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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 doktorski študij tretje stopnje Elektrotehnika** | | | | | **Vse smeri** | | | | | | | | **1** | | **-** | | |
| **Doctoral Study Programme**  **Electrical Engineering** | | | | | **All fields** | | | | | | | | **1** | | **-** | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | |  | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | |  | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **15** | | | **15** | | |  | | | |  | | | **65** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | Prof. dr. Franjo Pernuš | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | Slovensko (angleško) / Slovenian (English) | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | Slovensko (angleško) / Slovenian (English) | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Priporočeno je poznavanje matrične algebre, diferencialnih enačb in MATLABa. | | | | | | | | |  | Recommended basic knowledge of matrix algebra, differential equations and MATLAB. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| 1. Uvod: zgodovina, pomen in področja računalniško podprte analize slik v medicini. 2. Izvori medicinskih slik: rentgensko slikanje, računalniška tomografija, magnetno resonančno slikanje, ultrazvok in nuklearna medicina. 3. Razgradnja in kvantitativna analiza slik: delitev in uporaba postopkov, prilagodljivo upragovljanje, razgradnja na osnovi odvodov, razgradnja s širjenjem, združevanjem in razdruževanjem področij, razgradnja na osnovi razvrščanja ter razgradnja na osnovi poravnave modelov. Vrednotenje rezultatov razgradnje. 4. Poravnava: pomen poravnave slik v medicini, klasifikacija postopkov poravnav, modeliranje geometrijskih preslikav in deformacij, točkovne metode, določevanje in prileganje kontrolnih točk, postopki na osnovi površin, postopki na osnovi mere podobnosti, analiziranje in vrednotenje postopkov poravnav, klinični primeri poravnave in integracije slik. 5. Slikovno vodeni posegi v medicini: sistemi za sledenje in navigacijo, vizualizacija v slikovno vodenih posegih, načrtovanje posegov, poravnava slik, modelov in načrtov posega s pacientom ali s slikami pacienta, vrednotenje zanesljivosti in točnosti slikovno vodenih posegov, klinična uporaba. | | | | | | | |  | | 1. Introduction: history, importance and areas of computer-aided analysis of medical images. 2. Medical image sources: X-ray imaging, computed tomography, magnetic resonance imaging, ultrasound, nuclear medicine and molecular imaging. 3. Image segmentation and quantitative analysis: classification and applicability of methods, (adaptive) thresholding, edge-based segmentation techniques, region growing, segmentation with clustering, deformable models,   atlas- based methods. Validation of image segmentation methods.   1. Image registration: clinical applications of image registration, classification of registration methods, spatial transformation models, within- and across-modality registration,   landmark- based registrations, surface based registrations, intensity based registrations, similarity measures. Validation of registration methods.   1. Image guided procedures: tracking devices, visualization in image-guided procedures, planning, registration of preoperative images, models and plan with intraoperative images, 3D-2D registration, validation of image guided procedures, clinical applications. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| Sonka M, Fitzpatrick JM (eds) (2009) Handbook of Medical Imaging, Vol 2, Medical Image Processing and Analysis, SPIE Publications  Bankman IN(ed) (2008) Handbook of Medical Image Processing and Analysis, 2nd edn., Academic Press, San Diego  Peters T, Cleary K (eds) (2008) Image-Guided Interventions: Technology and Applications, Springer  Birkfellner W (2014) Applied Medical Image Processing*.* A basic course, 2nd edn., CRC Press | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Spoznati pomen ter osnovne principe analize medicinskih slik, ki so danes nepogrešljive pri postavljanju diagnoze, načrtovanju, simulaciji in izvedbi posega ter pri spremljanju učinkov zdravljenja oziroma napredovanja bolezni. Pridobiti znanje za analitično, numerično in eksperimentalno analizo medicinskih slik. | |  | | To gain understanding of the importance and the basic principles of medical image analysis, which are nowadays an indispensable tool for diagnosis, planning, simulation and execution of medical procedures and for monitoring the effects of therapy and progression of disease. To acquire basic knowledge for analytical, numerical and experimental analysis of medical images. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| **Znanje in razumevanje**: Študent bo razumel pomen analize slik v medicini ter osnovne principe razgradnje, poravnave in integracije slik. Znal bo analitično, numerično in eksperimentalno analizirati medicinske slike.  **Uporaba:** Študenti bodo pridobili znanja in spretnosti, ki so koristna za poklic, ki je povezan z analizo slik v kliničnem okolju, kliničnih raziskavah, znanstveno raziskovalnem delu ali tehnološkem razvoju.  **Prenosljive spretnosti:** Študenti bodo pridobili splošne prenosljive spretnosti, ki so potrebne v multidisciplinarnem znanstvenem ali kliničnem raziskovalnem okolju. Znanja bodo lahko uporabili tudi na področju avtomatske vizualne kontrole v industriji. | | |  | **Knowledge and understanding:**  The students will gain an understanding of the importance of medical images and of the basic principles of image segmentation, registration and information integration. They will gain knowledge to analytically, numerically and experimentally analyse the medical images.  **Application:** Equip the students with the knowledge and skills required for a career in an image-related field in clinical practice, clinical research, scientific research or technical development.  **Transferable skills:** The students will be equipped with generic transferrable skills required in a multidisciplinary scientific or clinical research environment. They will be able to use their skills in automated visual inspection in industry. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| V primeru zadostnega števila vpisanih študentov bodo predavanja potekala skozi celotni semester, sicer pa nekaj uvodnih predavanj, potem pa samostojni študij, vaje in seminarji pod mentorstvom nosilca. | | |  | Lectures throughout the semester if a sufficient number of students select this course. Otherwise, some introductory lectures, followed by individual research, tutorials and seminars under the supervision of the lecturer. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Vaje, seminar in pisni izpit. | vaje 10%  seminar 60%  izpit 30%  /  tutorial 10%  seminar 60%  exam 30% | | | | Tutorial, seminar and written exam. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| Galimzianova A, **Pernuš F**, Likar B, Špiclin Ž (2015) Robust Estimation of Unbalanced Mixture Models on Samples with Outliers. IEEE Tr on Pattern Analysis Machine Intelligence 37/11:2273-2285  Ibragimov B, Likar B, **Pernuš F**, Vrtovec T (2014) Shape representation for efficient landmark-based segmentation in 3-D. IEEE Tr on Medical Imaging 33/4:861-874  Mitrović U, Špiclin Ž, Likar B, **Pernuš F** (2013) 3D-2D registration of cerebral angiograms : a method and evaluation on clinical images. IEEE Tr on Medical Imaging 32/8:1550-1563  Špiclin Ž, Likar B, **Pernuš F** (2012) Groupwise registration of multimodal images by an efficient joint entropy minimization scheme. IEEE Tr. on Image Processing 21/5:2546-2558  Ibragimov B, Likar B, **Pernuš F**, Vrtovec T (2012) A game-theoretic framework for landmark-based image segmentation. IEEE Tr on Medical Imaging 31/9:1761-1776 | | | | | |