Kulturno izobraževalno društvo PiNA

Kulturno izobraževalno društvo PiNA
Association for culture and education PiNA
Gortanov trg 15
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Mednarodni trening Creative Climate Leadership

PiNA je NVO s področja participacije, izobraževanja, kulturnih in kreativnih industrij, z več kot 20 letno tradicijo. Po številu projektov in zaposlenih je med vodilnimi v Sloveniji. Je ena od treh partnerjev projekta RUK, mreže centrov raziskovalnih umetnosti in kulture, katerega cilj je integracija umetnosti in kulture v znanstvene, tehnološke in socialne raziskave, razvoj in inovacije, digitalizacijo, podjetništvo, usposabljanje in izobraževanje, s poudarkom na humanistiki in družboslovju, ekologiji, krožnem gospodarstvu in trajnostnem razvoju. RUK deluje v sozvočju s tremi stebri razvojne strategije S4: digitalnemu razvoju, krožnemu gospodarstvu in Industriji 4.0.

PROIZVODI / STORITVE:
PiNA, v sklopu mreže RUK, vodi laboratorij HEKA, ki s svojo raziskovalno dejavnostjo pokriva naslednja področja:

- Optična vlakna - raziskave senzorike optičnih vlaken
- Bioplastika - raziskava načinov proizvodnje in aplikacije polimerov iz bioplastike iz morskega bio materiala
- Zvok - raziskave na področju zvoka s prvo ambisonično sobo v regiji
- Morje - raziskave človeških vplivov na morski ekosistem
- Brain Scanning / B.M.I. - raziskave možnosti krmiljenja strojnih sistemov preko možganskih valov ter drugih aplikacij tovrstne tehnologije
- Mehatronika - učenje in prakse mehatronike

PiNA is an NGO, working in the field of participation, education, cultural and creative industries, with over 20 years of tradition. In terms of the number of projects and employees, it is among the leading NGOs in Slovenia. PiNA is one of the three national partners running the RUK project, a network of centers of research arts and culture, with the aim to integrate arts and culture into scientific, technological and social research, development and innovation, digitalization, enterpreneurship, training and education, with emphasis on humanities and social sciences, ecology, circular economy, and sustainable development. RUK works in harmony with the three pillars of the S4 Slovenian development strategy: digital development, the circular economy and Industry 4.0.

PRODUCTS & SERVICES:
Within the RUK network, PiNA runs the HEKA laboratory, covering the following fields of research:

- *Optical fibers - research in the field of optical fiber sensory qualities and sensor application*
- *Bioplastics - research of production methods and applications of polymers from bioplastics obtained from marine biomaterial (seagrass, crab shells ...)*
- *Sound - sound research with the first ambisonic room in the region*
- *Sea - research on human impacts on the marine ecosystem*
- *Brain Scanning / B.M.I. - research into the possibility of controlling machine systems via brain waves and other applications of this type of technology*
- *Mechatronics - learning and practices of mechatronics in connection with the secondary technical school in Koper*

Mednarodna podiplomska šola Jožefa Stefana

Institut "Jožef Stefan" Ljubljana, Slovenija

Mednarodna podiplomska šola Jožefa Stefana (MPŠ)
The Jožef Stefan International Postgraduate School (IPS)
Jamova cesta 39
1000 Ljubljana
Slovenija, EU

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www.mps.si

Neposredno povezovanje raziskovanja in podiplomskega izobraževanja za ustvarjanje znanja in spodbujanje inovativnosti

Mednarodna podiplomska šola Jožefa Stefana (MPŠ) je bila ustanovljena leta 2004 kot samostojni visokošolski zavod. Pobudo za ustanovitev je podal Institut "Jožef Stefan" ob močni podpori industrije (Gorenje, Kolektor, Salonit) in mednarodnega omrežja sodelujočih univerz in institutov iz Evropske unije, ZDA in Japonske ter vrste drugih držav.

Institut "Jožef Stefan" (IJS) zagotavlja središčno raziskovalno-izobraževalno osnovo, v MPŠ pa kot partnerji združujejo svoje znanje in inovativne zmogljivosti za reševanje razvojnih problemov tudi vabljene raziskovalne, industrijske in druge organizacije.

PROIZVODI / STORITVE:

Doktorski in magistrski študij s področij:
- Nanoznanosti in nanotehnologije
- Informacijske in komunikacijske tehnologije
- Ekotehnologije
- Senzorske tehnologije

Kompetenčni center tovarn prihodnosti

Direct integration of research and postgraduate studies to create knowledge and promote innovativeness

The Jožef Stefan International Postgraduate School *(IPS) was established in 2004 as an independent higher education institution. The initiative for the establishment of IPS came from the Jožef Stefan Institute (JSI). It was strongly supported by industry (Gorenje, Kolektor, Salonit) and an international network of cooperating universities and research institutes from the European Union, USA, Japan, and many other countries.*

The Jožef Stefan Institute provides the central research and educational basis, whereas other partners, such as invited research institutes, industrial and other enterprises also contribute their knowledge and innovation capacities for solving developmental problems.

PRODUCTS & SERVICES:

Doctoral and master studies from:
- *Nanosciences and Nanotechnologies,*
- *Information and Communication Technologies,*
- *Ecotechnologies,*
- *Sensor Technologies*

Competence Centre for Factories of the Future

Podjetniški inkubator Kočevje

PODJETNIŠKI INKUBATOR KOČEVJE
TRATA XIV 6a
1330 Kočevje
Slovenija, EU

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info@inkubator-kocevje.si
www.inkubator-kocevje.si

Inkubator kot del podpornega podjetniškega okolja aktivno pomaga podjetnikom in inovatorjem pri realizaciji poslovnih idej, lansiranju na trg in komercializaciji. Poleg tega povezujejo izobraževanje, prototipiranje, spodbujanje razvoja podjetniške miselnosti in mreženja ter sodelovanje z različnimi izobraževalnimi in razvojnimi inštitucijami.
Podjetniški inkubator Kočevje se je s prihodom japonske korporacije YASKAWA usmeril v spodbujanje temeljnih znanj robotike pri osnovnošolcih v regiji in to širi tudi na nacionalno raven.
Gre za robote KUBO, ki so prilagojeni izobraževanju otrok starih od 6-9 let in so zelo primerni za uporabo na nepredmetni stopnji – ko ima učitelj več svobode, na kakšen način predstaviti posamezno snov in kako interdisciplinarno povezati več predmetov v uporabno znanje. Na nivoju občine Kočevje se program KUBO uvaja za celotne generacije osnovnošolcev.
Po sistemu "Train-the-Trainer" želijo na inkubatorju to dobro prakso sistematično razširiti tudi v druge dele Slovenije in tako prispevati k tehnološkemu razvoju Slovenije in večjemu številu zainteresiranih učencev za tehniko in sodobne tehnologije.

PROIZVODI / STORITVE:
- pomoč pri razvoju poslovnega modela,
- pomoč pri izvedbi prototipov,
- izobraževanje (podjetništvo, modeliranje, robotika, tuji jeziki, računalništvo ...),
- KUBO roboti (zastopnik za Slovenijo).

***Incubator** is the main local institution in Kočevje sub-region that actively helps entrepreneurs and innovators to implement their business ideas, create prototypes, launch products, get funding and penetrate new markets.*
The incubator is working closely with educational institutions to develop entrepreneurial mindset among the youth and giving them the possibility to gain practical knowledge of new technologies (3D, 2D, programming, robotics, multimedia etc.)
With the arrival of the Japanese robot producer YASKAWA to Kočevje, the Incubator started to teach local children the basics of robotics. They are disseminating this on a national level as well.
They found that KUBO robots are great to teach the children between age 6 and 9. A teacher can use KUBO robots on his own as part of the regular class. They can use it to enhance teamwork, interdisciplinary connect more subjects into applied knowledge etc. KUBO program is now part of curriculum of every elementary school in the Municipality of Kočevje.
With Train-the-Trainer program, they wish to extend this good practice systematically to other parts of Slovenia, thus contributing to the technological development of Slovenia and to increase the number of students interested in new technologies.

PRODUCTS & SERVICES:
- *free consulting services (establishing business, generating business model etc.),*
- *help with product prototyping,*
- *courses (entrepreneurial, languages 3D modelling, robotics, programming etc.),*
- *KUBO robots (representative for Slovenia).*

Pomurski tehnološki park

Lokacija upravne zgradbe v Murski Soboti

Pomurski tehnološki park
Plese 9a
9000 Murska Sobota
Slovenija, EU

www.p-tech.si

Pomurski tehnološki park je mednarodno priznana svetovalna institucija in predstavlja skupnost z več kot 200 podjetij, partnerskih fakultet, inštitutov, šol in drugih raziskovalnih enot, z močnimi mednarodnimi povezavami in bogatimi izkušnjami z EU programi.
Institucija ima svoj RR oddelek registriran na nacionalni raziskovalni agenciji (ARRS), ima vzpostavljen mednarodni sistem kakovosti in pridobljen certifikat ISO 9001:2015 in v sklopu DG Digital certificirano Digitalno inovacijsko vozlišče za pametno proizvodnjo. Tehnološki park namenja posebno pozornost spodbujanju prenosa znanja, izkušenj in tehnologij v gospodarstvo, kar se odraža v ustvarjanju novih delovnih mest in višji dodani vrednosti.
Poleg kredibilnosti in ugleda, ki ga uživa v skupnosti, PTP ponuja podporne programe za start-up podjetja (novonastala podjetja) in scale-up podjetja (obstoječa podjetja v fazi razvoja in rasti). V zadnjih 10 letih si inštitucija krepi kompetence podpornih storitev tehnološkega transferja na področju Industrije 4.0. in digitalizacije ter optimizacije poslovnih procesov. Tehnološki park v strukturi storitev za proizvodna podjetja ponuja tudi prostore za proizvodno dejavnost.

PROIZVODI / STORITVE:
- Oddajanje prostorov v najem: co-working, pisarniški prostori, proizvodni prostori, sejna soba. Lokacija: Murska Sobota, Ljutomer.
- Storitve za start-up podjetja: specialistična svetovanja, mentorstvo, usposabljanja, organizacija dogodkov, ipd..
- Storitve za scale-up podjetja: pomoč pri optimizaciji poslovnih procesov, tehnološkem transferju, razvoju produktov/storitev, priprava razvojnih projektov, internacionalizacija.

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Pomurje Technology Park *is an internationally recognized consulting institution and represents a community of more than 200 companies, partner faculties, institutes, schools and other research units, with strong international connections and extensive experience with EU programs.*
The institution has R&D department registered at the National Research Agency (ARRS), has implemented international quality system, obtained the ISO 9001: 2015 certification and is certified by DG Digital as a Digital Innovation Hub for smart manufacturing. The Technology Park pays particular attention to promoting the transfer of knowledge, experience and technology to the economy, which is reflected in job creation and higher added value.
In addition to the credibility and reputation, which PTP enjoys in the community, institution offers support programs for start-ups and scale-ups. Over the last 10 years, the institution has been strengthening the competences of technology transfer support services in Industry 4.0. and digitization and optimization of business processes. The technology park beside the services also offers rental space for production activity.

PRODUCTS & SERVICES:
- *Renting of premises: co-working, office space, production premises, meeting room. Location: Murska Sobota, Ljutomer.*
- *Services for start-ups: specialist consultancy, mentoring, training, event organization, etc..*
- *Services for scale-ups: assistance in optimization of business processes, technological transfer, product / service development, preparation of R&D projects, internationalization.*

Razvojni center Novo mesto D.O.O.

Razvojni center Novo mesto,
Svetovanje in razvoj, D.O.O.
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8000 Novo mesto
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Razvojni center Novo mesto d.o.o. je bil ustanovljen leta 1997. Deluje na področju regionalnega razvoja in podjetništva. V zadnjih letih se intenzivno vključuje v različne projekte z gospodarskimi družbami. S tem namenom je bil leta 2017 ustanovljen »Center razvoja raziskav in inovacij« (CRRI). V njegovem okviru deluje tudi raziskovalna skupina, ki povezuje strokovnjake s področja strojništva, elektrotehnike, računalništva in matematike.
CRRI kot partner sodeluje na raziskovalnih projektih s področja avtomatizacije, organizacije proizvodnje in uvajanja sodobnih tehnologij v proizvodne procese. Vključuje se v vseh projektnih fazah, od priprave projektne ideje do njene realizacije, vodenja, nadziranja, poročanja in diseminacije dosežkov. CRRI ima vzpostavljeno partnersko sodelovanje z vsemi ključnimi izobraževalnimi ustanovami v lokalnem okolju, zato v svoje projekte lažje vključuje mlade strokovnjake. Poleg raziskovalnih projektov predstavljata pomemben del dejavnosti tudi svetovanje podjetjem s področja poslovne informatike in krepitev kompetenc posameznikov v zvezi s sodobnimi tehnologijami v vseh življenjskih obdobjih. Pri slednjem je še posebej pomembno delo z mladimi, saj organiziramo različne delavnice spoznavanja robotike in programiranja. Razvojni center ima tudi ekipo strokovnjakov za izvajanje izvedbenih projektov na področju robotizacije. Okrepitev tega področja je poleg dela z mladimi ena izmed prioritet za prihodnji razvoj. Postali bomo partner celovitih rešitev.
PROIZVODI / STORITVE:
Raziskovalno delo. Vodenje projektov. Svetovanje s področja poslovne informatike. Izobraževanja s področja robotike, programiranja in obdelave podatkov. Izvajanje projektov robotizacije. Mednarodni projekti.

Razvojni center Novo mesto d.o.o. *was established in 1997. It works in the field of regional development and entrepreneurship. In last years, it has been intensively involved in various projects with companies. Therefore, in 2017 we established the "Center for the Development, Research and Innovation" (CRRI), which brings together experts from the fields of mechanical engineering, electrical engineering, computer science and mathematics.*

CRRI participates as a partner in research projects in the field of automation, organization of production and introduction of modern technologies in production processes. It is active in all project phases, from the preparation of project ideas to their realization, management, monitoring, reporting and dissemination of achievements. CRRI has established partnerships with all key educational institutions in the local environment, which makes it easier for young professionals to participate in company's projects.
In addition to research projects, an important part of our activities represents consulting in the field of business informatics and improving the competencies of individuals on IT field. Especially important is work with youth. Therefore, we organize various workshops on robotics and programming.
Company has also a team of experts to carry out implementation projects in the field of robotics. Strengthening this area is one of the priorities for future development. Our vision is to become a partner of comprehensive solutions.

PRODUCTS & SERVICES:
Research work. Project management. Consulting in the field of Business Informatics. Training in the field of robotics, programming and data science. Implementation of robotization projects. International projects.

Šolski center Škofja Loka

Šolski center Škofja Loka - MIC

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NAŠE POSLANSTVO:
Glede na izzive okolja ponujamo kakovostne izobraževalne storitve in odgovorno izvajamo vzgojo in izobraževanje. Zagotavljamo izpolnjevanje potreb po izobraževanju mladine in odraslih na ravni poklicnega, strokovnega in višješolskega izobraževanja, spodbujamo vseživljenjsko učenje in sodelujemo z gospodarstvom ter lokalnimi skupnostmi.

V Medpodjetniškem izobraževalnem centru (MIC)

- Gradimo kulturo zaupanja in sodelovanja s podjetji in drugimi partnerji
- Sledimo odličnosti z vodenjem Konzorcija podjetij za spodbujanje kakovosti tehniškega izobraževanja
- Sledimo trendom digitalizacije in novim tehnologijam
- S podjetji razvijamo izobraževalne vsebine in izvajamo usposabljanja za realne potrebe trga dela
- Posodabljamo tehnološko opremo in v realnem okolju povezujemo teorijo s prakso
- Izvajamo razvojno-raziskovalne in podjetniške projekte s podjetji in drugimi partnerji
- Sodelujemo v mednarodnih partnerstvih in izmenjavah dobrih praks v okviru E+ projektov
- Podpiramo osebniostni in karierni razvoj posameznika in se vključujemo v lokalno, regionalno, nacionalno in mednarodno družbeno okolje.
- Razvijamo in povezujemo človeške vire z novimi pristopi v sodelovalnega vodenja in ustvarjanja učeče se skupnosti

Z gradnjo kulture sodelovanja med izobraževanjem in gospodarstvom zmoremo več!

OUR MISSION:
According to the challenges of the environment, we offer quality educational services and we perform education and training in a responsible way. We ensure to provide the educational needs of students and adults are met at the vocational, technical and higher vocational level of education. We promote lifelong learning and we cooperate with economy and local communities.

At our B2B Education Center (MIC):

- *We build a culture of trust and cooperation with companies and other partners*
- *We pursue excellence by leading a Consortium of companies to promote the quality of technical education*
- *We follow digitalization trends and new technologies*
- *We develop educational content with companies and provide training for the needs of the labor market*
- *We update technological equipment and connect theory with practice in a real environment (WBL)*
- *We carry out R&D projects as well as entrepreneurial projects with companies and other partners*
- *We participate in international partnerships and exchanges of good practices within Erasmus+ and Interreg projects*
- *We support personal and career development of the individual and get involved in the local, regional, national and international social environment.*
- *Develop and connect human resources with new approaches to collaborative leadership and creating a learning community.*

We can do more by building a culture of cooperation between education and economy!

Zavod C - TCS Celje

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TCS – Slovenski orodjarski grozd

TCS je eden od vodilnih slovenskih grozdov, ki vključuje podjetja s področij modernih proizvodnih tehnologij – orodjarstva, strojegradnje, predelave kovin, elektroindustrije in podpornih dejavnosti kot so elektronika, sodobne informacijske tehnologije in telekomunikacije. TCS vključuje tudi institucije raziskovalno-razvojno podpornega okolja, kot so razne raziskovalne organizacije in tehnološki centri, univerzitetne izobraževalne organizacije, kakor tudi podjetja s področij tehnološkega, poslovnega in kadrovskega svetovanja ter razvojne institucije širšega pomena.
Vizija TCS je postati regionalna mreža visoko usposobljenih podjetij in organizacij – razvojni partner najzahtevnejših industrij EU. Ciljni trgi članov TCS so predvsem avtomobilska industrija, letalska industrija in IT industrija.
Namen povezovanja v TCS je povečati konkurenčno sposobnost sodelujočih podjetij in organizacij, razvoj in osvajanje novih tehnologij, uvajanje novih bolj konkurenčnih poslovnih modelov, povečati obseg poslovanja, zniževati stroške poslovanja in vzpostaviti regionalno mrežo specializiranih podjetij in institucij, ki bodo razvojni partner na ravni EU.
Kompetenčni center (KC) ROBOFLEX je sestavni del EU mreže kompetenčnih centrov specializiranih za reševanje tehnoloških potreb robotizacije in digitalizacije poslovanja majhnih in srednje velikih proizvodnih podjetij. Mreža nastaja v okviru EU inovacijskega projekta HORSE (Horizon 2020).
DIGITECH SI-East je regijsko digitalno inovacijsko stičišče ustanovljeno s strani partnerjev industrijske inovacijske mreže LENS Living Lab in TCS.

TCS – Toolmakers Cluster of Slovenia

TCS is one of the leading Slovene clusters, whose members are companies dealing with modern production technologies – tool and die making, machine industry, electrical engineering, materials, electronics and ICT support products and services. TCS members are also R&D organizations – universities, different R&D institutes and technology centres as well as technology, management and HRM consulting companies and regional development institutions. TCS's vision is a regional network of highly qualified companies and organizations – a development partner of the most advanced industries in the EU. The target markets of TCS are automotive, aerospace and ICT industry.
The purposes of partnering with TCS are opportunities for improvement of the competitiveness of the participating companies and institutions, research and development of new technologies, the introduction of a new more competitive technologies, business models, sales increase, cost reduction and establishment of the regional network of specialized companies and institutions as the development partner on the EU level.
Competence centre (CC) ROBOFLEX is part of the EU network of competence centres, specialized in solving technological needs of robotisation and digitalisation of small and medium-sized enerprises. The network is developing within the EU R&D project HORSE (Horizon 2020).
DIGITECH SI-East is regional digital innovation hub, founded by partners of industrial innovation network LENS Living Lab and TCS.

TECOS

TECOS, Razvojni center orodjarstva Slovenije
Slovenian Tool and Die Development Centre

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TECOS deluje kot mednarodni razvojni grozd ter razvojno-raziskovalni center hkrati. Na ta način ponuja vrhunske storitve ne samo slovenski orodjarski industriji, temveč tudi vsem ostalim proizvodnim podjetjem v Sloveniji. TECOS si zelo aktivno prizadeva prispevati odlične ter neprekinjene storitve celovite podpore za dvig konkurenčnosti svojih članov na svetovnih trgih. Hkrati svoje storitve v razvojnih in drugih industrijskih projektih ponuja tudi tujim podjetjem.
Glavna strokovna področja, ki jih TECOS pokriva, so:

- razvoj izdelkov,
- modeliranje in izdelava orodij,
- rešitve za večjo energetsko in stroškovno učinkovitost v industrijskih procesih ter digitalizirani proizvodnji,
- robotika in nanotehnologija,
- materiali ter tehnološke novosti na področju pakiranja,
- razvoj na področju medicinskih tehnologij ter tehnologije bele tehnike,
- alternativni sourcing na področju naprednih materialov, optimizacija procesov, hibridne tehnologije ter inovativni bio-materiali, itn..

TECOS na osnovi bogatih izkušenj s področja proizvodnje in razvoja termoplastov ponuja tudi:

- proizvodnjo prototipnih in maloserijskih brizganih izdelkov,
- storitve in svetovanje industriji (napredne CAE in FEM analize, 3D analize in nadzor ter obratno inženirstvo, itd.),
- razvoj in implementacijo proizvodnih procesov za masovno proizvodnjo na terenu,
- laboratorijsko testiranje, specializirana izobraževanja ter aktivnosti na področju poslovnega mreženja.

TECOS *operates as an International Business Cluster, R&D centre and a VET Institution, providing top level services – not only for the TDM industry, but also to all other manufacturing companies in Slovenia. TECOS stands for excellent and continuous efforts to improve members' competitiveness through provision of valuable resources, and in so doing, active assistance in the global positioning of the TDM industry of Slovenia.*
Main expert areas of TECOS' expertise are:

- *product design,*
- *modelling and tool manufacturing,*
- *energy efficiency and cost reduction solutions for industrial processes and digital manufacturing,*
- *robotics and nanotechnologies,*
- *materials and advancements for packaging,*
- *development in the fields of medical and domestic appliances,*
- *alternative material sourcing, optimizing processes,hybrid technologies, innovative bio-materials, etc..*

Based on its extensive know-how in manufacturing processes gained through the production of various types of thermoplastic materials, TECOS can offer:

- *prototype and small-batch production of injection moulded parts,*
- *services and advice for the industry (advanced CAE and FEM analyses, 3D digitizing and reverse engineering, precise optical 3D inspection, turn-key product and technology development etc.),*
- *prototype series and test series of products,*
- *development and installation of manufacturing processes for mass production on-site,*
- *laboratory testing, specialized training and networking activities.*

Tehnološki park Ljubljana d.o.o.

Tehnološki park Ljubljana d.o.o.
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Tehnološki park Ljubljana d.o.o. je inovativna tehnološka skupnost več kot 300 podjetij, ki združuje podjetnike, inovatorje in raziskovalce. Je v večinski lasti Mestne občine Ljubljana ter treh največjih raziskovalnih ustanov in treh mednarodnih podjetij.

Podjetjem v zgodnjih fazah razvoja in podjetjem članicam ponujajo podporo pri razvoju in pospeševanju rasti od inkubacije do globalizacije. Podpirajo tehnološka podjetja z lastnim razvojem, agilno miselnostjo in globalnimi ambicijami, s področij informacijsko komunikacijskih tehnologij, digitalnega zdravja, zelenih ter pametnih tehnologij.

Z ekipo 18-ih zaposlenih s polnim delovnim časom in široko mrežo mentorjev ter globalnih partnerjev pomagajo pri rasti in širitvi poslovanja. Nudijo individualna svetovanja pri poslovni strategiji, mentoriranje izkušenih podjetnikov, oseben pristop, podporo in promocijo ter možnosti povezovanja s slovenskimi in tujimi partnerji.

Letno organizirajo več kot 100 dogodkov za start-up in scale-up podjetja (delavnice, seminarji, konference), nudijo 2.000 ur individualnega mentorstva in trenutno vodijo 28 sofinanciranih projektov (nacionalni in EU skladi).

Technology Park Ljubljana Ltd. *is an innovative tech community of more than 300 companies, uniting entrepreneurs, innovators and researchers.*

Owned by Municipality of Ljubljana, 3 largest research institutes and 3 multinational companies they offer start-ups and member companies unique access to network and support from incubation to globalisation.

With a team of 18 full time employees and a wide network of mentors and global partners they can help grow and expand business.

They support companies with their own development, agile mindset and global ambitions, in the fields of information and communication technologies, digital health, green and smart technologies.

Annually they organize more than 100 events for start-ups and scale-ups (workshops, seminars, conferences), offer 2.000 hours of individual mentorship and currently run 28 co-funded projects (national and EU funds).

UL, FE - Laboratorij LAK

Univerza *v Ljubljani*
Fakulteta *za elektrotehniko*

Laboratorijska procesna linija / *Modular production system*

Univerza v Ljubljani
Fakulteta za elektrotehniko
Laboratorij za avtomatiko in kibernetiko - LAK
University of Ljubljana
Faculty of Electrical Engineering
Laboratory for Machine Intelligence - LAK
Tržaška 25
1000 Ljubljana
Slovenija, EU

predstojnik / Head:
prof.dr. Igor Škrjanc
igor.skrjanc@fe.uni-lj.si
www.msc.fe.uni-lj.si

Raziskovalno in razvojno delo **Laboratorija za avtomatiko in kibernetiko** deluje na dveh glavnih področjih.
Prvo področje predstavljajo modeliranje, simulacija in vodenje kompleksnih procesov. Raziskave so usmerjene v temeljne pristope in razvoj metodologije, katerih namen je njihova uporaba v najrazličnejših praktičnih aplikacijah, kot npr. spremljanje in nadzor procesov, ocenjevanje nemerljivih procesnih veličin, napovedovanje procesnih veličin v prihodnosti, zaznavanje napak, rudarjenje podatkov, napredno vodenje industrijskih procesov itd.
Drugo področje raziskovalnega programa predstavlja v zadnjem času izjemno popularno in hitro se razvijajoče področje avtonomnih mobilnih sistemov. Raziskave so usmerjene v praktično problematiko in implementacijo razvitih metod v najrazličnejše avtonomne mobilne sisteme, kot npr. rehabilitacijska in pomožna avtonomna vozila, raziskovalne robote, avtomatsko vodena vozila, brezpilotne letalnike itd. To področje izkorišča tudi temeljna znanja in razvite metode področja modeliranja, simulacije ter vodenja, pri čemer je poudarek na povezovanju klasičnih teoretičnih pristopov ter metod umetne inteligence.
Za dejavnosti na področju gospodarstva je posebno pomembno sodelovanje raziskovalne skupine v Kompetenčnem centru za sodobne tehnologije vodenja – KC STV, Št.: OP13.1.1.2.03.0001, kjer je Igor Škrjanc vodil razvojno-raziskovalni projekt RRP1: Razvojno okolje in gradniki za implementacijo zahtevnih postopkov vodenja, projekt RRP 3.1. Razvoj naprednih metod in algoritmov za sprotno optimizacijo ter vodenje proizvodnje pa je vodil član RP Gašper Mušič. V projektu so sodelovala pomembna slovenska podjetja s področja tehnologij vodenja in avtomatizacije in končni uporabniki storitev s tega področja.

*The research and development work of **Laboratory for Control Systems and Cybernetics** covers two main areas.*
The first area represents modelling, simulation and process control. The field of research is focused on basic principles and development of methodology for the purpose of their implementation in various practical applications, i.e. monitoring and process supervision, estimation of unmeasured process values, prediction of the process values in the future, fault detection, data mining, advanced process control etc.
The second research area represents the field of autonomous mobile systems, which is lately gaining huge popularity and is rapidly growing and evolving. The research is focused on practical issues and implementation of the developed algorithms in various autonomous vehicles, i.e. rehabilitation and special autonomous vehicles, research robots, automated guided vehicles, unmanned aerial vehicles etc. Here also, the group has developed strong connections with successful domestic and foreign companies, with the aim of practical implementation of the developed solutions (implementation technology).
The participation of research group members in the Competence Centre for Advanced Control Technologies (CCACT, no.: OP13.1.1.2.03.0001) was of particular importance. Herewith, Igor Škrjanc led the development and research project RRP1: Development environment and elements for the implementation of complex control algorithms, project RRP3.1.: Production control based on built-in models was managed by RP member Gašper Mušič. The most important Slovenian companies in the field of control technologies together with the end-users were involved.

Univerza *v Ljubljani*
Fakulteta *za elektrotehniko*

UL, FE - Laboratorij za telekomunikacije, LTFE

Univerza v Ljubljani
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Laboratorij za telekomunikacije
Laboratorij za multimedijo
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Faculty of Electrical Engineering
Laboratory for Telecommunications
Laboratory for Multimedia
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Laboratorij za telekomunikacije na FE (LTFE) že več desetletij združuje pedagoško, znanstveno-raziskovalno in projektno delo ter povezuje podjetja, ustanove in inštitute v okviru panoge informacijsko-komunikacijskih tehnologij (IKT). V njegovem okviru deluje MakerLab, namenski odprti prototipni laboratorij IoT. Laboratorij deluje na področju telekomunikacijskih omrežij in storitev, interneta stvari, 5G in industrijskih vertikal ter tehnologije blokovnih verig. Na področju odprtega inoviranja, načrtovanja dostopne uporabniške izkušnje, digitalizacije različnih domenskih področij z uporabo multimedijskih znanj LTFE tesno sodeluje z Laboratorijem za multimedijo na isti fakulteti (LMMFE). Ekipa laboratorija je interdisciplinarna. Izvajanje dodiplomske-ga, podiplomskega in doktorskega študija zavzema 20 % aktivnosti, 80 % pa zavzema projektno sodelovanje z industrijo ter projekti Horizon 2020 in Interreg.

PROIZVODI IN STORITVE:

Razvoj: IoT-rešitve, telekomunikacijski protokoli, dodajanje funkcij tehnologije blokovnih verig na naprave, aplikacijski vmesniki (API), 5G in industrijske vertikale, digitalizacija drugih panog z uporabo IKT-znanj.

Testiranje: IoT-razvojno in predcertifikacijsko testiranje varnosti, zmogljivosti, skladnosti in vzdržljivosti omrežnih naprav ter podatkovnih storitev. Testiranje vzorcev opreme pred odločitvijo za nakup ali prodajo.

Multimedija: multimedijska produkcija, mobilne multimedijske aplikacije (AR/VR), načrtovanje uporabniške izkušnje in dostopnosti za vse.

ICT Academy: izobraževanja s področij kibernetske varnosti, interneta stvari, komunikacijskih omrežij in 5G, programiranja, obdelave podatkov, blokovnih verig, multimedije in AR/VR.

E-CHO+: sistem za multimedijsko izobraževanje, ki omogoča učenje na daljavo, mentoriranje, izdelavo e-izobraževalnih vsebin in upravljanje e-izobraževanj.

Laboratory for Telecommunications *at Faculty for Electrical Engineering (LTFE) has been combining pedagogic, scientific-research and project work for many decades, as well as connecting businesses, foundations and institutes in the frame of information-communication technologies (ICT). MakerLab, a dedicated open IoT prototype lab, is set up as a part of LTFE. The laboratory is engaged in the fields of telecommunications networks and services, the Internet of Things, 5G, industrial verticals, and blockchain technology. In the fields of open innovation, designing accessible user experience, digitization of different domain areas using multimedia knowledge, LTFE is working closely with the Laboratory for Multimedia at the same faculty (LMMFE). The lab team is interdisciplinary. Undergraduate, postgraduate and doctoral studies take up 20% of the activities and 80% of the activities are project collaborations with the industry and engagement in Horizon 2020 and Interreg projects.*

PRODUCTS AND SERVICES:

Development: IoT solutions, telecommunications protocols, adding blockchain technology features to devices, application interfaces (APIs), 5G and industry verticals, digitization of other industries using ICT skills.

Testing: IoT development and pre-certification testing of security, performance, compliance and endurance of network devices and data services. Testing equipment samples before buying/selling.

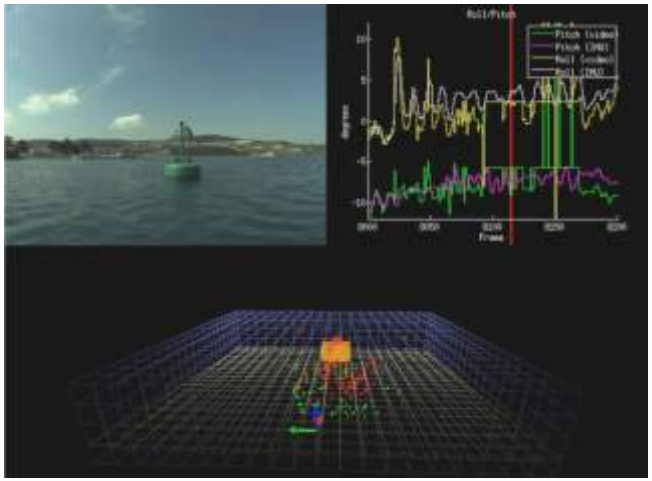
Multimedia: multimedia production, mobile multimedia applications (AR / VR), user experience planning and accessibility for everyone.

ICT Academy: cyber security training, Internet of Things, communications networks and 5G, programming, data processing, blockchain, multimedia and AR/VR.

E-CHO+: a multimedia education system that enables distance learning, mentoring, e-learning content creation and e-learning management.

UL, FE - Laboratorij za strojno inteligenco

Univerza *v Ljubljani*
Fakulteta *za elektrotehniko*



Univerza v Ljubljani
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Robotski vid. Razvita metoda za detekcijo ovir na vodni površini s pomočjo stereo para kamer, za uporabo v avtonomnem robotskem plovilu.
Robot vision. Developed method for detection of obstacles on the water surface using stereo pair of cameras for use in an autonomous robotic vessel.

Laboratorij za strojno inteligenco (LSI) na Fakulteti za elektrotehniko Univerze v Ljubljani (FE) je nastal leta 2018 z združitvijo Laboratorija za strojni vid ter Laboratorija za umetno zaznavanje, sisteme in kibernetiko. Preko svojih predhodnikov ima tako nekaj desetletij tradicije pri raziskovanju metod umetne inteligence, še posebej računalniškega vida, razpoznavanja govora, strojnega vida in biometričnih postopkov, ki temeljijo na slikovnih tehnologijah. Laboratorij neguje tako dobro razvito sodelovanje tako s sorodnimi laboratoriji na Fakulteti za računalništvo in informatiko kot tudi podjetji, s katerimi načrtuje sodobne industrijske rešitve. Laboratorij je preko svojih članov del programskih skupin ARRS „Vzporedni in porazdeljeni sistemi“ ter „Metrologija in biometrični sistemi“, na ta način pa sodeluje tudi s komplementarnimi raziskovalnimi skupinami iz FE in Instituta Jožef Stefan. Raziskave na področju analize gibanja ljudi so izvedene v sodelovanju s Fakulteto za šport Univerze v Ljubljani.
LSI se bo tudi v prihodnje posvečal raziskavam in razvoju na področjih, ki jih pokriva.

PROIZVODI / STORITVE:

- svetovanje pri vpeljavi modernih metod umetne inteligence (strojni vid, strojni sluh) v industrijsko proizvodnjo in kontrolo kvalitete,
- razvoj algoritmov umetne inteligence (računalniški vid, analiza signalov, globoke nevronske mreže), predvsem za reševanje težkih praktičnih problemov na vseh področjih delovanja laboratorija.

*The **Laboratory for Machine Intelligence (LMI)** at the Faculty of Electrical Engineering, University of Ljubljana (FE), was founded in 2018 with the merger of the Laboratory for Machine Vision and the Laboratory for Artificial Intelligence, Systems and Cybernetics. Through its predecessors, it has a tradition of several decades in researching methods of artificial intelligence, in particular computer vision, speech recognition, machine vision and biometric procedures based on image data. The Laboratory fosters well-developed cooperation with related laboratories at the Faculty of Computer and Information Science as well as companies with which it develops modern industrial solutions. Through its members, the Laboratory is part of the ARRS program groups "Parallel and Distributed Systems" and "Metrology and Biometric Systems". This way it also cooperates with complementary research groups from FE and Jožef Stefan institute. Research in the field of human movement analysis are carried out in cooperation with the Faculty of Sport of the University of Ljubljana.*
LMI will continue to focus on R & D in the areas it covers.

PRODUCTS & SERVICES:

- *consulting in the introduction of modern methods of artificial intelligence (machine vision, machine hearing) in industrial production and quality control,*
- *development of artificial intelligence algorithms (computer vision, signal analysis, deep neural networks), especially for solving difficult practical problems in all areas of laboratory competence.*

Univerza *v Ljubljani*
Fakulteta *za elektrotehniko*

UL, FE - Laboratorij za robotiko Robolab

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Faculty of Electrical Engineering, Laboratory for Robotics
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Vodja laboratorija / *Head of Laboratory*:
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www.cobotics.si

Sodelujoči roboti Centra za sodelujočo robotiko (CRC)

Laboratorij za robotiko (Robolab) se ponaša z dolgoletno tradicijo raziskav na področju gibanja človeka in stroja, robotike in robotskih aplikacij. Z namenom zagotavljanja konkurenčne prednosti slovenske industrije, Robolab sodeluje s številnimi slovenskimi podjetji pri razvoju robotskih tehnologij, prav tako pa tudi z drugimi Evropskimi partnerji. V letu 2016 je bil Robolab organizator Evropskega foruma robotike (ERF 2016).
Aktivnosti laboratorija obsegajo razvoj kompleksnih montažnih robotskih celic in rešitev za elektro in avtomobilsko industrijo, kontaktne in nekontaktne meritve (v kombinaciji z manipulacijo), ter razvoj tehnologij na področju stika robota z okoljem, na primer raziglanje. V sodelovanju s podjetjem Trimo, je bil razvit velik robotski manipulator, ki je bil nagrajen z nagrado Evropske Unije za prenos tehnologij v industrijsko okolje (The European Technology Transfer Award). Trenutne aktivnosti so usmerjene tudi v rekonfigurabilno, modularno robotsko okolje za kontrolo kvalitete izdelkov.
V okviru laboratorija deluje tudi Center za sodelujočo robotiko (CRC), ki je bil ustanovljen leta 2018. CRC je mesto znanja in inovacijsko središče, ki se ukvarja z sodelujočo robotiko, robotskimi sistemi za učinkovito in varno združevanje robotov, robotskih orodij, perifernih naprav in naprav za pritrjevanje, delovnih delov, okolja in človeka. CRC je opremljen s petimi najsodobnejšimi sodelujočimi roboti različnih konfiguracij (ABB Yumi, Franka Emika Panda, Yaskawa HC10, Universal Robots UR5e, Fanuc CR7i), vključno s perifernimi napravami, kamerami in varnostnimi sistemi. Dodatno je Robolab opremljen še z industrijskimi manipulatorji ABB IRB 1600, Staübli, EPSON PS3, parom robotov Motoman MH5 ter šest haptičnimi roboti Omega, Phantom in HapticMaster.

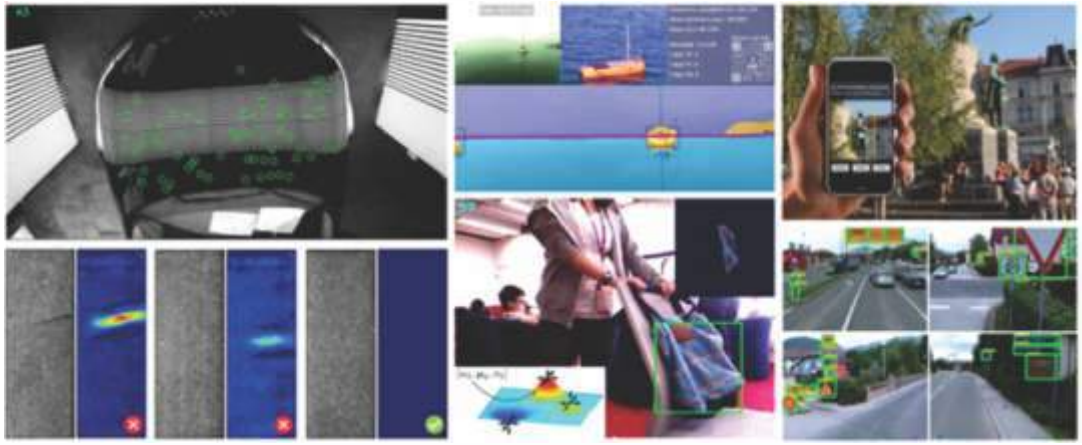
Laboratory of Robotics (Robolab) *has long-standing excellence in the field of man and machine movement analysis, robotics research, and robotic applications. Providing a competitive advantage to the Slovenian industry, Robolab is cooperating in evolution of the robotic technology for industrial companies, as well with other EU partners. In the year 2016, Robolab was the organizer of the European Robotics Forum (ERF 2016).*

Several complex assembly robot cells and solutions were developed and introduced in Slovenian electro and the automotive industry. One of the focus areas is robot contact with the environment, for example deburring. Another activity domain presents contact and non-contact measurements accompanied by manipulation. An original large-scale robotic telescopic handler that was introduced into building construction in partnership with Trimo, was awarded with The European Technology Transfer Award. Current activities also include reconfigurable, modular robotic measurement environment for quality control in production.

The Collaborative Robotics Centre (CRC) was established in the year 2018, as a part of the Laboratory. CRC is a location of knowledge and innovation hub, developing efficient and secure robotic concepts to combine collaborative robots, robotic tools, peripheral and fixture devices, work pieces, environment, and human. CRC is equipped with five collaborative robots of different configurations (ABB Yumi, Franka Emika Panda, Yaskawa HC10, Universal Robots UR5e, Fanuc CR7i) including peripherals, cameras and safety systems. In addition, Robolab is equipped with several 6 DOF industrial manipulators, such as ABB IRB 1600, Staübli, EPSON PS3, a pair of Motoman MH5 robots and 6 haptic robots Omega, Phantom and HapticMaster.

UL, FRI - LUVSS

Univerza *v Ljubljani*
Fakulteta *za računalništvo in informatiko*



Projekti laboratorija / *Laboratory's projects*

Univerza v Ljubljani
Fakulteta za računalništvo in informatiko
Laboratorij za umetne vizualne spoznavne sisteme (LUVSS)

Večna pot 113
1000 Ljubljana
Slovenija, EU

Laboratorij se ukvarja s temeljnimi in aplikativnimi raziskavami na področju vizualnih inteligentnih sistemov. Naši raziskovalni interesi vključujejo računalniški vid, strojno (globoko) učenje in spoznavo robotiko. Z raziskavami in razvojem rešujemo praktične probleme s ciljem poleg učinkovitosti in uspešnosti zagotavljati tudi prilagodljivost in splošnost rešitev, kar so tudi ključne zahteve paradigme Industrija 4.0. Imamo bogate izkušnje z razvojem algoritmov za vizualno sledenje objektov, detekcijo in kategorizacijo objektov, segmentacijo slik, inkrementalnim vizualnim učenjem, kot tudi s sistemi za interaktivno učenje človek-robot in razvojem rešitev računalniškega vida za pametne mobilne naprave ter industrijske sisteme, kot je vizualni nadzor kakovosti. Izkušnje pridobivamo v sodelovanju z različnimi partnerji v okviru številnih evropskih, nacionalnih in industrijskih projektov. Laboratorij je del Fakultete za računalništvo in informatiko Univerze v Ljubljani, ki ima bogato zgodovino prelomnih dosežkov na širokem področju umetne inteligence.

PROIZVODI / STORITVE:

Razvili smo napredne in robustne rešitve različnih praktičnih problemov, ki zahtevajo interpretacijo slik:

- detekcija in kategorizacija objektov na slikah,
- vizualni navigacijski sistemi za avtonomne robote,
- vizualno sledenje objektov,
- detekcija površinskih napak,
- detekcija in štetje vdolbin na karoseriji,
- semantična segmentacija slike za različne naloge.

The laboratory is involved in basic and applied research of visually enabled intelligent systems. Our research interests include computer vision, machine (deep) learning, and cognitive robotics. We have been developing efficient solutions for practical problems, aiming at flexibility and generality of solutions, which are the key requirements of the Industry 4.0 paradigm. We have extensive experience with visual object tracking, object detection and categorization, image segmentation, incremental visual learning, as well as with systems for human-robot interactive learning and development of computer vision solutions for smart mobile devices and industrial applications, such as automated visual inspection for quality control. Our experience has been accumulated in collaboration with a variety of partners in a number of EU, national and industry funded projects. The laboratory is part of the Faculty of Computer and Information Science, University of Ljubljana, which has a rich history of ground-breaking research in a wide area of artificial intelligence.

PRODUCTS & SERVICES:

We have developed advanced and robust image analysis solutions to a variety of problems:

- *detection and categorization of objects in images,*
- *visual navigation systems for autonomous robots,*
- *visual object tracking,*
- *detection of visual surface defects,*
- *detection and counting of dents on a car body,*
- *semantic image segmentation for various tasks.*

Univerza *v Ljubljani*
Fakulteta *za strojništvo*

UL, Fakulteta za strojništvo

Demonstracijski center Pametna tovarna s ključnimi tehnologijami (digitalni dvojčki, distribuirani sistemi, laserske merilne metode in obdelovalni procesi, laserji, fotonika, optodinamika, odrezovalni procesi, mehatronika in proizvodna kibernetika, hidravlika, hidravlične komponente in simulacije).
Demonstration center of the Smart factory wth key technologies (digital twins, distributed systems, laser measuring methods, laser machining processes, lasers, photonics and optodynamics, cutting processes, mechatronics and production cybernetics, hydraulics, hydraulic components and simulations).

Univerza v Ljubljani
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Fakulteta za strojništvo je pomembna in največja izobraževalno-raziskovalna ustanova v Sloveniji. Pedagoška dejavnost se izvaja na vseh treh ravneh študija. Diploma, pridobljena na Fakulteti za strojništvo, je mednarodno akreditirana na evropski ravni (ASIIN, ENUA, EUR-ACE) in tako enakovredna ostalim diplomam v Evropi. Na fakulteti ustvarjamo in prenašamo znanje našim študentom in partnerjem na raziskovalnem področju, kar jim omogoča konkurenčno vključevanje v mednarodno okolje. Poseben poudarek je dan prenosu znanja v realno industrijsko okolje.

Glavne raziskave laboratorijev, ki so člani SRIP ToP, se nanašajo na razvoj in integracijo pomembnih tehnologij Industrije 4.0 v skupen okvir pametne tovarne. V ta namen smo na Fakulteti za strojništvo razvili in postavili demonstracijski center Pametna tovarna, ki je namenjen v prvi vrsti raziskavam in razvoju obstoječih, predvsem pa novih tehnologij Industrije 4.0 in novih konceptov pametne tovarne ter prenosu znanj in kompetenc študentom strojništva, še posebej pa industrijskim partnerjem. Najpomembnejši segment raziskav na področju pametnih tovarn so digitalni dvojčki proizvodnih in logističnih procesov in sistemov ter digitalni agenti, podprti z umetno inteligenco, strojni vid, Big data itd. V koncept pametne tovarne vključujemo tudi znanja in kompetence s področij laserjev, laserskih tehnologij, hidravličnih in pnevmatičnih sistemov in krmilij kakor tudi izdelovalnih tehnologij.

*The **Faculty of Mechanical Engineering** of the University of Ljubljana is today the largest institution for education and research of mechanical engineering in Slovenia. The Faculty carries out its educational activities for all three study cycles in accordance with the Bologna Declaration guidelines. A degree, obtained at the Faculty of Mechanical Engineering, is internationally accredited on the European level (ASIIN, ENUA, EUR-ACE), and is equal to other degrees in Europe. In-house design and research work, and quality transfer of knowledge to the students and research partners enables a competitive integration into the international environment. A special emphasis is given to knowledge transfer into the real industrial environment.*

The main research activities of laboratories that are members of SRIP ToP relate to the development and integration of important technologies of Industry 4.0 into the common framework of the smart factory. To this end, we have developed and set up a Demonstration Center Smart factory, which is dedicated primarily to the research and development of the existing and, above all, the new technologies of Industry 4.0 and the new concepts of the smart factory, and the transfer of knowledge and competences to students of mechanical engineering and especially to industrial partners. The most important segment of research in smart factories are digital twins of manufacturing and logistics processes and systems, and digital agents supported by artificial intelligence, machine vision, Big data, etc. The concept of a smart factory also includes knowledge and competences from laser fields, laser technologies, hydraulic and pneumatic systems and controls as well as manufacturing technologies.

UL, FS - Laboratorij LASIM

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Laboratorij LASIM
University of Ljubljana
Faculty of Mechanical Engineering
Laboratory LASIM
Aškerčeva cesta 6
1000 Ljubljana
Slovenija, EU

Demonstracijski center Pametna tovarna Na osnovi lastnega arhitekturnega modela LASFA in s pomembnejšimi ključnimi Tehnologijami (distribuirani sistemi, digitalni dvojčki, digitalni agenti z AI, strojni vid, RFID, kolaboravitni robot, VR, AR, pametno ročno mesto…)
Demonstration Center of the Smart factory based on its own architectural model LASFA and with major key technologies (distributed systems, digital twins, digital agents with AI, machine vision, RFID, collaborative robot, VR, AR, smart manual workstation…).

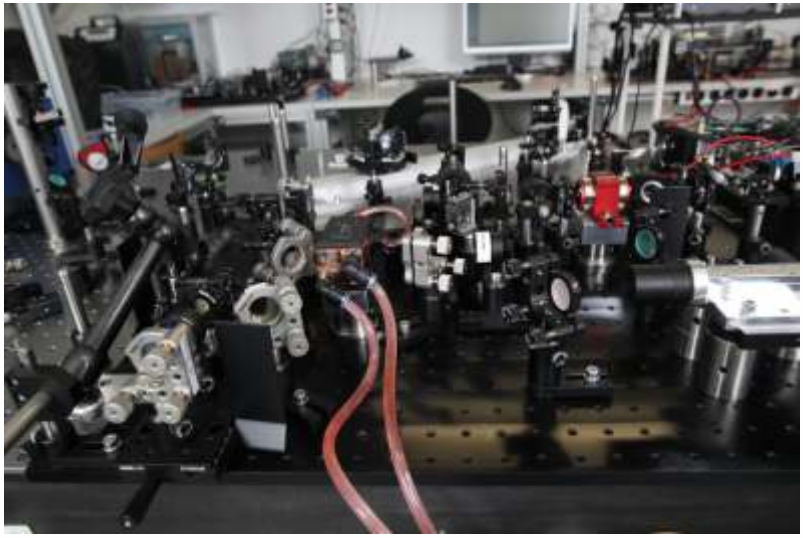
Na Fakulteti za strojništvo Univerze v Ljubljani smo v **Laboratoriju za strego, montažo in pnevmatiko – LASIM r**azvili in postavili demonstracijski center Pametna tovarna, ki je namenjen v prvi vrsti raziskavam in razvoju obstoječih, predvsem pa novih tehnologij I4.0 in novih konceptov pametne tovarne ter prenosu znanj in kompetenc študentom strojništva, še posebej pa industrijskim partnerjem.
Demonstracijski center je zgrajen v skladu z lastno razvitim arhitekturnim modelom LASFA in temelji na konceptu distribuiranih sistemov. Vključuje ključne tehnologije I4.0, ki so nujno potrebne za delovanje pametne tovarne. Hrbtenico pametne tovarne predstavljata globalni digitalni dvojček in globalni digitalni agent oz. umetna inteligenca, podprta s strojnim vidom. Ob tem ima vsak proces in sistem svojega digitalnega dvojčka in digitalne agente, ki ob podpori umetne inteligence samodejno krmilijo proizvodne in logistične procese, kakor tudi navezave na celotno dobaviteljsko verigo. Probleme rešujejo samodejno na lokalni ravni, vsi procesi in aktivnosti pa so vizualizirani in transparentni. RFID tehnologija omogoča sledljivost procesov in sistemov in komunikacijo med objekti in subjekti pametne tovarne. Poleg robotiziranih procesov je v demo center vključeno tudi pametno ročno delovno mesto vključno s tehnologijami kot so VR in AR, digitalizacija in transparentnost navodil za montažne operacije, prilagodljivost montažnih mest in zalogovnikov ter ergonomija delovnega mesta z vnaprejšnjo simulacijo človeka. Pametna tovarna v demo okolju omogoča na ta način popolnoma fleksibilno in agilno ter samodejno planiranje in optimiranje delovnega plana ter proizvodnega procesa.

*At the Faculty of Mechanical Engineering, University of Ljubljana, in the L**aboratory for handling, Assembly and Pneumatics - LASIM**, we developed and installed a demonstration center Smart Factory, which is primarily aimed at researching and developing existing and, above all, new I4.0 technologies and new concepts of the smart factory and transfer of knowledge and competences to students of mechanical engineering, and especially to industrial partners.*
The demonstration center is built according to our own developed architectural model LASFA and is based on the concept of distributed systems. It includes key I4.0 technologies that are essential for the operation of a smart factory. The backbone of the smart factory is the global digital twin and global digital agent or artificial intelligence, supported by machine vision. In addition, every process and system has separate digital twins and digital agents, which, with the support of artificial intelligence, automatically control the production and logistic processes as well as links to the entire supply chain. Problems are solved automatically at the local level, and all processes and activities are visualized and transparent. RFID technology enables traceability of processes and systems and communication between objects and subjects of a smart factory. In addition to robotized processes, the demo center also includes a smart manual assembly station including technologies such as VR and AR, digitalization and transparency of instructions for assembly operations, adaptability of assembly station and buffers as well as ergonomics of the workplace with advanced human simulation. The smart factory in the demo environment allows in this way fully flexible and agile as well as automatic planning and optimization of the work plan and the production process.

Univerza *v Ljubljani*
Fakulteta *za strojništvo*

FOLAS
Laboratory for photonics and laser systems

UL, FS - Laboratorij FOLAS



Univerza v Ljubljani
Fakulteta za strojništvo
Laboratorij za fotoniko in laserske sisteme (FOLAS)
University of Ljubljana,
Faculty of Mechanical Engineering
Laboratory for Photonics and Laser Systems (FOLAS)

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1000 Ljubljana
Slovenija, EU

izr. prof. dr. Rok Petkovšek
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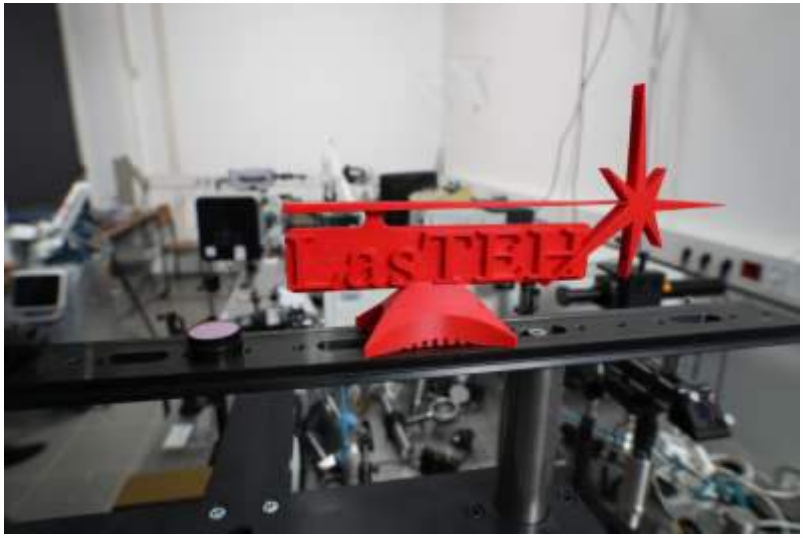
rok.petkovsek@fs.uni-lj.si

Laboratorij za fotoniko in laserske sisteme (FOLAS) je bil ustanovljen na pobudo slovenskih proizvajalcev laserskih sistemov in deluje na Fakulteti za strojništvo, Univerze v Ljubljani.
Vse ključne raziskave in razvoj potekajo v tesnem sodelovanju z industrijskimi partnerji. Znanstveno raziskovalno področje laboratorija se nanaša tako na laserske izvore, kot na njihovo uporabo v industriji in medicini. V obeh navedenih primerih gre za raziskave in razvoj laserskih sistemov, ki omogočajo natančno digitalno kontrolirano dovajanje energije iz laserskih izvorov v snov. Tako na primer v laboratoriju FOLAS potekajo raziskave in razvoj industrijskih laserskih sistemov z zelo širokim modulacijskim območjem izhodne moči, primernih za ultrahitro lasersko transferno tiskanje, ki omogoča visoko hitrost premikanja laserskega snopa po vzorcu (velikostnega reda km/s) ter hkrati zagotavlja visoko prostorsko natančnost dovajanja energije.
Pomemben primer predstavlja tudi visoko prilagodljiv laserski izvor z ultrakratkimi izhodnimi laserski pulzi in načinom delovanja, ki omogoča generiranje laserskih pulzov na zahtevo. Na medicinskem področju se aktivnosti nanašajo na raziskave in razvoj konceptov multifunkcionalnih laserskih izvorov, ki v kombinaciji z naprednimi nadzornimi sistemi omogočajo hkratno diagnostično in terapevtsko delovanje. Poleg raziskav laserskih izvorov za medicino potekajo tudi raziskave in razvoj novih diagnostičnih in terapevtskih posegov v oftalmologiji.

*The **Laboratory for Photonics and Laser Systems (FOLAS)** was founded on the initiative of Slovenian manufacturers of laser systems and operates at the Faculty of Mechanical Engineering, University of Ljubljana.*
All key R & D projects are in close cooperation with industrial partners. The scientific research area of the laboratory relates both to laser sources and to their application in industry and medicine. In both of these cases, it involves the research and development of laser systems that enable accurate digitally controlled input of energy from laser sources to the matter. For example, in the FOLAS laboratory, research and development of industrial laser systems with a very wide modulation bandwidth suitable for ultrafast laser transfer printing is carried out. The system allows high moving speed of the laser beam along the sample (on the order of km/s) while ensuring high spatial precision supply of energy.
An important example is also a highly customizable laser source with ultrashort output laser pulses and "pulse on demand" operation. In the medical field, the activities are related to the research and development of concepts of multifunctional laser sources, which in combination with advanced control systems enable simultaneous diagnostic and therapeutic action. In addition to the research of laser sources for medicine, research and development of new diagnostic and therapeutic procedures in ophthalmology is underway.

UL, FS - Laboratorij LASTEH



Univerza v Ljubljani
Fakulteta za strojništvo
Laboratorij za lasersko tehniko LASTEH
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Faculty of Mechanical Engineering
Laboratory for laser techniques
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vodja laboratorija / *Head of Laboratory*:
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Fakulteta za strojništvo je pomembna in največja izobraževalno-raziskovalna ustanova v Sloveniji. Na fakulteti ustvarjamo in prenašamo znanje našim študentom in partnerjem na raziskovalnem področju, kar jim omogoča konkurenčno vključevanje v mednarodno okolje.
Pedagoška dejavnost se izvaja na vseh treh ravneh študija. Diploma, pridobljena na Fakulteti za strojništvo, je mednarodno akreditirana na evropski ravni (ASIIN, ENUA, EUR-ACE) in tako enakovredna ostalim diplomam v Evropi.
Znanstvenoraziskovalna dejavnost na Fakulteti za strojništvo poteka na področjih energetskega in procesnega strojništva, konstruiranja, mehanike in vzdrževanja strojev, proizvodnega strojništva, mehatronike, mikromehanskih sistemov ter avtomatizacije.
Laboratorij LASTEH izvaja sledeče razvojno-raziskovalne aktivnosti:

- raziskave in razvoj laserskih obdelovalnih tehnologij,
- raziskave in razvoj medicinskih laserskih posegov,
- raziskave in razvoj optičnih nadzornih sistemov,
- raziskave in razvoj laserskih 3D merilnih tehnologij,
- raziskave in razvoj metod adaptivnega vodenja robotov na osnovi 3D izmere,
- nadzor kvalitete izdelkov na osnovi 3D izmere.

V prihodnosti bo poseben poudarek na raziskavah in razvoju sledečih tehnologij:

- robotizirani obdelovalni sistemi za hitro prilagodljivo maloserijsko ali personalizirano proizvodnjo,
- fleksibilni robotizirani laserskih medicinski posegi z zmožnostjo samoregulacije
- integracija umetne inteligence v laserske tehnologije.

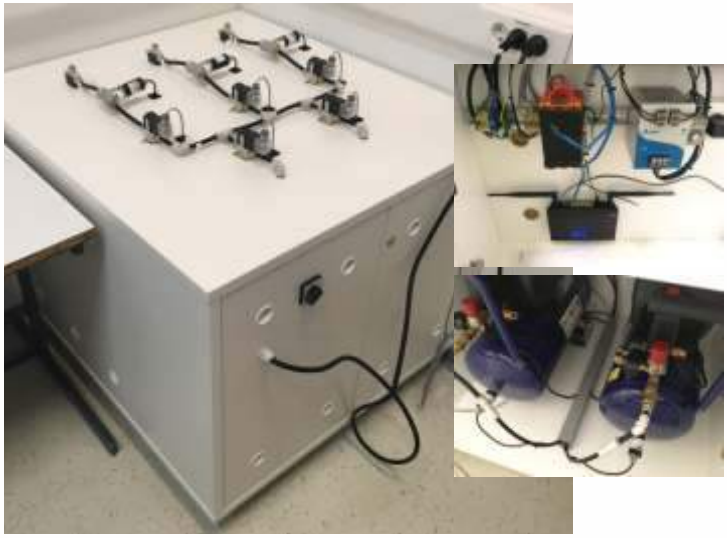
The Faculty of Mechanical Engineering of the University of Ljubljana is today the largest institution for education and research of mechanical engineering in Slovenia. In-house design and research work, and quality transfer of knowledge to the students and research partners enables a competitive integration into the international environment. The Faculty of Mechanical Engineering carries out its educational activities for all three study cycles in accordance with the Bologna Declaration guidelines. The degree, obtained at the Faculty of Mechanical Engineering, is internationally accredited on the European level (ASIIN, ENUA, EUR-ACE), and is equal to other degrees in Europe. Scientific Research work at the Faculty of Mechanical Engineering is carried out in the fields of power and process engineering, design, mechanics and maintenance of machines, production engineering, mechatronics, micromechanic systems and automatisation.
*The **LASTEH Laboratory** carries out the following R&D activities:*

- *research and development of laser processing technologies,*
- *research and development of medical laser therapies,*
- *research and development of optical control systems*
- *research and development of laser 3D measurement technologies,*
- *research and development of methods for adaptive robot control based on 3D measurements,*
- *quality control of products based on optical 3D measurements.*

In the future, special emphasis will be placed on the research and development of the following technologies:

- *robotic based machining systems for small-scale or personalized production,*
- *flexible robotized laser medical therapies with the self-regulation functionality,*
- *integration of artificial intelligence into laser technologies.*

UL, FS - Laboratorij LAKOS



Univerza v Ljubljani
Fakulteta za strojništvo
Laboratorij za tehnično kibernetiko,
obdelovalne sisteme in računalniško tehnologijo (LAKOS)
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Faculty of Mechanical Engineering,
Laboratory LAKOS
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Slovenija, EU

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Laboratorij **LAKOS**, UL-FS, je vodilna skupina na področju mehatronike, avtomatizacije, proizvodne kibernetike in integracije proizvodnih in poslovnih procesov. Glavna področja raziskav obsegajo porazdeljeno krmiljenje, podatkovno analitiko in robotiko.

Izpostavljene objave v zadnjih treh letih obsegajo (1) Škulj et al.: Energy efficient communication based on self-organisation of IoT devices for material flow tracking [CIRP Annals 2019], (2) Vrabič et al.: Distributed control with rationally bounded agents in cyber-physical production systems [CIRP Annals 2018] in (3) Kozjek et al.: Identifying the business and social networks in the domain of production by merging the data from heterogeneous internet sources [International Journal of Production Economics 2018]. Izpostavljen tekoči projekt: GOSTOP – Gradniki, orodja in sistemi za tovarne prihodnosti, nacionalni projekt, SPS (1. 11. 2016 - 30. 4. 2020).

PROIZVODI / STORITVE:

Ekspertize skupine obsegajo modeliranje porazdeljenih sistemov, teorijo in analitiko omrežij, razvoj večagentnih krmilnih sistemov, razvoj strojne in programske opreme za industrijski internet stvari, obvladovanje velepodatkov, rudarjenje podatkov, uporabo metod spodbujevalnega učenja, razvoj elektronike, senzorjev in aktuatorjev za robotiko, ter razvoj algoritmov adaptivnega krmiljenja.

***LAKOS** is a leading group in the fields of mechatronics, automation, manufacturing cybernetics, and integration of manufacturing and business processes. The main activities are focused on distributed control, data analytics, and robotics.*

Important publications in the last three years include (1) Škulj et al.: Energy efficient communication based on self-organisation of IoT devices for material flow tracking [CIRP Annals 2019], (2) Vrabič et al.: Distributed control with rationally bounded agents in cyber-physical production systems [CIRP Annals 2018] and (3) Kozjek et al.: Identifying the business and social networks in the domain of production by merging the data from heterogeneous internet sources [International Journal of Production Economics 2018]. An important ongoing project: GOSTOP – Building blocks, tools and systems for the Factories of the Future, national project, SPS (1.11.2016 - 30. 4. 2020).

PRODUCTS & SERVICES:

The expertises of the group are modelling of distributed systems, network analitics, development of multiagent control systems, development of hardware and software for industrial internet of things, big data management, data mining, use of reinforcement learning, development of electronics, sensors, and actuators for robotics, and development of adaptive control algorithms.

UL, FS - Laboratorij za fluidno tehniko LFT

Univerza *v Ljubljani*
Fakulteta *za strojništvo*

Univerza v Ljubljani
Fakulteta za strojništvo
Laboratorij za fluidno tehniko LFT
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Laboratory for fluid power and control (LFT)
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laboratirij za fluidno tehniko (LFT)
laboratory for fluid power and controls (LFT)

Laboratorij za fluidno tehniko (LFT) je bil ustanovljen leta 1973 na Fakulteti za strojništvo Univerze v Ljubljani.
Naše glavna raziskovalna dejavnost je povezana z oljno in vodno hidravliko, hidravličnimi sistemi in napravami, tehnično diagnostiko, čistočo hidravličnih kapljevin in filtracijo, krmilno tehniko, z industrijskimi in mobilno-hidravličnimi komponentami, z 1D in 3D računalniškimi simulacijami (CFD in MKE), tribologijo v hidravliki (trenje in obraba, trajnost delovanja ...), srednji čas do okvare hidravličnih komponent (MTTF) ...
LFT je močno vpet v industrijsko okolje, saj sodeluje s številnimi podjetji.

LFT ima veliko izkušenj z razvojem, izboljšavami in testiranjem hidravličnih ventilov za uporabo v industriji in širše. Projekti, ki so povezani s tem področjem so: oljno-hidravlični konvencionalni in proporcionalni potni ventili, tlačno krmiljeni hidravlični valji, servo hidravlični ventili, digitalni hidravlični ventili, hidravlični bloki, vodno-hidravlični konvencionalni, digitalni in proporcionalni potni ventili, hidravlični valji, tlačni ventili, hidravlični akumulatorji, hidravlična tesnila, …
Eden izmed naših pomembnejših projektov je bil razvoj in testiranje orbitalnega hidravličnega motorja z visokimi navori in nizko vrtilno hitrostjo gredi.
Prav tako se ukvarjamo z raziskavo, razvojem in testiranjem hidravličnih črpalk in motorjev s konstantno in spremenljivo iztisnino za oljno in vodno hidravliko.

Več informacij j na:
www.lab.fs.uni-lj.si/lft/

Laboratory for fluid power and controls (LFT) *was established in 1973 at the Faculty of Mechanical Engineering University of Ljubljana.*
Our main research activities are related to: hydraulic systems and devices, condition monitoring, cleanliness of hydraulic fluids and filtration, control technology, industrial and mobile hydraulic components – oil and water, industrial and mobile hydraulic systems – oil and water, pneumatic components and systems, 1D and 3D computational fluid dynamics – CFD, finite element analysis – FEA, tribology, mean time to failure of hydraulic components (MTTF), etc..
LFT is markedly integrated into the industrial environment, as it works with many companies.
LFT has many of experiences with development, improvement and testing of hydraulic valves for industrial applications. Projects which are relevant to this field are: oil conventional directional hydraulic valves, proportional directional hydraulic valves with solenoid, proportional directional hydraulic valves pressure regulated, servo directional hydraulic valves, oil digital hydraulic valves, hydraulic block for hydraulic valves, water conventional directional hydraulic valves, water proportional directional hydraulic valves with solenoid and digital hydraulics, hydraulic cylinders, pressure control valves, hydraulic accumulators ...
One of our most important projects was to develop and test the orbital hydraulic motor for high torque and low rotation speed. LFT deals with development and testing of constant and variable displacement hydraulic pump and motor (oil and water).

More information on:
www.ab.fs.uni-lj.si/lft/pch_single-ANG.pdf

UM - Inštitut za robotiko

Univerza v Mariboru
Fakulteta za elektrotehniko, računalništvo in informatiko
Inštitut za robotiko
University of Maribor
Faculty of Electrical Engineering and Computer Science
Institute of Robotics
Koroška cesta 46
2000 Maribor
Slovenija, EU

www.iro.feri.um.si

Industrijska robotizacija se intenzivno modernizira - v tovarnah prihodnosti bosta človek in robot sodelovala z roko v roki

Laboratorij za industrijsko robotiko deluje v okviru **Inštituta za robotiko UM - FERI** z razvojno raziskovalnimi dejavnostmi na naslednjih področjih: robotski sistemi, mehatronski sistemi, industrijska robotika in avtomatizacija proizvodnje, ter vgrajeni sistemi za mehatronske naprave. Posebni poudarek naših raziskovalnih aktivnosti je na naprednih regulacijskih algoritmih za vodenje različnih mehatronskih sistemov. Sodelujemo v izobraževalnem procesu na FERI v okviru naslednjih vsebin: robotika, servosistemi, mikrokrmilniki, krmilna tehnika in industrijska avtomatizacija, itd.

Na področju industrijske robotike se v zadnjih 10 letih opaža prodor kolaborativne robotike, kjer si človek in robot lahko delita skupni delovni prostor in tudi varno sodelujeta pri izvedbi delovnih operacij v neograjeni delovni celici. Naše raziskave v zadnjem času so usmerjene v razvoj spremljajočih tehnologij kolaborativne robotike, ki bodo omogočale višjo stopnjo fleksibilnosti, adaptivnosti in produktivnosti kolaborativnih robotskih aplikacij. Ukvarjamo se tudi z razvojem uporabniških vmesnikov z obogateno in mešano resničnostjo za intuitivno komunikacijo in interakcijo z robotskim sistemom.

V našem laboratoriju izobražujemo iz področja industrijske robotike. Svetujemo lahko pri razvoju kolaborativnih robotskih aplikacij. Podjetja lahko pri nas preizkusijo svoje lastne ideje aplikacij s kolaborativnimi roboti danskega proizvajalca Universal Robots. Ponujamo tudi razvojne storitve na področju praktičnih kolaborativnih robotskih aplikacij v proizvodnih in neproizvodnih okoljih.

*The Laboratory for industrial robotics is a part of the **Institute of Robotics** at Fac. of El. Eng. & Comp. Sc., University of Maribor, with its R&D activities in the following fields: robotic systems, mechatronic systems, industrial robotics and manufacturing automatisation, and embedded systems for mechatronic devices. A special emphasis of our research activities is related to advanced control algorithms for different mechatronic systems. We are involved in the educational process within the following topics: robotics, servosystems, microcontrollers, control engineering and industrial automatisation, etc.*

In last 10 years, we can observe increasing growth of collaborative robotics, where a human and a robot share a common workspace and safely collaborate at manufacturing operations in a fenceless work-cell. Our recent research activities are oriented towards supporting technologies, which will enable higher degree of flexibility, adaptivity and productivity of collaborative robotic applications. We also deal with the development of user interfaces based on augmented and mixed reality for intuitive communication and interaction with a robotic system.

We provide education from the field of industrial robotics. We also consult in the development of collaborative robotic applications. Companies may test their own ideas of applications with UR collaborative robots in our lab as well. We can help at the development of practical collaborative applications for manufacturing and non-manufacturing environment.

UM - Inštitut za avtomatiko

Univerza v Mariboru
Fakulteta za elektrotehniko, računalništvo in informatiko

Univerza v Mariboru
Fakulteta za elektrotehniko, računalništvo in informatiko
Inštitut za avtomatiko
University of Maribor
Faculty of Electrical Engineering and Computer Science
Institute of Automation
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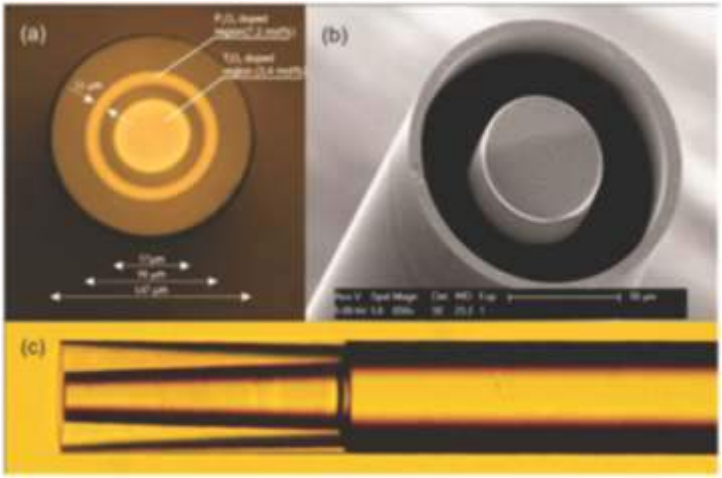
www.au.feri.um.si



Miniaturen optičen vlakenski senzor za merjenje raztezkov in z raztezki povezanih veličin (sil, deformacij, navorov, itd.). Dimenzije so približno 125 µm premer in dolžina 400 µm. Senzor je izdelan z lastno thenologijo za mikro-obdelavo optičnih vlaken, razvito v sodelovanju s podjetjem Optacore (sedaj del Lumentum).

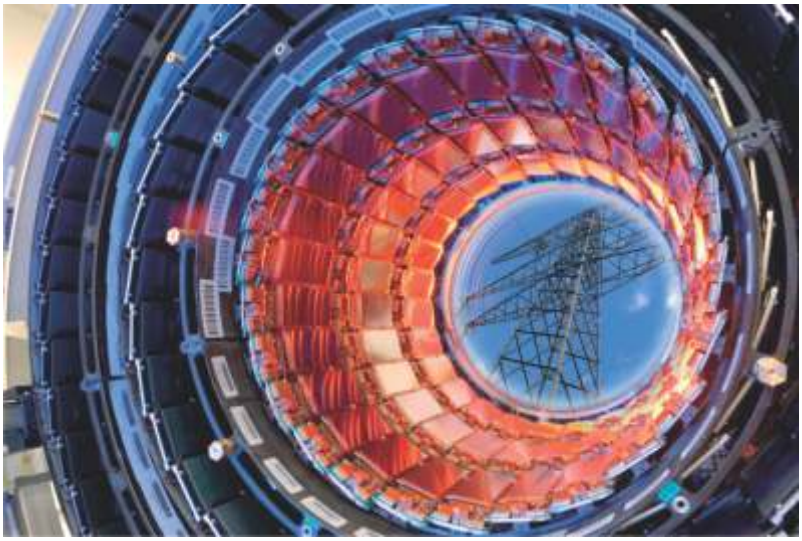
Inštitut za avtomatiko kot samostojna raziskovalno-izobraževalna enota s svojim delovanjem pokriva celotno področje avtomatike v elektrotehniki. Sestavljajo ga trije laboratoriji: Laboratorij za elektro-optične in senzorske sisteme, Laboratorij za procesno avtomatizacijo in Laboratorij za obdelavo signalov in daljinska vodenja. Raziskovalno delo poteka na naslednjih področjih: meroslovje, senzorji in senzorski sistemi, posebej optični senzorji, sistemi daljinskega vodenja, daljinsko zaznavanje, opto-elektronski in fotonski sistemi, optična vlakna, regulacijska teorija, posebej robustne regulacije in vodenje z umetno inteligenco. Člani inštituta so avtorji ali soavtorji več kot 15 ameriških patentov na področjih optičnih vlaken in optičnih senzorjev. Razvijamo algoritme, ki temeljijo na napredni obdelavi signalov za obdelavo satelitskih radarskih posnetkov, radarskih sistemov na tleh in sistemov strojnega vida. Uporabljamo tehnike nadzorovanega učenja s katerimi lahko analiziramo vsebino podatkov in iz njih izločamo koristne informacije. Prav tako se ukvarjamo s porazdeljenim daljinskim vodenjem. Razvijamo algoritme na osnovi teorije robustnega vodenja in mehke logike, ki jih prenašamo v procesno avtomatizacijo. Glavna aktivnost Inštituta za avtomatiko je raziskovalna dejavnost na širokem področju avtomatike v elektrotehniki, ki jo lahko strnemo v naslednje točke:

- sodelovanje z industrijo in udeležba pri industrijskih raziskavah (Laboratoriji Inštituta za avtomatiko vzdržujejo kontakte z večino slovenskih podjetij, ki so aktivna na področju avtomatike, prav tako pa sodelujemo z več tujimi podjetji),
- s projektnim sodelovanjem prenašati znanje in izkušnje ter hkrati spletati vezi s strokovnjaki iz našega področja doma in v tujini,
- z raziskovalnim delom pridobljeno znanje prenašati v pedagoške programe in širiti bazo visoko kvalificiranega strokovnega kadra.

Institute of Automation *as an independent research and educational unit at FERI UM with its operation covers the entire area of automation in electrical engineering. It consists of three laboratories: Laboratory for Electro Optics and Sensor Systems, Laboratory for Process Automation, and Laboratory for Signal Processing and Remote Control. The Institute of Automation conducts education in the fields of measurements, sensors, remote control, signal processing, system theory, control systems, modelling, artificial intelligence, identifications, opto-electronics/photonics, etc. Institute members have authored or co-authored more than 15 US patents in the fields of optical fibers and optical sensors. Algorithms, based on advanced signal processing have been developed for the processing of satellite radar data, ground radar data and systems of machine vision. Several technologies based on supervised learning are used for information extraction and data understanding. The principles of distributed remote control, robust control theory and Fuzzy logic have been intensively studied over the past few decades and developed algorithms have been successfully implemented in process automation.*
Main activities of the Institute of Automation are research on all areas of industrial automation which can be summarized in following points:

- *cooperation with industry and participating in the industrial research (Institute of automation continuously cooperate with majority of Slovenian and also foreign companies that are active in the field of automation),*
- *transferring knowledge and experience through industrial projects and at the same time concluding new contacts with professionals from Slovenia and abroad,*
- *through educational programs transmit the knowledge to the new generations of students and expands the base of high qualified technical staff.*

Zavod KC STV



Kompetenčni center za sodobne tehnologije vodenja (KCSTV)
Competence Centre for Advanced Control Technologies
Zavod KC STV
CC ACT
Stegne 11
1000 Ljubljana
Slovenija, EU

info@kcstv.si
www.kcstv.si

Zavod KCSTV so ustanovila podjetja konzorcija tehnološke mreže Tehnologija vodenja procesov. Povezuje javne raziskovalne institucije ter podjetja pri prenosu znanja in tehnologij v industrijo. Obenem pomaga pri razvoju produktov in storitev za prodajo na trgu.
Področje delovanja KCSTV obsega celotno piramido vodenja procesov v podjetju, zajema pa tudi sisteme vodenja na drugih področjih kot so energetika, promet, varovanje okolja in podobno.
KCSTV je v okviru Strateškega razvojno-inovacijskega partnerstva »Tovarne prihodnosti« izvajalec načrta za vertikalno verigo vrednosti »Inteligentni sistemi vodenja za tovarne prihodnosti« in horizontalno mrežo »Tehnologija vodenja«.

Prioritetna tehnološka področja inteligentni sistemi vodenja za tovarne prihodnosti.

- Inteligentni sistemi za upravljanje proizvodnih operacij (MES – MOM),
- Diagnostika, prognostika in samo-vzdrževanje pametnih strojev in procesov,
- Razvoj sodobnih orodij in gradnikov za vodenje in nadzor sistemov ter procesov,
- Distribuirani sistemi vodenja in IoT,
- Pametni aktuatorji,
- Energetika v tovarnah prihodnosti.

Tehnologija vodenja.
Kot horizontalna tehnologija, ki obsega avtomatizacijo, informatizacijo in kibernetizacijo, se vključuje v tehnološka področja tudi v drugih Strateških razvojno-inovacijskih partnerstvih, zlasti v Pametna mesta in skupnosti, Pametne zgradbe in dom in Krožno gospodarstvo.

*The **Competence Centre for Advanced Control Technologies (CC ACT)** was founded by the companies within the consortium of the technology network Process Control Technology (PCT). The centre links public research institutions and companies in transferring knowledge and technology to industry, as well as helps in developing products and services for sale in the market. The scope of CC ACT is to cover the entire process control pyramid in the company. It also focuses on control systems in other areas such as energy, transport, environmental protection and others. CC ACT is one of the leading partners of the Strategic Research and Innovation Partnership of the Factories of the Future responsible for the development and implementation of action plans in the focus area Intelligent control systems and horizontal network Control technology.*

Intelligent control systems for the Factories of the Future.

- *Smart Manufacturing Execution Systems and Manufacturing Operations Management (MES - MOM),*
- *Diagnostics, prognostics and self-maintenance of smart machines and processes,*
- *Development of modern tools and building blocks for control and supervision of systems and processes,*
- *Distributed control systems and internet of things (IoT),*
- *Smart actuators,*
- *The energy in the factories of the future.*

Control technology horizontal network.
As a horizontal technology encompassing automation, informatization and cybernetization, control technology is also integrated into technology areas in other Strategic Research and Innovation Partnerships, notably Smart Cities and Communities, Smart Buildings and Homes and the Networks for the Transition to Circular Economy.

Institut „Jožef Stefan“, fotografija: Arne Hodalič in Katja Bidovec / *Jožef Stefan Institute, photo: Arne Hodalič and Katja Bidovec*

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Ljubljana, Slovenija

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Chamber of Commerce and Industry of Slovenia

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