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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Obdelava slik in videa | | | | | | | | | | | | | | |
| **Course title:** | | | Image and video processing | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Telekomunikacije (Informacijsko komunikacijske tehnologije) | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Telecommunications (Information and Communication Technologies) | | | | | | | | 1 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64238 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 45 |  | | | 30 | | |  | | | |  | | | 75 | |  | 6 |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | prof. dr. Boštjan Likar | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski/Slovenian | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski/Slovenian | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites:** | | | | | | | |
| Vpis v 1. letnik študija. | | | | | | | | |  | Enrolment in the 1st year of study. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Zajem, vzorčenje in rekonstrukcija slik (prenosna funkcija slikovnega sistema, 2D vzorčenje, analiza vzorčenja, slikovni senzorji, vzorčenje slikovnih signalov in rekonstrukcija slike, modeliranje sistema zajema in prenosna funkcija). Barve in barvni prostori (fizikalni pomen barv, kolorimetrija, barvni prostori in metrika, primerjava in pretvorba med barvnimi prostori). Slikovne transformacije (definicije, slikovne transformacije, analiza glavnih komponent, uporaba transformacij, dekorelacija, transformacija kot orodje za zgoščen zapis slike). Standardi za shranjevanje slikovnih podatkov. Metode izboljšave slike (linearno in nelinearno filtriranje, izboljšava v frekvenčnem prostoru). Robljenje in segmentacija objektov (robljenje, filtri za iskanje robov, postopki segmentacije, morfologija). Razpoznavanje in klasifikacija objektov. Posebnosti slikovnega gradiva v obliki video posnetkov (zgoščevanje, vektorji premika, analiza videa) in standardi. Postopki za vrednotenje kakovosti slik in videa. Percepcija slikovnega gradiva. Kvaliteta slikovnih in video komunikacijskih storitev. | | | | | | | |  | | Acquisition, sampling and reconstruction of images (transfer function of imaging system, 2D sampling, sampling theory, imaging sensors, sampling and reconstruction of images, modelling acquisition systems and transfer function). Colours and colour spaces (physical interpretation of colours, colorimetry, colour spaces and metrics, comparison and conversion between colour spaces). Image transformations (definitions, image transformations, principal component analysis, transformation applications, decorrelation, transformation as a tool for image compression). Standards for storage of images. Methods for image enhancement (linear and nonlinear filtering, enhancement in frequency domain). Edge detection and segmentation of objects (edge detection, edge detection filters, image segmentation, morphology). Object recognition and classification. Special features of video signals (video compression, motion vectors, video analysis) and related standards. Quality evaluation of images and video. Image perception. Quality of imaging and video communication services. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Gonzalez RC, Woods RE, Digital Image Processing Pearson Prentice Hall, 2008. 2. Likar B, Biomedicinska slikovna informatika in diagnostika Založba FE in FRI, 2008. 3. Burger W, Burge MJ, Principles of Digital Image Processing: Fundamental Techniques Springer, 2009. 4. Burger W, Burge MJ, Principles of Digital Image Processing: Core Algorithms Springer, 2009. 5. Burger W, Burge MJ, Principles of Digital Image Processing: Advanced Methods Springer, 2013. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznavanje digitalne obdelave slikovnega gradiva. Razumevanje metod digitalne obdelave signalov na večdimenzionalnih podatkih. Pridobitev usposobljenosti za izbor načina zajema, obdelave in shranjevanja slik. Interpretacije barv v digitalnih slikovnih sistemih. Usposobljenost za izgradnjo sistemov za izboljšavo kakovosti slikovnega gradiva. Poznavanje postopkov za kompresijo slik in videa. Pridobitev osnovnih znanj s področja razpoznavanja 2D in 3D slik, identifikacija objektov na slikah in videih. Osnovna znanja s področja standardov zgoščevanja slik in videov. | |  | | Introduction of digital image processing. Understanding digital signal processing methods for multidimensional data. Obtaining qualifications for choosing relevant methods for image acquisition, processing and storage. Interpretation of colours in digital imaging systems. Competences to build systems for image quality enhancements. Understanding image and video compression algorithms. Acquisition of basic knowledge in the field of 2D and 3D image recognition, identification of objects in images and videos. Fundamentals of image and video compression standards. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| * Izbor postopkov zajema, obdelave in shranjevanja slikovnega gradiva. * Spoznati interpretacije barv v digitalnih slikovnih sistemih. * Zmožnost izgradnje sistemov za izboljšavo kakovosti slikovnega gradiva. * Poznati postopke za zgoščevanje slik in videa. | | |  | * The ability to choose relevant methods for image acquisition, processing and storage. * To understand interpretation of colours in digital imaging systems. * Competences to build systems for image quality enhancements. * Understanding image and video compression. | |
| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja s teoretičnimi izhodišči, praktično naravnane laboratorijske vaje in samostojna seminarska naloga v obliki projekta z možnostjo dela v skupini. | | |  | Lectures with strong theoretical background, practically oriented lab assignments and individual seminary project assignment with optional teamwork. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Laboratorijske vaje  Praktično znanje (pisni izpit)  Teoretično znanje (ustni izpit) | 33%  33%  34% | | | | Lab works  Practical knowledge (written exam)  Theoretical knowledge (oral exam) |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. JERMAN, Tim, PERNUŠ, Franjo, LIKAR, Boštjan, ŠPICLIN, Žiga. Blob enhancement and visualization for improved intracranial aneurysm detection. IEEE transactions on visualization and computer graphics, 2016, vol. 22, no. 6, str. 1705-1717. 2. GALIMZIANOVA, Alfiia, PERNUŠ, Franjo, LIKAR, Boštjan, ŠPICLIN, Žiga. Robust estimation of unbalanced mixture models on samples with outliers. IEEE transactions on pattern analysis and machine intelligence, 2015, vol. 37, no. 11, str. 2273-2285. 3. JEMEC, Jurij, PERNUŠ, Franjo, LIKAR, Boštjan, BÜRMEN, Miran. Push-broom hyperspectral image calibration and enhancement by 2D deconvolution with a variant response function estimate. Optics express, 2014, vol. 22, no. 22, str. 27655-27668. 4. BRATANIČ, Blaž, PERNUŠ, Franjo, LIKAR, Boštjan, TOMAŽEVIČ, Dejan. Real-time rotation estimation using histograms of oriented gradients. PloS one, 2014, vol. 3, no. 9, str. 1-9. 5. KATRAŠNIK, Jaka, PERNUŠ, Franjo, LIKAR, Boštjan. Radiometric calibration and noise estimation of acousto-optic tunable filter hyperspectral imaging systems. Applied optics, 2013, vol. 52, no. 15, str. 3526-3537. | | | | | |