|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Biomedicinske slikovne tehnologije | | | | | | | | | | | | | | |
| **Course title:** | | | Biomedical Imaging Technologies | | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | |  | |  | | |
| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Podiplomski magistrski študijski program druge stopnje Elektrotehnika | | | | | Biomedicinska tehnika | | | | | | | | 1 | | 2 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Biomedical Engineering | | | | | | | | 1 | | 2 | | |
|  | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
|  | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64214 | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** |  | | | **45** | | |  | | | |  | | | **75** | |  | **6** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Boštjan Likar | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenščina / Slovene** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenščina / Slovene** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisites:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the year of the course. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Pridobivanje biomedicinskih slik: s pomočjo digitalnih fotoaparatov in kamer v vidnem in nevidnem delu spektra elektromagnetnega valovanja, mikroskopske tehnike, rentgensko slikanje in računalniška tomografija, magnetno resonančno slikanje in ultrazvok – fizikalni principi, tehnologije in geometrije zajemanja, izvedbe in lastnosti naprav, nepravilnosti in kakovost slik.  Obnova, rekonstrukcija in kalibracija slik: modeliranje in ocenjevanje šuma, glajenje in ostrenje, statistično in prilagodljivo filtriranje, postopki za rekonstrukcijo slik, kalibracija in obnova sivinskih vrednosti in prostorskih nehomogenosti, geometrijska kalibracija slik.  Poravnava in integracija slik: delitev in uporaba postopkov poravnav, modeliranje geometrijskih preslikav in deformacij, določevanje in prileganje kontrolnih točk, poravnava na osnovi maksimizacije podobnosti, mere podobnosti in optimizacijski postopki, analiziranje in vrednotenje postopkov poravnav, primeri integracije slik. | | | | | | | |  | | Acquisition of biomedical images: digital photography and cameras, microscopic techniques, X-ray imaging, computer tomography, magnetic resonance imaging and ultrasound – physical principles, acquisition technologies and geometries, implementations and characteristics of imaging devices, image artefacts and quality.  Restoration, reconstruction and calibration: modelling and estimation of noise, image smoothing and sharpening, statistical and adaptive filtering, reconstruction algorithms, calibration and restoration of intensities, geometric calibration.  Image registration and integration: classifications and applications of image registration methods, modelling geometrical transformations and deformations, identification and matching of control points, registration by maximization of similarities, similarity measures and optimization methods, analysis and evaluation of registration methods, image integration examples. | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temeljna literatura in viri / Readings:** | | | | | |
| 1. Paul Suetens, Fundamentals of Medical Imaging, Cambridge University Press, 2nd edition, 2009. 2. Jerry L. Prince, Jonathan Links, Medical Imaging Signals and Systems, Prentice Hall, 2nd edition, 2014. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznati naprave in tehnologije za pridobivanje biomedicinskih slik ter postopke za njihovo obnovo, rekonstrukcijo, kalibracijo in integracijo. | |  | | To introduce basic technologies for the acquisition of biomedical images and the procedures for their restoration, reconstruction, calibration and integration. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Razumevanje in obvladovanje večdimenzionalnih podatkov: fizikalna ozadja, omejitve in nepopolnosti, informacijska vsebina, digitalna obdelava in upravljanje. | | |  | Understanding and mastering multidimensional data: physical principles, limitations and artefacts, information content, digital processing and management. | |
|  | | |  |  | |
| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Teoretične osnove, postopke in primere uporabe študentje spoznajo na predavanjih, praktična znanja pa pridobijo z reševanjem nalog na laboratorijskih vajah. | | |  | Basic theory, procedures and practical examples are considered at lectures, while practical knowledge is gained through problem-solving tasks at lab works. | |
| **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. Jaka Katrašnik, Franjo Pernuš in Boštjan Likar. Radiometric calibration and noise estimation of acousto-optic tunable filter hyperspectral imaging systems. Applied Optics, 52(15):3526-3537, 2013. 2. Bulat Ibragimov, Boštjan Likar, Franjo Pernuš in Tomaž Vrtovec. Shape representation for efficient landmark-based segmentation in 3D. IEEE Transactions on Medical Imaging, 33(4):861-874, 2014. 3. Jurij Jemec, Franjo Pernuš, Boštjan Likar in Miran Bürmen. Push-broom hyperspectral image calibration and enhancement by 2D deconvolution with a variant response function estimate. Optics Express, 22(22):27655--27668, 2014. 4. Tomaž Vrtovec, Franjo Pernuš in Boštjan Likar. Investigation of the reproducibility and reliability of sagittal vertebral inclination measurements from MR images of the spine. Computerized Medical Imaging and Graphics, 38(7):620-627, 2014. 5. Bulat Ibragimov, Jerry L. Prince, Emi Z. Murano, Jonghye Woo, Maureen Stone, Boštjan Likar, Franjo Pernuš in Tomaž Vrtovec. Segmentation of tongue muscles from super-resolution magnetic resonance images. Medical Image Analysis, 20(1):198-207, 2015. | | | | | |