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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Računalniški vid | | | | | | | | | | | | | | |
| **Course title:** | | | Computer Vision | | | | | | | | | | | | | | |
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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 | | | | | Avtomatika in informatika | | | | | | | | 1 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Control systems and computer engineering | | | | | | | | 1 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64206 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **45** | **0** | | | **30** | | |  | | | |  | | | **75** | |  | **6** |
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| **Nosilec predmeta / Lecturer:** | | | | | Stanislav Kovačič | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | Slovenščina in angleščina / Slovenian and English | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | Slovenščina in angleščina / Slovenian and English | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the year of the course. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| 1. **Uvod**    * Cilji računalniškega vida, sorodna področja.    * Smeri razvoja in področja uporabe. 2. **Nastanek slike**    * Osnovne lastnosti digitalnih slik.    * Centralno projekcijski model kamere.    * Kalibracija kamere, direktna linearna transformacija, korekcija distorzije leč.    * Širjenje svetlobe, osnove fotometrije, fotometrična enačba leče.    * Kamere in leče. Tehnike osvetlitve.    * Človeško oko, zaznavanje barv. Predstavitev barv, barvni prostori. 3. **Analiza slik**    * Osnove filtriranja slik. Operacije s histogrami.    * Detekcija robov, detekcija oglišč.    * Houghova transformacija.    * Analiza povezanih komponent.    * Morfološko filtriranje.    * Aktivni modeli krivulj (kače).    * Opis oblike.    * Prostor ločljivosti in slikovne piramide.    * Geometrične transformacije slik, mere podobnosti.    * Registracija slik, prileganje modela, RANSAC. 4. **Stereo vid**    * Osnove stereo vida.    * Stereo primerjanje.    * Modeliranje in kalibriranje stereo sistema, epipolarna geometrija.    * Aktivni stereo, strukturirana osvetlitev. 5. **Analiza gibanja**    * Detekcija gibanja.    * Čas do dotika.    * Optični tok, polje gibanja, polje hitrosti.    * Vizualno sledenje, osnove Kalmanovega filtra. | | | | | | | |  | | 1. **Introduction**  * The aims of computer vision, the origins of computer vision, and related fields. * Computer vision trends and application domains.  1. **Image formation**  * Basic image properties. * Perspective projection camera model. * Camera calibration, direct linear transform, lens distortion correction. * Propagation of light, photometry, photometric lens equation. * Cameras and lenses, lighting techniques. * Human eye, color perception, reproducing color, color spaces.  1. **Image analysis**  * Image filtering basics, histogramming. * Edge detection, corner detection. * Hough transform. * Connected components analysis. * Morphological filtering. * Active contour models (snakes). * Shape description. * Scale space and image pyramids. * Geometric image transformations, similarity measures. * Image registration, model fitting, RANSAC.  1. **Stereo vision**  * Basic concepts of stereo vision. * Stereo matching. * Modeling and calibration, epipolar geometry. * Active stereo, structured lighting.  1. **Visual motion analysis**  * Motion detection. * Time to collision. * Optic flow, motion field, velocity field. * Visual tracking, Kalman filtering basics. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. D. Forsyth, J. Ponce, Compuer vision, a modern approach, 2nd ed., Pearson 2012. 2. E. Trucco, A. Verri, Introductory techniques for 3-D computer vision, Prentice Hall, 1998. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Razumevanje osnovnih načel in tehnologij vidnega zaznavanja v inteligentnih sistemih avtomatike in robotike. | |  | | The aims of this course are to understand basic concepts, underlying theory, algorithms, and applications of computer vision. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Sposobnost izvedbe zmerno zahtevnih algoritmov računalniškega vida.  Sposobnost rešiti klasične probleme s področja računalniškega in strojnega vida. | | |  | To be able to implement moderately complex computer vision algorithms.  To be able to solve elementary computer and machine vision problems. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Predavanja, teoretične podlage s praktičnimi prikazi.  Laboratorijske vaje, priprave na praktično delo. Programske rešitve v Matlabu in/ali C-ju. | | |  | Lectures, underlying theory with illustrative demonstrations.  Laboratory work, instructions and assignments. Programming solutions in Matlab and/or C. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Opravljene laboratorijske vaje s poročili.  Vmesni pisni izpit.  Končni pisni (30) in ustni (10) izpit. | 40  20  40 | | | | Laboratory solutions with written reports.  Mid-term written exam.  Final written (30) and oral (10) exam. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. KRISTAN, Matej, SULIĆ KENK, Vildana, KOVAČIČ, Stanislav, PERŠ, Janez. Fast image-based obstacle detection from unmanned surface vehicles. *IEEE transactions on cybernetics*, ISSN 2168-2267, Mar. 2016, vol. 46, no. 3, pp. 641-654. 2. MANDELJC, Rok, KOVAČIČ, Stanislav, KRISTAN, Matej, PERŠ, Janez. Tracking by identification using computer vision and radio. *Sensors*, ISSN 1424-8220, Jan. 2013, vol. 13, no. 1, pp. 241-273. 3. KRISTAN, Matej, KOVAČIČ, Stanislav, LEONARDIS, Aleš, PERŠ, Janez. A two-stage dynamic model for visual tracking. *IEEE transactions on systems, man, and cybernetics. Part B, Cybernetics*, ISSN 1083-4419, Dec. 2010, vol. 40, no. 6, str. 1505-1520. 4. PERŠ, Janez, SULIĆ, Vildana, KRISTAN, Matej, PERŠE, Matej, POLANEC, Klemen, KOVAČIČ, Stanislav. Histograms of optical flow for efficient representation of body motion. *Pattern recognition letters*, ISSN 0167-8655, Aug. 2010, vol. 31, no. 11, str. 1369-1376. 5. PERŠE, Matej, KRISTAN, Matej, KOVAČIČ, Stanislav, VUČKOVIĆ, Goran, PERŠ, Janez. A trajectory-based analysis of coordinated team activity in a basketball game. *Computer vision and image understanding*, ISSN 1077-3142, May 2009, vol. 113, no. 5, str. 612-621. | | | | | |