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| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Večpredstavne interaktivne 3D tehnologije | | | | | | | | | | | | | | |
| **Course title:** | | | Multimodal interactive 3D technologies | | | | | | | | | | | | | | |
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| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| Univerzitetni študijski program tretje stopnje Elektrotehnika | | | | |  | | | | | | | | 1. | |  | | |
| 3rd cycle academic study programme Electrical Engineering | | | | |  | | | | | | | | 1. | |  | | |
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| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni / elective | | | | | |
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| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64824 | | | | | |
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| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** |  | | |  | | |  | | | |  | | | **95** | |  | **5** |
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| **Nosilec predmeta / Lecturer:** | | | | | prof. dr. Matjaž Mihelj | | | | | | | | | | | | |
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| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | Slovenski, gostujoča predavanja v angleščini / Slovenian, guest lectures in English | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | Slovenski / Slovenian | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik. | | | | | | | | |  | Enrolment in the first year. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Psihofiziologija človekovega zaznavanja vidnih, zvočnih in kinestetičnih/taktilnih dražljajev; Metode modeliranja in renderiranja tridimenzionalnih dražljajev vseh treh modalnost (vidnih, zvočnih in haptičnih); Detekcija trka med kompleksnimi navideznimi objekti; Tehnologije za prostorski prikaz sintetiziranih dražljajev (stereoskopski in hologramski prikazovalniki, ustvarjanje prostorskega zvoka, haptični roboti za prikazovanje kinestetičnih in taktilnih informacij); Tehnologije in metode sledenja lege uporabnika, ki omogočajo interakcijo z okoljem in navigacijo v okolju; Obogatena resničnost kot interakcija z realnim in teleprisotnost kot interakcija z oddaljenim okoljem preko digitalnega medija; Analiza psihofizioloških odzivov uporabnika in načini adaptivnega prilagajanja navideznega okolja glede na psihofiziološko stanje uporabnika; Uporaba interaktivnih 3D tehnologij v dejavnostih, kot so načrtovanje izdelkov, proizvodnja, trženje in prodaja, arhitektura in oblikovanje, izobraževanje na osnovi interaktivnih 3D simulacij, medicina, raziskave in razvoj. | | | | | | | |  | | Psychophysiology of human visual, auditory and haptic sensing; Methods for modelling and rendering of three-dimensional stimuli of all three modalities (visual, auditory and haptic); Collision detection between complex virtual objects; Technologies for spatial presentation of synthesized 3D stimuli (stereoscopic and holographic displays, spatial sound generation, haptic robots for presentation of kinaesthetic and tactile stimuli); Technologies and methods for user movement tracking that enable interaction with the environment and navigation within the environment; Augmented reality as interaction with real and telepresence as interaction with remote environment through digital medium; Analysis of users’ psychophysiological responses and strategies for real time adaptation of virtual environment based on users’ psychophysiological state; Use of interactive 3D technologies in areas such as product design, sales and marketing, architecture and design, education, medicine, research and development. | | | | | | | |

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| **Temeljni literatura in viri / Readings:** | | | | | |
| 1. Mihelj M, Podobnik J (2012) Haptics for Virtual Reality and Teleoperation, Springer, Berlin.  2. Mihelj M, Novak D, Beguš S (2013) Virtual Reality Technology and Applications, Springer, Berlin.  3. Furht B (2011) Handbook of Augmented Reality, Springer, Berlin.  4. Sherman W, Craig AB (2003) Understanding Virtual Reality, Morgan Kaufmann. | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Predmet omogoča študentu razumevanje interaktivnih 3D predstavitev, izvedbo interaktivnih 3D aplikacij in izbiro ustreznih tehnologij prikazovanja. Študent pridobi znanje o metodah in tehnologijah za interaktivno predstavitev 3D računalniško generiranih okolij s posredovanjem vizualnih, zvočnih in haptičnih dražljajev. Analizirani so učinki navideznih okolij na psihofiziološke odzive uporabnika in razložene metode ocenjevanja navidezne prisotnosti v realnem času. Znanje omogoča načrtovanje in izvedbo interaktivnih 3D simulacij in interaktivnih predstavitev za potrebe analize delovanja produktov, za izobraževanje na osnovi 3D simulacij (medicina), za potrebe trženja, zabave in drugih aplikacij. Poudarek je na interakcijah, ki zahtevajo fizičen stik s haptičnim robotom. | |  | | The course enables the student to understand interactive 3D presentations, to design interactive 3D applications and to select adequate presentation technologies. It deals with methods and technologies for interactive presentations of three-dimensional computer generated environments by conveying visual, auditory and haptic stimuli. Analysed are effects of multimodal virtual environments on human psychophysiological state (immersion, presence) and presented are methods for assessment of psychophysiological responses in real-time. Students learn to design and implement interactive 3D simulations and interactive presentations used for functional product analysis, 3D simulation based learning (medicine), marketing applications, entertainment and other applications. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Poznavanje psihofiziologije človekovega zaznavanja dražljajev iz okolja; Metode analize in sinteze gibanja človeka in robota; Sinteza vizualnih, zvočnih in haptičnih dražljajev; Metode vplivanja na psihofiziološke odzive človeka.  Reševanje konkretnih problemov iz področja interacije med človekom in strojem (robot, računalnik).  Spretnosti zasnove in izvedbe nalog ter reševanja problemov, kritična analiza in sinteza, poznavanje računalniških orodij.  Izvedba interaktivnih 3D aplikacij na področjih industrije, medicine, znanosti, … | | |  | Understanding psychophysiology of human perception of environmental stimuli; Methods for analysis and synthesis of movement in human and robot; Synthesis of visual, auditory and haptic stimuli; Methods of affecting human’s psychophysiological responses.  Finding solutions to practical problems related to human/machine (robot, computer) interactions.  Skills required for problem solving, design, and implementation of solutions, critical analysis and synthesis, use of software tools.  Implementation of interactive 3D applications in industry, medicine, science, … | |
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| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Multimedijsko podprta predavanja in samostojno projektno delo. | | |  | Multimedia supported lectures and individual project based work. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Rezultat samostojnega projektnega dela.  Ustni izpit na osnovi predavane snovi | 70 %  30 % | | | | Result of individual project based work  Oral exam based on lecture topics |
| **Reference nosilca / Lecturer's references:** | | | | | |
| 1. Mihelj M, Podobnik J (2012) Haptics for Virtual Reality and Teleoperation, Springer, Berlin (znanstvena monografija)  2. Mihelj M, Novak D, Beguš S (2013) Virtual Reality Technology and Applications, Springer, Berlin (znanstvena monografija)  3. Mihelj M, Novak D, Milavec M, Ziherl J, Olenšek A, Munih M (2012) Virtual rehabilitation environment using principles of intrinsic motivation and game design. Presence 21:1-15  4. Novak D, Mihelj M, Ziherl J, Olenšek A, Munih M (2011) Psychophysiological measurements in a biooperative feedback loop for upper extremity rehabilitation. IEEE transactions on neural systems and rehabilitation engineering 19:400-410  5. Koenig A, Novak D, Omlin X, Pulfer M, Perreault E, Zimmerli L, Mihelj M, Riener R (2011) Real-time closed-loop control of cognitive load in neurological patients during robot-assisted gait training. IEEE transactions on neural systems and rehabilitation engineering 19: 453-464 | | | | | |