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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Modul A: Navidezna resničnost | | | | | | | | | | | | | | |
| **Course title:** | | | Module A: Virtual Reality | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program prve stopnje Elektrotehnika | | | | | Vse smeri | | | | | | | | 3. | | letni | | |
| 1st cycle academic study programme Electrical Engineering | | | | | All fields | | | | | | | | 3. | | summer | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni – splošni/ elective general | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64134 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| 30 |  | | | 30 | | |  | | | |  | | | 65 | |  | 5 |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Matjaž Mihelj | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | slovenski | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | slovenski | | | | | | | | | | | |
| **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):** | | | | | | | |
| Uvod (navidezno okolje, navidezna prisotnost, senzorna povratna informacija, interaktivnost, večpredstavna navidezna okolja), človeški faktor (vidne, zvočne, haptične in vestibularne zaznave, motorični sistem), ustvarjanje navideznega sveta, vizualna modalnost (grafično modeliranje, animacija, vizualno upodabljanje, tehnologije 3D grafičnih prikazovalnikov), zvočna modalnost navideznega okolja (akustika, prostorski zvok, zvočno upodabljanje), haptična modalnost navideznega okolja (kinestetični in taktilni haptični vmesniki, haptično upodabljanje), dinamika navideznega sveta (gibanje, deformacije, detekcija trka, modeliranje sveta), sledenje gibanja (merjenje položaja in gibanja uporabnika, merjenje sil interakcije, zaznavanje okolice), interakcija (manipulacija objektov, virtualna navigacija, interakcija z ostalimi uporabniki), sodelovanje in interakcija v večuporabniških navideznih okoljih, navidezna prisotnost (mentalna in fizična navidezna prisotnost, ustvarjanje pogojev za navidezno prisotnost, merjenje navidezne prisotnosti uporabnika), obogatena resničnost, sistemi navidezne resničnosti (”cave” okolja, platforme, vmesniki človek/stroj), virtualni prototipi, uporaba navidezne resničnosti v industrijskih aplikacijah, medicini in oblikovanju. | | | | | | | |  | | Introduction (virtual environment, presence, sensory feedback, interactivity, multimodal virtual environments), human factors (visual, acoustic, haptic and vestibular perceptions, motor system), creation of virtual environment, visual modality (graphical modeling, animation, visual rendering , 3D displays), auditory modality (acoustics, surround sound, audio rendering), haptic modality (kinesthetic and tactile haptic interfaces, haptic rendering), dynamics of virtual environment (motion, deformation, collision detection, virtual environment modeling), motion tracking (user’s pose and motion tracking, measurement of interaction forces, environment sensing), interaction (manipulation of objects, virtual navigation, interaction with other users), cooperation and interaction in multi-user virtual environments, presence (mental and physical immersion and presence, creating conditions for presence, measuring presence), augmented reality, virtual reality systems ("cave" environment, platforms, man/machine interfaces), virtual prototypes, use of virtual reality in industrial and medical applications and design. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. M. Mihelj, D. Novak, S. Beguš, D. Fefer: Navidezna resničnost, Založba FE in FRI, 2014 (v izdajanju). 2. M. Mihelj, D. Novak, S. Beguš, Virtual Reality Technology and Applications, Springer, 2013. 3. B. Furht, Handbook of Augmented Reality, Springer, 2011. 4. W. Sherman, A. B. Craig: Understanding Virtual Reality, Morgan Kaufmann, 2003. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Predmet ciljno obravnava interakcijo med človekom in računalniško generiranim navideznim okoljem. Analizira fizikalne osnove, tehnološke izzive ter možnosti in omejitve pri gradnji večpredstavnih navideznih okolij. Poudarek je na konceptih potrebnih za razumevanje navideznih okolij in odzivov uporabnika na sintetično generirane vizualne, zvočne in haptične dražljaje. Praktična znanja pridobijo študenti v laboratoriju ob izvajanju interdisciplinarnih skupinskih projektov. | |  | | The course addresses the interaction between a human and a computer-generated virtual environment. It analyzes physical background, technological challenges as well as opportunities and constraints related to the construction of multimodal virtual environments. The emphasis is on concepts necessary for understanding virtual environments and user’s responses to synthetic visual, auditory and haptic stimuli. Students acquire practical knowledge in the laboratory while completing interdisciplinary research projects. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Razumevanje človekovega zaznavanja vizualnih, zvočnih, taktilnih in kinestetičnih dražljajev; meritve in analiza gibanja človeka; znanje potrebno za sintezo vizualnih, zvočnih in haptičnih dražljajev ter integracijo v večpredstavna navidezna okolja, ki omogočajo uporabniku fizično in mentalno navidezno prisotnost. | | |  | Understanding of human visual, acoustic, tactile and kinesthetic perceptions; measurement and analysis of human movement; knowledge necessary for synthesis of visual, auditory and haptic artificial stimuli, as well as integration of these stimuli into a multimodal virtual environment that allows the user to feel physically and mentally present within the environment. | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Študenti imajo na voljo knjigo z vsebino predmeta. Na predavanjih je poudarek na teoretičnih osnovah večpredstavnih navideznih okolij. Zaradi specifičnosti predmeta, se del predavanj izvaja s pomočjo multimedijskih predstavitev. Najnovejši dosežki s področja navideznih okolij so predstavljeni v "video predavanjih". Praktične vaje potekajo v laboratoriju, ki je opremljen z večjim številom haptičnih robotov, avdio sistemov za generiranje prostorskega zvoka in 3D grafičnimi zasloni. Študentje delajo v interdisciplinarnih projektnih skupinah, kjer se posamezen študent ukvarja z določeno modalnostjo navideznega okolja. | | |  | Students have access to a book with the course content. In the lectures, the emphasis is on theoretical basics of multimodal virtual environments. Due to the specificity of the course, lectures are mostly conducted with the help of multimedia presentations. Latest developments in the field of virtual environments are presented in the form of “video lectures". Practical exercises are conducted in the laboratory, which is equipped with a number of different haptic robots, surround sound systems and 3D stereoscopic graphical displays. Students work in interdisciplinary project teams, where each student engages in a particular modality of virtual environment. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Način: laboratorijske vaje, pisni izpit, ustni izpit.  Ocene od 1 do vključno 5 so negativne, ocene od vključno 6 do 10 so pozitivne.  Pozitivna ocena laboratorijskih vaj je pogoj za pristop k izpitu.  Zahtevana je obvezna prisotnost pri praktičnih vajah. Študent lahko opravičeno izostane največ od ene vaje. Študent zagovarja semestrski projekt.  Pisni izpit obsega reševanje primerov; na podlagi pridobljenega znanja mora študent predlagati rešitev konkretnega problema (medicinski, industrijski, izobraževalni) z uporabo navidezne resničnosti.  Študent opravlja tudi ustni izpit, kjer so vprašanja postavljena predvsem na osnovi odgovorov pisnega izpita. Ustni izpit lahko študent nadomesti z izvedbo samostojnega projekta.  Prispevki k oceni:  laboratorijske vaje  pisni izpit  ustni izpit | 40%  30%  30% | | | | Type: laboratory exercises, written exam, oral exam.  Negative grades: from 1 to 5, positive grades: from 6 to 10.  Positive evaluation of laboratory exercises is a prerequisite for the exam.  Mandatory presence at practical courses. Student can justifiably miss maximally one practical course time slot. Students orally defend their semester project.  Written exam is based on problem solving; based on the acquired knowledge student proposes a virtual reality solution for a specific problem (medical, industrial, educational).  Oral exam is based primarily on the basis of answers in the written exam. Oral exam can be replaced by completing a voluntary semester project.  Contributions to final grade:  laboratory exercises  written exam  oral examination |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. M. Mihelj, D. Novak, S. Beguš, Virtual Reality Technology and Applications, Springer, 2013. 2. M. Mihelj, J. Podobnik, Haptics for Virtual Reality and Teleoperation, Springer, 2012. 3. MIHELJ, Matjaž, NOVAK, Domen, MILAVEC, Maja, ZIHERL, Jaka, OLENŠEK, Andrej, MUNIH, Marko. Virtual rehabilitation environment using principles of intrinsic motivation and game design. Presence, ISSN 1054-7460. [Print ed.], Feb. 2012, vol. 21, no. 1, str. 1-15. 4. NOVAK, Domen, MIHELJ, Matjaž, ZIHERL, Jaka, OLENŠEK, Andrej, MUNIH, Marko. Psychophysiological measurements in a biooperative feedback loop for upper extremity rehabilitation. IEEE transactions on neural systems and rehabilitation engineering, ISSN 1534-4320. [Print ed.], Aug. 2011, vol. 19, no. 4, str. 400-410. 5. KOENIG, Alexander, NOVAK, Domen, OMLIN, Ximena, PULFER, Michael, PERREAULT, Eric, ZIMMERLI, Lukas, MIHELJ, Matjaž, RIENER, Robert. Real-time closed-loop control of cognitive load in neurological patients during robot-assisted gait training. IEEE transactions on neural systems and rehabilitation engineering, ISSN 1534-4320. [Print ed.], Aug. 2011, vol. 19, no. 4, str. 453-464. | | | | | |