

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	INTELIGENTNI STREŽNI IN MONTAŽNI SISTEMI
Course title:	INTELLIGENT HANDLING AND ASSEMBLY SYSTEMS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Strojništvo, tretja stopnja, doktorski	Proizvodno inženirske znanosti, kibernetika in mehatronika (smer)		Celoletni

Univerzitetna koda predmeta/University course code:

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
90					160	10

Nosilec predmeta/Lecturer:

Izvajalci predavanj:	Niko Herakovič
Izvajalci seminarjev:	
Izvajalci vaj:	
Izvajalci kliničnih vaj:	
Izvajalci drugih oblik:	
Izvajalci praktičnega usposabljanja:	

Vrsta predmeta/Course type:

Jeziki/Languages:	Predavanja/Lectures:	Slovenščina
	Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	Prerequisites:
Veljajo splošni pogoji za doktorski študij.	General prerequisites for the third level studies.

Vsebina:

Strežni in montažni (SiM) procesi in sistemi (pregled tehnologij, naloge in osnovni koncepti SiM procesov in sistemov, načrtovanje in ovrednotenje SiM sistemov).
Montažne operacije, zaporedje montažnih operacij kot osnova za opredelitev montažnega procesa.
Predstavitev sestavljenca in montažnih operacij v fazi razvoja in konstruiranja ter kreiranje podatkovne baze za računalniško podprto projektiranje montažnih postrojev.
Načrtovanje izdelkov in simultano inženirstvo.
Avtomatizirani strežni in montažni (SiM)sistemi:

- Fleksibilna avtomatizacija strege in montaže.
- Modularna zasnova SiM sistemov.

Robotizirani strežni in montažni (SiM) sistemi:

- Roboti v stregi in montaži.
- Robotizirane montažne celice.
- Robotizirane montažne linije.
- Fleksibilna prijemala v robotiziranih SiM sistemih.

Content (Syllabus outline):

Handling and assembly (H&A) processes and systems (a review of technologies, tasks and basic concepts of (H&A) processes and systems, planning and evaluation of(H&A)systems).
Assembly operations, sequence of assembly operations as a basis for defining the assembly process.
Presentation of assembled part and assembly operations in the development and design and the creation of a database for computer-aided design of assembly systems.
The design of products and simultaneous engineering.
Automated handling and assembly systems:

- Flexible automation of handling and assembly.
- The modular design of the (H&A).

Robotized handling and assembly systems:

- Robots in handling and assembly.
- Robotic assembly cells.
- Robotic assembly line.

<p>Oblikovanje izdelkov za avtomatizirano in robotizirano strego in montažo in sočasni razvoj izdelkov ter SiM sistemov.</p> <p>Senzorika in aktorika v SiM sistemih:</p> <ul style="list-style-type: none"> • Dotični in brezdotačni senzori v SiM sistemih. • Strojni vid v SiM sistemih. • Inteligentni senzori in aktuatorji v SiM sistemih. <p>Opredelitev inteligentnih strežnih in montažnih (SiM) sistemov:</p> <ul style="list-style-type: none"> • Vrste inteligentnih naprav in sistemov. • Koncepti inteligentnih SiM. • Obvladovanje variantnosti izdelka v procesu strege in montaže. <p>Inteligentni strežni in montažni (SiM) sistemi:</p> <ul style="list-style-type: none"> • Strojna in programska oprema v SiM sistemih. • Umetna inteligenca v SiM sistemih. <p>Načrtovanje strežnih in montažnih sistemov:</p> <ul style="list-style-type: none"> • Računalniško podprto načrtovanje SiM sistemov z uporabo metod simulacije v procesu načrtovanja in analize. • Modeliranje, simulacija in optimizacija SiM sistemov in naprav. • Sredstva in integracija skladiščenja ter proizvodnje. <p>»Low cost« inteligentni strežni in montažni sistemi:</p> <ul style="list-style-type: none"> • Strežni in montažni sistemi v malih in srednje velikih podjetjih. • Vloga enostavne avtomatizacije v sinhronih proizvodnih sistemih. • Enostavna avtomatizacija v stregi in montaži. • Enostavna avtomatizacija v pretoku polproizvodov, proizvodov in sestavljanecv in v skladiščenju končnih proizvodov. • Pokayoke in uporaba enostavnih senzorjev v procesu strege in montaže. • Zagotavljanje in kontrola kakovosti v procesu strege in montaže. 	<ul style="list-style-type: none"> • Flexible grippers in robotized (H&A) systems. <p>Product design for automated and robotised handling and assembly and simultaneous development of products and (H&A)systems.</p> <p>Sensors and actuators in (H&A) systems:</p> <ul style="list-style-type: none"> • Tactile and non-tactile sensors in the (H&A) system. • Machine vision in the (H&A) sitemi. • Intelligent sensors and actuators in the (H&A) system. <p>The definition of intelligent handling and assembly systems:</p> <ul style="list-style-type: none"> • Types of intelligent devices and systems. • Concepts of intelligent (H&A)systems. • The mastering of product variants in the process of assembly and handling. <p>Intelligent handling and assembly (H&A) systems:</p> <ul style="list-style-type: none"> • Hardware and software in the (H&A) system. • Artificial Intelligence in the (H&A) system. <p>Planning of handling and assembly systems:</p> <ul style="list-style-type: none"> • Computer-aided design of H&A systems with using the methods of simulation in the process of planning and analysis. • Modeling, simulation and optimization of H&A systems and equipment. • Resources and integration of storage and production. <p>Low-cost intelligent hanling and assembly systems:</p> <ul style="list-style-type: none"> • Handling and assembly systems in small and medium-sized enterprises. • The role of simple automation in a synchronous production systems. • Simple automation in handling and assembly. • Simple automation in the flow of semi-products, products and assembled parts and in the storage of finished products. • Pokayoke and use of simple sensors in the process of assembly and handling. • Quality assurance and control in the process of handling and assembly.
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Temeljna literatura in viri/Readings:

<p>[1] Boothroyd, G.: Assembly Automation and Product Design, Second edition, CRC Press, 2005.</p> <p>[2] Herakovič, N., Noe, D.: Strežni in montažni procesi ter sistemi, Učno gradivo, FS, 2009 (v nastajanju).</p> <p>[3] Takeda, H.: LCIA – Low Cost Intelligent Automation – produktivitätsvorteile durch Einfachautomatisierung, Mi-Fachverlag, 2006.</p> <p>[4] Gemeinschaftsausschuss CIM: Rechnerintegrierte Konstruktion und Produktion, Band 8: Flexible Montage, VDI verlag, 1992.</p> <p>[5] Intelligent Assembly Systems, 1995, World Scientific, Edditors: M.H. Lee and J.J. Rowland.</p> <p>[6] S.Y. Nof, W.E. Wilhelm, H.-J. Warnecke, Industrial Assembly, Chapman & Hall, London, 1997.</p> <p>[7] P.K. Wright, D.A. Bourne, Manufacturing Intelligence, Addison-Wessley, 1988.</p> <p>[8] H.K. Rampersad, Integrated and Simultaneous Design for Robotic Assembly, John Wiley & Sons, Inc. New York, NY, USA, 1994.</p>

Cilji in kompetence:

<p>Cilji:</p> <ul style="list-style-type: none"> • Nadgraditi znanja, potrebna za izbiro, snovanje in integracijo inteligentnih strežnih in montažnih procesov sistemov v proizvodnem procesu. • Naučiti študente analize in snovanja strežnih in
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Objectives and competences:

<p>Goals:</p> <ul style="list-style-type: none"> • The principal goal is to upgrade the skills needed for the selection, design and integration of intelligent handling and assembly processes and systems in the production process.

<p>montažnih procesov ter sistemov in jim prikazati vlogo in pomen različnih inteligentnih sistemov v stregi in montaži.</p> <p>Kompetence:</p> <ul style="list-style-type: none"> • Študent osvoji znanja s področja strežnih in montažnih procesov in sistemov ter pridobi sposobnost odločanja in izbire tehnologij pri njihovem snovanju. • Znanje in sposobnost izbire ustreznih montažnih postopkov z vidika stopnje avtomatizacije in inteligence ter s tehnoloških in ekonomskih vidikov. • Razumevanje delovanja inteligentnega strežnega in montažnega sistema in sposobnost sodelovanja pri njegovem načrtovanju in upravljanju. 	<ul style="list-style-type: none"> • To teach students to analyse and design of handling and assembly processes and systems and to demonstrate the role and importance of the various intelligent systems in handling and assembly. <p>Competences:</p> <ul style="list-style-type: none"> • The student acquires the knowledge in the field of handling and assembly processes and systems and the ability to obtain a decision and selection of technologies in their conception. • Knowledge and the ability of the selection of appropriate assembly procedures in the light of of automation and intelligence assembly level, and technological and economic considerations. • To understand the operation of intelligent handling and assembly system and the ability to participate in its planning and management.
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<p>Predvideni študijski rezultati:</p> <ul style="list-style-type: none"> - Študent osvoji znanja s področja strežnih in montažnih procesov in sistemov ter pridobi sposobnost odločanja in izbire tehnologij pri njihovem snovanju. - Znanje in sposobnost izbire ustreznih montažnih postopkov z vidika stopnje avtomatizacije in inteligence ter s tehnoloških in ekonomskih vidikov. - Razumevanje delovanja inteligentnega strežnega in montažnega sistema in sposobnost sodelovanja pri njegovem načrtovanju in upravljanju. 	<p>Intended learning outcomes:</p> <p>Knowledge and understanding:</p> <ul style="list-style-type: none"> - The student acquires the knowledge in the field of handling and assembly processes and systems and the ability to obtain a decision and selection of technologies in their conception. - Knowledge and the ability of the selection of appropriate assembly procedures in the light of of automation and intelligence assembly level, and technological and economic considerations. - To understand the operation of intelligent handling and assembly system and the ability to participate in its planning and management.
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<p>Metode poučevanja in učenja:</p> <p>Predavanja, laboratorijske vaje, seminarsko delo, e-izobraževanje, konzultacije. Seminarsko delo v čim večji meri navezuje se na področje doktorskega raziskovanja. Študij z uporabo priporočene literature.</p>	<p>Learning and teaching methods:</p> <p>Lectures, laboratory practice & seminar work, e-education, consulting. The seminar work is related, as much as possible, to the student's doctoral research field. Study on a recommended literature basis.</p>
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Načini ocenjevanja:	Delež/Weight	Assessment:
<p>Ustni izpit, poročilo o seminarskem delu. Pogoj za opravljanje ustnega izpita je uspešno izdelano in pozitivno ocenjeno seminarsko delo. Način (ustno izpraševanje, naloge, projektni seminar) • Naloge (30%) • Projektni seminar (40%) • Ustno izpraševanje (30%)</p>		<p>Oral exam, report on seminar work. The condition for admission to oral exam is successful completion of seminar work, rewarded with a passing grade. Method (written exam, oral examination, assignments, project): • assignments (30%) • project seminar (40%) • oral examination (30%)</p>

<p>Reference nosilca/Lecturer's references:</p> <p>prof. dr. Niko HERAKOVIČ HERAKOVIČ, Niko, METLIKOVIČ, Peter, DEBEVEC, Mihael. Motivational lean game to support decision between push and pull production strategy. International journal of simulation modelling, ISSN 1726-4529, Dec. 2014, vol. 13, nr. 4, str. 433-446. HERAKOVIČ, Niko. Računalniški in strojni vid v robotizirani montaži = Computer and machine vision in robot-based assembly. Strojniški vestnik, ISSN 0039-2480, 2007, letn. 53, št. 12, str. 858-873. HERAKOVIČ, Niko, ŠIMIC, Marko, TRDIČ, Francelj, SKVARČ, Jure. A machine-vision system for automated quality control of welded rings. Machine vision and applications, ISSN 0932-8092, 2011, vol. 22, no. 6, str. 967-981. DEBEVEC, Mihael, ŠIMIC, Marko, HERAKOVIČ, Niko. Virtual factory as an advanced approach for production process</p>
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optimization. International journal of simulation modelling, ISSN 1726-4529, Mar. 2014, vol. 13, no. 1, str. 66-78.
PIPAN, Miha, KOS, Andrej, HERAKOVIČ, Niko. Adaptive algorithm for the quality control of braided sleeving : Miha Pipan, Andrej Kos, and Niko Herakovic. Advances in mechanical engineering, ISSN 1687-8132. [Printed ed.], 2014, str. 1-8.