

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	<b>Obdelava slik</b>
<b>Course title:</b>	<b>Image processing</b>

<b>Študijski program</b> Study programme and level	<b>Študijska smer</b> Study field	<b>Letnik</b> Academic year	<b>Semester</b> Semester
Inženiring in avtomobilska industrija		prvi	drugi
Engineering and Automotive Industry	The program has no study fields	first	second

**Vrsta predmeta / Course type**

Izbirni 4

**Univerzitetna koda predmeta / University course code:**

DR\_31020

<b>Predavanja</b> Lectures	<b>Seminar</b> Seminar	<b>Sem. vaje</b> Tutorial	<b>Lab. vaje</b> Laboratory work	<b>Teren. vaje</b> Field work	<b>Samost. delo</b> Individ. work	<b>ECTS</b>
25	-	-	15	-	260	10

**Nosilec predmeta / Lecturer:**

dr. Mario Žganec, dr. Jerneja Žganec Gros

**Jeziki /**  
**Languages:**

**Predavanja /**  
**Lectures:**  
**Vaje / Tutorial:**

Slovenski / slovenian

Slovenski / slovenian

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

**Prerequisites:**

- II stopnja naravoslovno-tehniške smeri
- osnovna znanja iz področja računalništva in teorije obdelave signalov

- Second level degree from a natural sciences or engineering program,
- Basic knowledge of computer science and signal processing

**Vsebina:**

**Content (Syllabus outline):**

<u>Predavanja:</u> <ul style="list-style-type: none"> <li>- Slike in človeški vid,</li> <li>- Vzorčenje slik,</li> <li>- Kamere in slikovni senzorji,</li> <li>- Spektralna občutljivost,</li> <li>- Kvaliteta slik,</li> <li>- Obdelava slik,</li> <li>- Analiza slik,</li> </ul>	<u>Lectures:</u> <ul style="list-style-type: none"> <li>- Pictures and human vision,</li> <li>- Sampling of images,</li> <li>- Cameras and imaging sensors,</li> <li>- Spectral sensitivity</li> <li>- The quality of images,</li> <li>- Image processing,</li> <li>- Image Analysis,</li> </ul>
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<ul style="list-style-type: none"> <li>– Klasifikacija in razpoznavanje objektov,</li> <li>– Zajem in obdelava globinskih slik,</li> <li>– Prikaz slik,</li> <li>– Uporabniški vmesniki.</li> </ul> <p><u>Laboratorijske vaje in samostojno delo:</u></p> <ul style="list-style-type: none"> <li>– Poglobitev teoretičnih znanj s področja obdelave slik na praktičnem primeru izbire, uporabe, evaluacije, ali načrtovanja sistema za obdelavo slik.</li> </ul>	<ul style="list-style-type: none"> <li>– Classification and object recognition,</li> <li>– Acquisition and processing of depth images,</li> <li>– Image presentation,</li> <li>– User interfaces.</li> </ul> <p><u>Laboratory work and individual work:</u></p> <ul style="list-style-type: none"> <li>– Implementation of the theoretical knowledge in a specific application comprising selection, use, evaluation or design of an image processing system.</li> </ul>
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#### Temeljni literatura in viri / Readings:

<ul style="list-style-type: none"> <li>– Rafael C. Gonzalez, Richard E. Wood, Digital Image Processing, Prentice Hall, 2008, (<a href="http://folk.uio.no/ainard/Folder2/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez,%20R.%20Woods.pdf">http://folk.uio.no/ainard/Folder2/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez,%20R.%20Woods.pdf</a>)</li> <li>– E. R. DAVIES, Computer and Machine Vision: Theory, Algorithms, Practicalities, Fourth Edition, Elsevier, 2012, ISBN: 978-0-12-386908-1, (<a href="https://robot.bolink.org/ebooks/Computer%20and%20Machine%20Vision%204e%20-%20Theory,%20Algorithms,%20Practicalities%20By%20E%20R%20Davies.pdf">https://robot.bolink.org/ebooks/Computer%20and%20Machine%20Vision%204e%20-%20Theory,%20Algorithms,%20Practicalities%20By%20E%20R%20Davies.pdf</a>)</li> </ul>
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#### Priporočljiva literatura / Recommended Textbooks

<ul style="list-style-type: none"> <li>– Tutorials Point, Digital Image Processing: <a href="https://www.tutorialspoint.com/dip/dip_useful_resources.htm">https://www.tutorialspoint.com/dip/dip_useful_resources.htm</a></li> </ul>
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#### Cilji in kompetence:

<p><b>Cilji</b></p> <p>Predmet je namenjen pridobitvi osnovnih znanj in orodij, potrebnih za razvoj metod in sistemov ter praktičnih znanj pri razvoju algoritmov za zajem, obdelavo, razpoznavo slik in objektov na sliki. Program je usmerjen v tri glavne cilje: postaviti cilje obdelave in razpoznavanja, uporabiti primerne postopke in orodja ter nazadnje poznati postopke verifikacije doseženih ciljev. Predavanja so usmerjena v koncepte obdelave razpoznavanja in klasifikacije, kot tudi v funkcionalnost in uporabnost programskih orodij in naprav za zajemanje slik.</p> <p><b>Kompetence</b></p> <p><i>Učna enota prispeva k razvoju naslednjih splošnih in specifičnih kompetenc:</i></p> <ul style="list-style-type: none"> <li>– sposobnost uporabe pridobljenega</li> </ul>
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#### Objectives and competences:

<p><b>Objectives</b></p> <p>The course provides basic knowledge and tools needed to develop methods, systems and algorithms for capturing and processing of images as well as recognizing objects in an image. The program focuses on three main objectives: to set goals for image processing and object recognition, to use appropriate procedures and tools to achieve these goals, and finally to be able to verify the achieved objectives. Lectures are focused on the concepts of image processing recognition and classification, as well as the functionality and usability of software and hardware for capturing images.</p> <p><b>Competences</b></p> <p><i>Learning Unit contributes to the development of generic and specific competences:</i></p> <ul style="list-style-type: none"> <li>– the ability to apply theoretical knowledge in practice,</li> </ul>
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<p>teoretičnega znanja v praksi,</p> <ul style="list-style-type: none"> <li>– sposobnost načrtovanja preprostih postopkov obdelave slik,</li> <li>– sposobnost sodelovanja pri razvoju inteligentnega razpoznavanja in klasifikacije objektov na sliki ,</li> <li>– sposobnost izbire primernih naprav za zajemanje slike in primernih postopkov za obdelavo slike pri reševanju specifičnega problema.</li> </ul>	<ul style="list-style-type: none"> <li>– ability to design simple image processing algorithms,</li> <li>– the ability to collaborate in the development of intelligent recognition and classification of objects in the picture,</li> <li>– the ability to select the appropriate hardware for image capturing and appropriate image processing procedures needed to solve a specific problem.</li> </ul>
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**Predvideni študijski rezultati:**

**Intended learning outcomes:**

<p>Znanje in razumevanje: <i>Študent/študentka:</i></p> <ul style="list-style-type: none"> <li>– pozna naprave in postopke za zajemanje slik,</li> <li>– pozna programska orodja in osnovne postopke za obdelavo slike,</li> <li>– pozna postopke za analizo slik in razpoznavanje objektov na slikah,</li> <li>– zna oceniti zmogljivosti, prednosti in omejitve strojne in programske opreme za zajemanje in obdelavo slik,</li> <li>– lahko sodeluje pri razvoju sistemov, ki vsebujejo zajemanje in obdelavo slik.</li> </ul>	<p>Knowledge and understanding: <i>Student:</i></p> <ul style="list-style-type: none"> <li>– is familiar with systems and methods for capturing images,</li> <li>– is familiar with software tools and basic image processing procedures,</li> <li>– is familiar with the image analysis procedures and object recognition algorithms,</li> <li>– is able to assess the capabilities, strengths and limitations of the hardware and software for image capturing and processing,</li> <li>– can participate in the development of systems incorporating image acquisition and processing.</li> </ul>
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**Metode poučevanja in učenja:**

**Learning and teaching methods:**

<ul style="list-style-type: none"> <li>– predavanja z aktivno udeležbo študentov, ki vsebujejo razprave, diskusije, odgovore na vprašanja in prikaz praktičnih primerov,</li> <li>– laboratorijske vaje in/ali individualno in skupinsko delo s študenti v obliki konzultacij,</li> <li>– projektna naloga s praktičnim primerom implementacije inteligentnih senzorjev.</li> </ul>	<ul style="list-style-type: none"> <li>– lectures with active participation of students, including discussions, debates, answers to questions and practical examples,</li> <li>– laboratory work and/or individual and group work with students in the form of consultations,</li> <li>– seminar with practical examples of the implementation of intelligent sensors.</li> </ul>
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**Načini ocenjevanja:**

**Delež (v %) / Assessment:  
Weight (in%)**

<ul style="list-style-type: none"> <li>– projektna naloga</li> <li>– teoretični del izpita</li> </ul>	<p>(50%) (50%)</p>	<ul style="list-style-type: none"> <li>– seminar project</li> <li>– theoretical examination</li> </ul>
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Reference nosilca / Lecturer's references:

*Ključne reference nosilca:*

- KRAVANJA, Jaka, ŽGANEC, Mario, ŽGANEC GROS, Jerneja, DOBRIŠEK, Simon, ŠTRUC, Vitomir. Exploiting spatio-temporal information for light-plane labeling in depth-image sensors using probabilistic graphical models. Informatica, ISSN 0868-4952, 2016, vol. 27, no. 1, str. 67-84
- VOLKOV, Alexey, ŽGANEC GROS, Jerneja, ŽGANEC, Mario, JAVORNIK, Tomaž, ŠVIGELJ, Aleš. Design of spreading-codes-assisted active imaging system. International journal of advanced robotic systems, ISSN 1729-8814, 2015, vol. 12, str. 80-1-80-8
- VOLKOV, Alexey, ŽGANEC GROS, Jerneja, ŽGANEC, Mario, JAVORNIK, Tomaž, ŠVIGELJ, Aleš. Modulated acquisition of spatial distortion maps. Sensors, ISSN 1424-8220, 2013, vol. 13, no. 8, str. 11069-11084,
- GOLOB, Žiga, ŽGANEC GROS, Jerneja, ŽGANEC, Mario, VESNICER, Boštjan, DOBRIŠEK, Simon. FST-based pronunciation lexicon compression for speech engines. International journal of advanced robotic systems, ISSN 1729-8814, 2012, vol. 9, no. 211, str. 1-9
- ŽGANEC, Mario, ČERNE, Tomaž, ŽGANEC GROS, Jerneja. SmartPARK - sistem za samodejno prepoznavo vozil. V: MOHORČIČ, Mihael (ur.), ROBNIK, Ana (ur.), BAŠKOVČ, Dalibor (ur.). Delavnica Pametna mesta in skupnosti kot razvojna priložnost Slovenije : zbornik 18. mednarodne multikonference Informacijska družba - IS 2015, 12. oktober 2015, Ljubljana, Slovenia: Institut Jožef Stefan, 2015, str. 113-114,
- ŽGANEC, Mario, LAVRENČAK, Jaka, BABIČ, Ankica, US-KRAŠOVEC, Marija. Detection of compact low-chromation areas in cell nuclei images. V: CESNIK, Branko (ur.), MCCRAY, Alexa (ur.), SCHERRER, Jean-Raoul (ur.). MEDINFO '98 : proceedings of the Ninth World Congress on Medical Informatics, (Studies in health technology and informatics, vol. 52). Amsterdam [etc.]: IOS Press, cop. 1998, part 2, str. 1017-1021
- ŽGANEC, Mario, BABIČ, Ankica, US-KRAŠOVEC, Marija, PALČIČ, Branko. 3D presentation of the nuclear cell features in quantitative cytometry. V: CIMINO, James J. (ur.). Beyond the superhighway: exploiting the Internet with medical informatics : proceedings, 1996 AMIA Annual Fall Symposium, October 26-30, 1996, Washington, DC, (Journal of the American Medical Informatics Association, ISSN 1067-5027, Symposium supplement). Philadelphia: Hanley & Belfus, cop. 1996, str. 679-683
- PAVEŠIČ, Nikola, KOVAČIČ, Stanislav, ŽGANEC, Mario. Laboratory stereoscopic system : calibration, matching and error analysis. V: HORVAT, Bogomir (ur.), KAČIČ, Zdravko (ur.). Modern modes of man-machine communication : proceedings. Maribor: Univerza Maribor, 1994, str. 9-1 - 9-15
- KOVAČIČ, Stanislav, PAVEŠIČ, Nikola, GYERGYÉK, Ludvik, ŽGANEC, Mario. Stereo-matching by deformation. V: PAVEŠIČ, Nikola (ur.), NIEMANN, Heinrich (ur.), PAULUS, Dietrich (ur.). Image processing and stereo analysis : proceedings of the Slovenian-German workshop, Erlangen, December 3, 1992, (Arbeitsberichte des Instituts für Mathematische Maschinen und Datenverarbeitung (Informatik), ISSN 0344-3515, Bd. 26, Nr. 1). Erlangen: Institut für Mathematische Maschinen und Datenverarbeitung (Informatik), 1993, str. 23-36
- ŽGANEC, Mario, PAVEŠIČ, Nikola, KOVAČIČ, Stanislav. Stereo-matching by dynamic programming. V: PAVEŠIČ, Nikola (ur.), NIEMANN, Heinrich (ur.), PAULUS, Dietrich (ur.). Image processing and stereo analysis : proceedings of the Slovenian-German workshop, Erlangen, December 3, 1992, (Arbeitsberichte des Instituts für Mathematische Maschinen und Datenverarbeitung (Informatik), ISSN 0344-3515, Bd. 26, Nr. 1). Erlangen: Institut für Mathematische Maschinen und Datenverarbeitung (Informatik), 1993, str. 37-51
- ŽGANEC, Mario, KRIŽAJ, Janez, ŽGANEC GROS, Jerneja, ŠTRUC, Vitomir. Method and device for depth imaging : SI24755 (A) - 2015-12-31. Ljubljana: Urad RS za intelektualno lastnino, 2015.
- ŽGANEC, Mario, ŽGANEC GROS, Jerneja. Postopek in oprema za nadziranje ustreznosti geometrije

cevastega predmeta : SI24725 (A) - 2015-11-30. Ljubljana: Urad RS za intelektualno lastnino, 2015. 14 str

- ŽGANEC, Mario, ŽGANEC GROS, Jerneja. Active 3D triangulation-based imaging method and device : patent : EP 1997322 (B1), 2011-12-28. Munich; Hague; Vienna: European Patent Office, 2011.
- MACAULAY, Calum E., GARNER, David, US-KRAŠOVEC, Marija, STROJAN FLEŽAR, Margareta, ŽGANEC, Mario, LAVRENČAK, Jaka, PALČIČ, Branko, FERGUSON, Gary William. A method and a system for detection of malignancy-associated changes : EP 1532573 (B1), 2008-10-15. München: European Patent Office, 2008.
- FERGUSON, Gary William, US-KRAŠOVEC, Marija, STROJAN FLEŽAR, Margareta, ŽGANEC, Mario, LAVRENČAK, Jaka, PALČIČ, Branko. Filter devices for depositing material and density gradients of material from sample suspension : US 7211225 (B2), 2007-05-01 : appl. no. 10/228,353, filed Aug. 26, 2002. Alexandria: United States Patent and Trademark Office, 2007.
- ŽGANEC, Mario, ŽGANEC GROS, Jerneja. Postopek komuniciranja v sistemu za telefonijo po internetnem protokolu (IP) z IP - telefoni in sistem za takšno telefonijo : patent : 20499 (A), 2001-08-31. Ljubljana: Urad RS za intelektualno lastnino, 2001
- ŽGANEC, Mario. Modul periferne enote večnivojskega procesnega sistema : delo je pripravljeno po razpisu odbora za Prešernove nagrade študentom za leto 1989, št. teme 25, pod mentorstvom prof. dr. Petra Šuhla dipl. ing. in komentorstvom asistenta Romana Blenkuša dipl. ing.. Ljubljana: [M. Žganec], 1989.
- STROJAN FLEŽAR, Margareta, LAVRENČAK, Jaka, ŽGANEC, Mario, STROJAN, Primož. Image cytometric nuclear texture features in inoperable head and neck cancer : a pilot study. Radiology and oncology, ISSN 1318-2099. [Print ed.], 2011, vol. 45, no. 1, str. 40-45, tabele, doi: 10.2478/v10019-011-0002-y. [COBISS.SI-ID 28182745]
- US-KRAŠOVEC, Marija, ERŽEN, Janez, ŽGANEC, Mario, STROJAN FLEŽAR, Margareta, LAVRENČAK, Jaka, GARNER, David M., DOUDKINE, Alexei, PALČIČ, Branko. Malignancy associated changes in epithelial cell of buccal mucosa : a potential cancer detection test. Analytical and quantitative cytology and histology, ISSN 0884-6812, 2005, vol. 27, no. 5, str. 254-262. [COBISS.SI-ID 272507]
- POHAR-MARINŠEK, Živa, US-KRAŠOVEC, Marija, GOLOUH, Rastko, ŽGANEC, Mario. Value of image cytometry in the subclassification of rhabdomyosarcoma. Analytical and quantitative cytology and histology, ISSN 0884-6812, 2002, letn. 24, št. 4, str. 212-220. [COBISS.SI-ID 15987929]