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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Analiza medicinskih slik | | | | | | | | | | | | | | |
| **Course title:** | | | Medical Image Analysis | | | | | | | | | | | | | | |
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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 | | | | | Biomedicinska tehnika | | | | | | | | 2 | | 1 | | |
| 2nd cycle masters study programme in Electrical Engineering | | | | | Biomedical Engineering | | | | | | | | 2 | | 1 | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Obvezni-strokovni / Compulsory professional | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64279 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 30 |  | | | 45 | | |  | | | |  | | | 75 | |  | 6 |
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| **Nosilec predmeta / Lecturer:** | | | | | Franjo Pernuš | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski / Slovenian | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | Prerequisits: | | | | | | | |
| Vpis v letnik predmeta | | | | | | | | |  | Enrolment in the year of the course | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| **Uvod**: področja uporabe analize medicinskih slik.  **Razgradnja in kvantitativna analiza**: delitev in uporaba postopkov, prilagodljivo upragovljanje, razgradnja na osnovi odvodov, razgradnja s širjenjem, združevanjem in razdruževanjem področij, razgradnja na osnovi razvrščanja, razgradnja na osnovi poravnave modelov, opisovanje slik z matematičnimi in fizikalnimi modeli, opisovanje z osnovnimi komponentami, statistični modeli pojavnosti in oblike.  Računalniško podprta diagnostika: izbira in izločanje značilnic, odločitvene funkcije, razvrščanje na osnovi mer razdalj in rojenja, statistično razvrščanje, mehko razvrščanje, nevronske mreže. Osnove ROC (receiver operating characteristics) analize. Področja uporabe računalniško podprte diagnostike.  **Slikovno vodeni posegi**: slikovni in neslikovni sistemi za sledenje in navigacijo, načrtovanje in prikazovanje posegov, poravnava slik, modelov in načrtov posegov s pacientom in s slikami pacienta, vrednotenje zanesljivosti in točnosti posegov, področja uporabe slikovno vodenih posegov. | | | | | | | |  | | **Introduction**: medical image analysis in clinical practice  **Segmentation and quantitative analysis**: classification and applicability of methods, thresholding, edge- and region-based techniques, model- and atlas-based methods, supervised and unsupervised methods, cluster-based, principal component analysis, statistical shape and appearance models  **Computer-aided diagnosis**: feature selection and extraction, decision functions, distance measures in cluster analysis, statistical classification, fuzzy classification, neural networks, receiver operating characteristics (ROC), successful applications.  **Image-guided medical procedures**: intrinsic and extrinsic information-based tracking and navigation, procedure planning and visualization, registration of pre- and intra-interventional data, validation of registration methods, applications of image-guided procedures. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Wolfgang Birkfellner. Applied Medical Image Processing, Second Edition: A Basic Course. CRC Press; 2 edition, 2014. 2. Isaac Bankman. Handbook of Medical Image Processing and Analysis, Second Edition (Academic Press Series in Biomedical Engineering), Academic Press; 2 edition, 2008. 3. Michael Fitzpatrick and Milan Sonka. Handbook of Medical Imaging, Volume 2. Medical Image Processing and Analysis (Parts 1 and 2) (SPIE Press Monograph Vol. PM80/SC), SPIE Publications; Reprint edition, 2009. 4. Terry Peters, Kevin Cleary. Image-Guided Interventions: Technology and Applications, Springer, 1st edition, 2008. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Razložiti in demonstrirati principe kvantitativne analize medicinskih slik, ki je danes nepogrešljiva pri postavljanju diagnoze, načrtovanju, simulaciji in izvedbi posega ter pri spremljanju učinkov posega oziroma napredovanja bolezni. Spoznati postopke za razgradnjo in kvantitativno analizo ter postopke za samodejno diagnostiko in vodenje medicinskih posegov na osnovi slikovnih podatkov in informacij. | |  | | The objective of this course is to provide students with an overview of the computational and mathematical methods in medical image processing and analysis.  Several up-to-date automated methods aimed to enhance and extract useful information from medical images, such as X-ray, CT, MRI, PET, will be presented. A variety of diagnostic and interventional scenarios will be used as examples to motivate the methods. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Študent se bo naučil izločati, modelirati in analizirati informacijo, ki je vsebovana v medicinskih slikah, ter uporabiti to informacijo za boljšo diagnostiko, zdravljenje in spremljanje učinkov zdravljenja ter napredovanja bolezni. | | |  | The students will learn how to extract, model, and analyse information from medical images and apply this information in order to help/enhance diagnosis, treatment and monitoring of diseases through engineering techniques. | |
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| **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. | | |  | Lectures, lab works and individual assignements. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: domače naloge, pisni izpit ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od 6 do 10 so pozitivne.  Pozitivna ocena domačih nalog je pogoj za pristop k pisnemu izpitu. Pozitivna ocena pisnega izpita je pogoj za pristop k ustnemu izpitu.  Prispevki k oceni:  domače naloge  pisni izpit  ustni izpit | 35%  35%  30% | | | | Type: homework, written and oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of homework is a prerequisites for the written exam. Positive evaluation of the written exam is a prerequisites for the oral exam.  Contributions to final grade:  homework  written exam  oral exam |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. MARKELJ, Primož, TOMAŽEVIČ, Dejan, LIKAR, Boštjan, PERNUŠ, Franjo. A review of 3D/2D registration methods for image-guided interventions. Medical Image Analysis, 2012, vol. 16, no. 3, str. 642-661. 2. IBRAGIMOV, Bulat, LIKAR, Boštjan, PERNUŠ, Franjo. VRTOVEC, Tomaž. A game-theoretic framework for landmark-based image segmentation. IEEE Tr Medical Imaging, 2012, vol. 31, no. 9, str. 1761-1776. 3. MITROVIĆ, Uroš, ŠPICLIN, Žiga, LIKAR, Boštjan, PERNUŠ, Franjo. 3D-2D registration of cerebral angiograms: a method and evaluation on clinical images. IEEE Tr Medical Imaging, 2013, vol. 32, no. 8, str. 1550-1563. 4. KOREZ, Robert, IBRAGIMOV, Bulat, LIKAR, Boštjan, PERNUŠ, Franjo, VRTOVEC, Tomaž. A framework for automated spine and vertebrae interpolation-based detection and model-based segmentation, IEEE Tr on Medical Imaging, 2015, vol. 34, no. 8, str. 1649-1662. 5. JERMAN, Tim, PERNUŠ, Franjo, LIKAR, Boštjan, ŠPICLIN, Žiga. Blob enhancement and visualization for improved intracranial aneurysm detection. IEEE Tr Visualization and Computer Graphics, 2016, vol. 22, no. 6, str. 1705-1717. | | | | | |