HPP", September 2007 and January 2008 (member of working team)
4. „Analysis and determination of final as-built condition of the installation of air conditioning and heating on Agency for Telecomunications, Podgorica", March 2009, (member of working team)
5. "Preliminary assessment of possibility for hydro energetic utilization of Bjeluha and Moraca river ", March 2010, (member of working team)
6. „Idea solutions for small hydropower plants (SHPP) on Komaraca river", April 2010, (member of working team)
7. „Hydropotential analysis of Komaraca river", April 2010, (member of working team)
8. "Preliminary assessment of possibility for hydro energetic utilization of Meho water stream ", May 2010, (member of working team)
9. "Preliminary assessment of possibility for hydro energetic utilization of Skrbusa river ", July 2010, (member of working team)
10. „Calculation of the stress state on A2 „Piva" HPP generator shaft in the zone of crack's appearance", September 2010, (responsible designer for calculation of axial hydraulic force)
11. "Preliminary assessment of hydro potential utilization of some rivers from Šavnik municipality", November 2010, (member of working team)
12. "Preliminary assessment of hydro potential utilization of some rivers from Plav municipality", November 2010, (member of working team)
13. "Preliminary assessment of hydro potential utilization of some rivers from Bijelo Polje municipality", November 2010, (member of working team)
14. "Preliminary assessment of hydro potential utilization of some rivers from Kolašin municipality", November 2010, (member of working team)
15. Environmental impact assessment for the SHPP "Grlja", ECG Ltd. 2011
16. „Technical solution for exhaust system from diesel engine", Telenor doo, Podgorica, February 2011, (member of working team)
17. „Program of continuous monitoring of penstock III on Perucica HPP", EPCG, March 2011, (member of working team)
18. "Preliminary assessment for possibility of hydro energetic utilization of river Vrelo", Synergy doo, Podgorica, March 2011, (member of working team)
19. „Idea solution with pre-feasibility study for small hydropower plant (SHPP) on river Vrelo", Synergy doo, Podgorica, April 2011, (leader of working team)
20. "Preliminary assessment for possibility of hydro energetic utilization of river Ljevak", BEI doo, Podgorica, August 2011, (member of working team)

21. Idea project for Jara SHPP, Kronor doo, Podgorica, June 2012, (leader of working team)
22. Environmental impact assessment of the SHPP "Jara", Kronor doo, 2012
23. Idea project for Vrelo SHPP, Synergy doo, Podgorica, October 2012, (leader of working team)
24. Environmental impact assessment of Babino polje SHPP, Kronor doo, 2013
25. Idea project for Rastak SHPP, Kol-energy doo, Kolasin, Montenegro February 2013, (member of working team)
26. Idea project for Babino Polje SHPP, Kronor doo, Podgorica, March 2013, (member of working team)
27. Idea project for Meteh SHPP, Kronor doo, Podgorica, March 2013, (member of working team)
28. Main design for Vrelo SHPP, Synergy doo, Podgorica, May 2013, (leader of working team)
29. "Preliminary assessment for possibility of hydro energetic utilization of river Sjevernica", BMR, Oxon, UK May 2013, (member of working team)
30. „Development of Conceptual design for reconstruction of water supply system and construction of SHPP on Krkori water source in municipality of Andrijevica (Montenegro)" , UNDP – Montenegro, May-June 2013, (member of working team)
31. „Idea solution for small hydropower plant (SHPP) on river Bistrica Majstorovina", Synergy doo, Podgorica, November 2013, (member of working team)
32. „Idea solution for small hydropower plant (SHPP) on river Djuricka with tributaries", Triangle inc, New York, November 2013, (member of working team)
33. „Idea solution for small hydropower plant (SHPP) on river Vrbnica", Hydropol, Prague, November 2013, (member of working team)
34. „Idea solution for small hydropower plant (SHPP) on river Kaludarska", Hydropol, Prague, November 2013, (member of working team)
35. Main design for Jara SHPP, Kronor doo, Podgorica, April 2014, (member of working team)
36. Idea solution for small hydropower plant (SHPP) on river Ljevak, Simes Engineering, Podgorica, April 2014, (member of working team)
37. Main design for Babino Polje SHPP, Kronor doo, Podgorica, May 2014, (member of working team)
38. Idea solution for small hydropower plant (SHPP) on river Leverska, BB Hydro, Podgorica, May 2014, (member of working team)
39. Idea solution for small hydropower plant (SHPP) on river Ljevak, Simes ingeniering Ltd. , 2014, (member of working team)
40. Idea solution for small hydropower plant (SHPP) on river Slatina, BB Hydro, 2014, (member of working team)
41. Idea solution for small hydropower plant (SHPP) on river Bistrica Lipovska, BB Hydro, 2014. (member of working team)

42. Idea solution for small hydropower plant (SHPP) on river Bistrica Lipovska, BB Hydro, 2014. (member of working team)
43. Idea solution for small hydropower plant (SHPP) on river Ratnja, Ljetopis automotive Ltd, 2014. (member of working team)
44. Idea solution for small hydropower plant (SHPP) on river Požnja, Ljetopis automotive Ltd, 2014. (member of working team)
45. Idea solution for small hydropower plant (SHPP) on river Trnovačka, Ljetopis automotive Ltd, 2014. (member of working team)
46. Idea solution for small hydropower plant (SHPP) on river Skrbuša, Soko group , 2014. (member of working team)
47. Idea solution for small hydropower plant (SHPP) on river Slatina, BB Hydro, 2014. (member of working team)
48. Idea project of the wind park "Možura", Možura wind park Ltd., 2014. (member of working team)
49. Main design of the SHPP „Raštak 1", KOL ENERGY Ltd., 2014. (member of working team)
50. Idea solution for small hydropower plant (SHPP) on river Radmanska, SHPP Montenegro 2, 2014. (member of working team)
51. Preliminary assessment for possibility of hydro energetic utilization of Umski water stream, Synergy, 2015. (member of working team)
52. Preliminary assessment for possibility of hydro energetic utilization of Rupočajski water stream, Municipility Kolašin, 2015. (member of working team)
53. Preliminary assessment of possibility for hydro energetic utilization for SHPP Šitarička , 2015. (member of working team)
54. Preliminary assessment of possibility for hydro energetic utilization for SHPP Rzačka, 2015. (member of working team)
55. Preliminary assessment of possibility for hydro energetic utilization of Vrelo Ljućansko, 2015. (member of working team)
56. Preliminary assessment of the possibility of using the hydropower potential of water courses for SHP "Štitska", 2015. (member of working team)
57. Main design of the SHPP „Bistrica Majstorovina", Hidro Bistrica, 2015. (member of working team)
58. Idea solution for small hydropower plant (SHPP) on river Šeremet, Nord Electro, 2015. (member of working team)
59. Idea solution for small hydropower plant (SHPP) on river Vrbnica, MHE Vrbnica d.o.o. , 2015. (member of working team)
60. Idea solution for small hydropower plant (SHPP) on river Vođenički potok, Nord Electro, 2015. (member of working team)
61. Preliminary assessment of the possibilities for using hydropower potential of the Crnja river, the municipality of Rožaje, 2015. (member of working team)
62. Idea solution for small hydropower plant (SHPP) on river Meteška, Normal Company, 2015. (member of working team)
63. Idea solution for small hydropower plant (SHPP) on river Bukeljka, Artek Ltd. , 2015. (member of working team)
64. Idea solution for small hydropower plant (SHPP) on river Lazanjska, Erlang Ltd. , 2015. (member of working team)
65. Preliminary assessment of the possibility of using the hydropower potential of river Bukovica, municipality Šavnik, 2016, (member of

66. Preliminary assessment of the possibility of using the hydropower potential of watercourses for SHPP Perućica, municipalities Andrijevica, 2016. (member of working team)
67. Idea solution for small hydropower plant (SHPP) on river Mišnjića potok, 2016. (member of working team)
68. Idea solution for small hydropower plant (SHPP) on river Bukovička Vrela, Water group Ltd., 2016. (member of working team)
69. Preliminary assessment of the possibility of using the hydropower potential of river Bjelojevićka, municipality Mojkovac, 2016, (member of working team)
70. Main design for Meteh SHPP, Kronor doo, Podgorica, 2016, (member of working team)
71. Main design of the wind park "Možura", Možura wind park Ltd., 2016. (member of working team)
72. Main design for small hydropower plant (SHPP) on river Ljevak, Simes engineering Ltd., 2016, (member of working team)
73. Main design of the SHPP „Bistrica Lipovska", BB Hidro, 2017, (member of working team)
74. Main design of the SHPP „Đurička 1&2 ", Plawa Hidro Power, 2017, (member of working team)
75. Revision of Idea Project of SHPP "Slap Zete" , Zeta Energy Ltd, 2017, (member of working team)
76. Revision of Idea Project of SHPP "Glava Zete" , Zeta Energy Ltd, 2017, (member of working team)
77. Main design of the SHPP „Bjelojevićka 1", C&S Energy, 2018, (member of working team)
78. Main design of the SHPP „Bjelojevićka 2", C&S Energy, 2018, (member of working team)

15.	Memberships
	Member of IAHR (International Association for Hydro-Environment Engineering and Research) since January 2009 Member of Engineering Chamber of Montenegro since December 2009 Member of CG KO CIGRE since January 2012

16.	Awards
	University of Montenegro recognition award for the achieved results and contribution to the development of scientific research and professional work at the Faculty of Mechanical Engineering in 2018 Annual award from Engineering Chamber of Montenegro for achievements in professional activities in 2013

Uroš Karadžić	11.06.2019.
Signature	Date

Doc. dr Esad Tombarević

BIOGRAFIJA

Doc. dr Esad Tombarević, dipl.inž.maš., je rođen 28.09.1983. godine u Baru. U rodnom gradu 1998. godine završava osnovnu školu (Osnovna škola „Blažo Jokov Orlandić") kao đak generacije, a 2002. godine i srednju školu (Gimnazija „Niko Rolović", prirodno-matematički smjer) kao dobitnik diplome „Luča".

Mašinski fakultet Univerziteta Crne Gore, odsjek energetika, smjer termotehnika upisuje 2002. godine. Ispite na osnovnim studijama polaže sa prosječnom ocjenom 9,81. Zvanje diplomiranog mašinskog inženjera stiče u martu 2007. godine braneći diplomski rad pod nazivom „Analiza rada rashladnih kula u klimatskim uslovima Podgorice". Za uspjehe na osnovnim studijama nagrađen studentskom nagradom „19. decembar" za 2003. godinu i nagradom Univerziteta Crne Gore za školsku 2004/2005. godinu. U organizaciji ZAMTES-a (Zavod za međunarodnu naučnu, prosvjetno kulturnu i tehničku saradnju) u periodu od 11.09.2005. do 25.09.2005. pohađa dvonedjeljni kurs engleskog jezika (Upper Intermediate Level) na St. Gilles koledžu, Highgate, London. Kao apsolvent, u organizaciji IAESTE (International Association for the Exchange of Students for Technical Experience) u periodu od 07.07.2006. do 07.08.2006. obavlja tehničku praksu u kompaniji za proizvodnju bijele tehnike „Al Hafez", Damask, Sirija.

U septembru 2007. godine upisuje magistarske studije na Mašinskom fakultetu, Univerziteta Crne Gore, odsjek energetika. Ispite na magistarskim studijama polaže sa prosječnom ocjenom 10. Zvanje magistra tehničkih nauka stiče u martu 2009. godine braneći magistarski rad pod nazivom „Modeliranje faznog prelaza u akumulatorima leda sa horizontalnim cijevima". Neki od rezultata iz magistarskog rada su objavljeni na dvije međunarodne konferencije i u jednom časopisu sa SCI liste.

U septembru 2009. godine upisuje doktorske studije na Mašinskom fakultetu, Univerziteta Crne Gore, odsjek energetika. Ispite na doktorskim studijama polaže sa prosječnom ocjenom 10. Zvanje doktora tehničkih nauka stiče u junu 2016. godine braneći doktorsku disertaciju pod nazivom „Analiza nestacionarnog prenosa toplote kod geotermalnog razmjenjivača sa U-cijevima". Neki od rezultata dosadašnjeg istraživanja su objavljeni na više međunarodnih konferencija i u jednom časopisu sa SCI liste.

Odlukom Senata Univerziteta Crne Gore broj 03-547 od 12.02.2019. godine dr Esad Tombarević je izabran u zvanje docent za oblast Termotehnika (Energija i životna okolina – osnovne studije, studijski program Mašinstvo; Osnove tehnike hlađenja – osnovne studije, studisjki program Mašinstvo; Klimatizacija – master studije, studijski program Mašinstvo; Energetska efikasnost u zgradarstvu – master studije, studijski program Energetska efikasnost), na Mašinskom fakultetu Univerziteta Crne Gore, na period od pet godina.

Od početka svog angažovanja na Mašinskom fakultetu, učestvuje na više seminara i radionica iz oblasti energetike. U periodu od 02.11.2007. do 11.12.2007. učestvuje na seminaru o malim hidroelektranama koji organizuje Međunarodni Centar za male hidroelektrane, u Hangdžouu, NR Kina.

U periodu od 10.08. do 21.08.2009. godine učestvuje u Petoj međunarodnoj ljetnjoj školi: „Obnovljiva energija i energetska efikasnost u Jugoistočnoj Evropi" u Fojnici, Bosna i Hercegovina, u organizaciji Regionalnog centra za obrazovanje i informisanje iz održivog razvoja za Jugoistočnu Evropu.

U periodu od 04.10. do 10.10.2009. pohađa Osmi SimLab kurs o paralelnim numeričkim simulacijama u Kluž-Napoci, Rumunija, u organizaciji Tehničkog univerziteta Minhen i Tehničkog univerziteta Kluž-Napoka.

U periodu od januara do maja 2011. godine u okviru programa JFDP (Junior Faculty Development Programe), američkog savjeta za visko obrazovanje, boravi na Univerzitetu Minesota, Mineapolis, Minesota, SAD. Akademski savjetnik u toku ovog programa bio je profesor Vaughan Voller sa kojim kasnije nastavlja uspješnu saradnju.

Sa studentima završne godine Mašinskog fakulteta, odsjek energetika, 08.11.2012. godine je bio u studijskoj posjeti fabrike kompanije Wolf GmbH, Mainburg, Njemačka. Kompanija Wolf se bavi proizvodnjom opreme za grijanje i klimatizaciju. Posjeta je realizovana u organizaciji firme Dravidis d.o.o. i Saveza mašinskih i elektrotehničkih inženjera i tehničara Srbije.

Sa studentima završne godine Mašinskog fakulteta, odsjek energetika, učestvovao je na Sedmom međunarodnom kursu „Efikasnost ventilacije i uslovi ugodnosti" koji pod sponzorstvom DAAD organizovan od 25.08.2015. do 29.05.2015. u Ohridu.

U periodu od 12.11. do 18.11.2017. godine je kao član crnogorskog tima za mitigaciju radona učestvuje u programu obuke „ENUSA Training Course on Radon for Building Professionals" koji je održan u gradu Ciudad Rodrigo u Španiji. Organizaciju obuke je podržala Međunarodna agencija za atomsku energiju.

U proteklom periodu uključen je u aktivnosti Mašinskog fakulteta i njegovog Centra za energetiku. Između ostalih poslova ističu se mjerenja na terenu, na termotehničkim instalacijama, učešće u izradi elaborata za rješavanja problema zagađenja vazduha u Pljevljima i učešće u organizaciji programa obuke lica za vršenje energetskih pregleda zgrada. Pohađanjem obuke koju je organizovala Norveška konsultantska kompanija ENSI postao je sertifikovani energetski auditor. Takođe, bio je uključen i u aktivnosti na sprovođenju nacionalnog projekta „Procjena i smanjenje radona u crnogorskim školama i vrtićima"

Angažovan je na poslovima Centra za energetiku Mašinskog fakulteta u Podgorici.

Naučno istraživačka interesovanja su orjentisana na oblast prenosa toplote i mase, numeričke simulacije prenosa toplote i mase, sistema grijanje, hlađenje i ventilaciju i na mašinske aspekte energetske efikasnosti u zgradarstvu. Dosadašnji naučno-istraživački rad rezultirao je objavljivanjem radova u međunarodnim časopisima i prezentacijama na međunarodnim i domaćim naučnim skupovima. U proteklom periodu je bio saradnik je na nacionalnom naučnoistraživačkom projektu „Numeričko i eksperimentalno istraživanje mogućnosti korišćenja geotermalne energije za potrebe rada geotermalnih toplotnih pumpi" koji je sufinansiran od strane Ministarstva nauke Crne Gore, kao i na projektu „Savremene tehnologije za akumulaciju toplote sa osvrtom na modeliranje termomehaničkih procesa u akumulatorima toplote" u okviru bilateralne naučne i tehnološke saradnje između Crne Gore i Republike Srbije.

Govori, čita i piše engleski jezik, a služi se i francuskim jezikom.

BIBLIOGRAFIJA

Rad u međunarodnom časopisu

Radoje Vujadinović, **Esad Tombarević**, Uroš Karadžić (2017): Valorization of Potentials of Wind Energy in Montenegro. Thermal Science, vol. 21(5), pp.1893-1903. (ISSN 0354-9836)

Esad Tombarević; Vaughan R. Voller; Igor Vušanović (2013): Detailed CVFEM Algorithm for Three Dimensinal Advection-diffusion Problems. Computer Modeling in Engineering and Sciences (CMES), vol. 96(1), pp.1-29. (ISSN 1526-1492)

Esad Tombarević; Igor Vušanović (2011): Modeling of ice-water phase change in horizontal annulus using modified enthalpy method. Advances in Applied Mathematics and Mechanics, vol. 3(3), pp.354-369. (ISSN 2070-0733)

Rad u časopisu međunarodnog zanačaja

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Saopštenje (naučni rad) na naučnom skupu međunarodnog značaja štampano u cjelini

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Rukovodilac projekta: Prof. dr Igor Vušanović

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