

UČNI NAČRT PREDMETA/COURSE SYLLABUS

Predmet:	Napredni senzorski sistemi in omrežja
Course title:	ADVANCED SENSORY SYSTEMS AND NETWORKS
Članica nosilka/UL Member:	UL FS

Študijski programi in stopnja	Študijska smer	Letnik	Semestri
Strojništvo - Razvojno raziskovalni program, druga stopnja, magistrski	Mehatronika in laserska tehnika (smer	2. letnik	1. semester

Univerzitetna koda predmeta/University course code: 0566822

Koda učne enote na članici/UL Member course code: 6062-M

Predavanja	Seminar	Vaje	Klinične vaje	Druge oblike študija	Samostojno delo	ECTS
30		30			65	5

Nosilec predmeta/Lecturer: Primož Podržaj

Vrsta predmeta/Course type: Obvezni strokovni predmet na smeri Mehatronika in laserska tehnika, ki je izbirni strokovni predmet na ostalih smereh./Compulsory specialised course in the study of Mechatronics and laser technology, which is an elective specialised course in other fields of study.

Jeziki/Languages:

Predavanja/Lectures:	Slovenščina
Vaje/Tutorial:	Slovenščina

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Prerequisites:

Izpolnjevanje pogojev za vpis v Magistrski študijski program II. stopnje Strojništvo - Razvojno raziskovalni program.	Meeting the enrollment conditions for the Master's study programme of Mechanical Engineering - Research and Development program.
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Vsebina:

Content (Syllabus outline):

<ol style="list-style-type: none"> Predavanje: Osnove računalniške obdelave slik <ul style="list-style-type: none"> Slika kot matrika Zapis slike v računalniku Barvna, črno-bela slika Barvni prostori in pretvorbe med njimi Predavanje: Točkovne operacije nad slikami 	<ol style="list-style-type: none"> Lecture: The basics of digital image processing <ul style="list-style-type: none"> Image as a matrix Image representation in a computer Color, black and white image Color spaces and transformations between them Lecture: Point processing
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<ul style="list-style-type: none"> - Linearne in nelinearne operacije - Histogram 	<ul style="list-style-type: none"> - Linear and nonlinear operations - Histogram
3. Predavanje: Večtočkovne operacije nad slikami	3. Lecture: Neighbourhood processing
<ul style="list-style-type: none"> - Korelacija - Detekcija robov - Ostrenje slik 	<ul style="list-style-type: none"> - Correlation - Edge detection - Image sharpening
4. Predavanje: Naprednejši algoritmi	4. Lecture: Advanced algorithms
<ul style="list-style-type: none"> - Razširjanje, krčenje - BLOB analiza 	<ul style="list-style-type: none"> - Dilation, erosion - BLOB analysis
5. Predavanje: Strojni vid	5. Lecture: Machine vision
<ul style="list-style-type: none"> - Segmentacija - Značilnice - Sledenje 	<ul style="list-style-type: none"> - Segmentation - Features - Tracking
6. Predavanje: Uporaba Python-a za namene strojnega vida	6. Lecture: Application of Python for machine vision
<ul style="list-style-type: none"> - Pregled najpomembnejših knjižnic - Praktični primeri 	<ul style="list-style-type: none"> - Overview of the most important libraries - Applications
7. Predavanje: Nekonvencionalni senzorji	7. Lecture: Nonconventional sensors
<ul style="list-style-type: none"> - MEMS - Mikrosenzorji - Pametni senzorji in pametni senzorski sistemi 	<ul style="list-style-type: none"> - MEMS - Microsensors - Smart sensors and smart sensory systems
8. Predavanje: Mehka logika	8. Lecture: Fuzzy logic
<ul style="list-style-type: none"> - Osnove mehkih množic - Mehko sklepanje - Krmiljenje na osnovi mehke logike 	<ul style="list-style-type: none"> - The basics of fuzzy sets - Soft inference - Fuzzy logic based control
9. Predavanje: Nevronske mreže	9. Lecture: Neural networks
<ul style="list-style-type: none"> - Osnovni tipi nevronske mreže - Učenje nevronske mreže - Uporaba nevronske mreže 	<ul style="list-style-type: none"> - The basic types of neural networks - Neural network learning - Application of neural networks
10. Predavanje: Fuzija senzorjev	10. Lecture: Sensor fusion
<ul style="list-style-type: none"> - Tipi fuzije - Aplikacije - Praktični pristopi 	<ul style="list-style-type: none"> - Types of fusion - Applications - Practical approaches
11. Predavanje: Internet	11. Lecture: Internet
<ul style="list-style-type: none"> - Delovanje - DNS - Usmerjanje z vektorjem razdalj - Usmerjanje s stanjem povezav 	<ul style="list-style-type: none"> - Functioning - DNS - Distance vector routing - Link-state routing
12. Predavanje: Spletno programiranje	12. Lecture: Internet programming
<ul style="list-style-type: none"> - Okolje Node.js, jezik JavaScript 	<ul style="list-style-type: none"> - Node.js environment, JavaScript programming language
13. Predavanje: Strežniki	13. Lecture: Servers
<ul style="list-style-type: none"> - Postavitev strežnika - Branje in pisanje na strežnik 	<ul style="list-style-type: none"> - Server setup - Reading from and writing on a server
14. Predavanje: Varnost	14. Lecture: Security
<ul style="list-style-type: none"> - Enkripcija - Napadi na strani strežnika - Napadi na strani klienta - SQL vstavljanje - Pisanje skozi spletišče 	<ul style="list-style-type: none"> - Encryption - Attacks on the server side - Attacks on the client side - SQL injection - Cross-site scripting
15. Predavanje: Programiranje IoT aplikacij	15. Lecture: Programming of IoT applications
<ul style="list-style-type: none"> - Senzorski del (oddaljeni zajem) - Aktuatorski del (oddaljeno vodenje) - Razvoj IoT krmilne aplikacije na izbrani platformi 	<ul style="list-style-type: none"> - Sensor part (remote acquisition) - Actuator part (remote control) - Development of IoT control application on the

	selected platform
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Temeljna literatura in viri/Readings:

1. Thomas B. Moeslund: Introduction to Video and Image Processing, Springer, 2012
2. Ali Zilouchian: Intelligent Control Systems Using Soft Computing Methodologies, CRC Press, 2001
3. Deep Medhi: Network Routing: Algorithms, Protocols, and Architectures, Morgan Kaufmann, 2018

Cilji in kompetence:

Cilji:

1. Razviti sposobnost snovanja naprednih senzorskih sistemov in omrežij.
2. Razviti sposobnost prenosa teoretično pridobljenega znanja na realne sisteme.
3. Razviti sposobnost uporabe različnih programskih paketov in jezikov povezanih z naprednimi senzorskimi sistemi in omrežji.

Kompetence:

1. S2-MAG: Širitev sposobnosti kritičnega, analitičnega in sintetičnega mišljenja na področju naprednih senzorskih sistemov.
2. S7-MAG: Usposobljenost za uporabo pridobljenih znanj pri samostojnem reševanju tehničnih problemov na področju naprednih senzorskih sistemov in omrežij.
3. P3-MAG: Široka usposobljenost na področju naprednih senzorskih sistemov in omrežij, ki omogoča nadaljevanje študija na doktorskem študijskem programu.
4. P6-MAG: Sposobnost samostojnega razvoja naprednih senzorskih sistemov in omrežij.
5. P7-MAG: Na osnovi analize in sinteze razvita sposobnost iskanja optimalnih rešitev na področju naprednih senzorskih sistemov.

Objectives and competences:

Objectives:

1. Develop the capability of designing of advanced sensory systems and networks.
2. Develop the capability to transfer the theoretical knowledge to real systems.
3. Develop the capability to use various software packages and programming languages related to advanced sensory systems and networks.

Competences:

1. S2-MAG: Improved capability of critical, analytical and synthetical thinking in the field of advanced sensorial systems.
2. S7-MAG: The qualification to use the attained knowledge to autonomously solve technical problems in the field of advanced sensory systems and networks.
3. P3-MAG: A broad qualification in the field of advanced sensory systems and networks as a prerequisite for continuing the study on the doctoral study program.
4. P6-MAG: The ability to autonomously develop advanced sensory systems and networks.
5. P7-MAG: The ability to find optimal advanced sensory system and network solutions based on analysis and synthesis.

Predvideni študijski rezultati:

Znanja:

Z1: Poglobljeno teoretično, metodološko in analitično poznavanje naprednih senzorskih sistemov in omrežij.

Spretnosti:

S2.1: Obvladovanje zelo zahtevnih, kompleksnih matematičnih postopkov povezanih z naprednimi senzorskimi sistemi in omrežji.

Intended learning outcomes:

Knowledge:

Z1: Deeper theoretical, methodological and analytical knowledge of advanced sensory system and networks.

Skills:

S2.1: Mastering very demanding and complex mathematical procedures for advanced sensory

S2.3: Sposobnost izvirnih dognanj na področju naprednih senzorskih sistemov in omrežij.	systems and networks.. S2.3: Ability of unique innovations in the field of advanced sensory systems and networks.
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Metode poučevanja in učenja:

Learning and teaching methods:

<p>P1 Avditorna predavanja z reševanjem izbranih - za področje značilnih - teoretičnih in praktično uporabnih primerov.</p> <p>P2 Obravnava snovi po urejeni in vnaprej razloženi sistematiki.</p> <p>P4 Laboratorijske vaje z namenski didaktičnimi pripomočki kot so osebni računalnik ali računalnik Raspberry Pi in različnimi programskimi jeziki.</p>	<p>P1 Auditorial lectures with solving selected field-specific theoretical and applied use cases.</p> <p>P2 Presenting the content according to the explained systematics.</p> <p>P4 Laboratory exercises with special-purpose didactic devices (PC or Raspberry Pi computer with various programming languages).</p>
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Načini ocenjevanja:

Delež/Weight

Assessment:

Pisni izpit.	50,00 %	Written examination.
Ustno izpraševanje.	30,00 %	Oral examination.
Projekt.	20,00 %	Project.

Reference nosilca/Lecturer's references:

Primož Podržaj:

1. FINŽGAR, Miha, PODRŽAJ, Primož. A wavelet-based decomposition method for a robust extraction of pulse rate from video recordings. PeerJ, Nov. 2018, vol. 6, f. 1-26
2. SIMONČIČ, Samo, PODRŽAJ, Primož. An improved digital image correlation calculation in the case of substantial lighting variation. Experimental mechanics, Jun. 2017, vol. 57, iss. 5, str. 743-753
3. PODRŽAJ, Primož, ČEBULAR, Andrej. The application of LVQ neural network for weld strength evaluation of RF welded plastic materials. IEEE/ASME transactions on mechatronics, Apr. 2016, vol. 21, no. 2, str. 1063-1071
4. SIMONČIČ, Samo, PODRŽAJ, Primož. Resistance spot weld strength estimation based on electrode tip displacement/velocity curve obtained by image processing. Science and technology of welding and joining, Jun. 2014, vol. 19, no. 6, str. 468-475
5. PODRŽAJ, Primož, SIMONČIČ, Samo. A machine vision-based electrode displacement measurement. Welding in the world, vol. 58, iss. 1, str. 93-99