|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UČNI NAČRT PREDMETA / COURSE SYLLABUS** | | | | | | | | | | | | | | | | | |
| **Predmet:** | | | Inteligentni mobilni transportni sistemi | | | | | | | | | | | | | | |
| **Course title:** | | | Intelligent mobile transport systems | | | | | | | | | | | | | | |
|  | | | | |  | | | | | | | |  | |  | | |
| **Študijski program in stopnja**  **Study programme and level** | | | | | **Študijska smer**  **Study field** | | | | | | | | **Letnik**  **Academic year** | | **Semester**  **Semester** | | |
| doktorski študijski program tretje stopnje Elektrotehnika | | | | | Ni smeri | | | | | | | | 1 | |  | | |
| 3rd cycle: doctoral study programme Electrical Engineering | | | | |  | | | | | | | |  | |  | | |
|  | | | | | | | | | | | | | | | | | |
| **Vrsta predmeta / Course type** | | | | | | | | | | | | Izbirni/elective | | | | | |
|  | | | | | | | | | | | |  | | | | | |
| **Univerzitetna koda predmeta / University course code:** | | | | | | | | | | | | 64823 | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Predavanja**  **Lectures** | **Seminar**  **Seminar** | | | **Vaje**  **Tutorial** | | | **Klinične vaje**  **work** | | | | **Druge oblike študija** | | | **Samost. delo**  **Individ. work** | |  | **ECTS** |
| **30** | **60** | | |  | | |  | | | |  | | | **35** | |  | **5** |
|  | | | | | | | | | | | | | | | | | |
| **Nosilec predmeta / Lecturer:** | | | | | Roman Kamnik | | | | | | | | | | | | |
|  | | | | | | | | | | | | | | | | | |
| **Jeziki /**  **Languages:** | | **Predavanja / Lectures:** | | | | **Slovenščina/Slovenian** | | | | | | | | | | | |
| **Vaje / Tutorial:** | | | | **Slovenščina/Slovenian** | | | | | | | | | | | |
| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | | | | | | | | |  | **Prerequisits:** | | | | | | | |
| Vpis v letnik 3. stopnje študija. | | | | | | | | |  | Enrollment into doctoral program. | | | | | | | |
| **Vsebina:** | | | | | | | |  | | **Content (Syllabus outline):** | | | | | | | |
| Uvod: pregled avtonomnih mobilnih sistemov glede na izvedbo pogona ter vrsto uporabe. Zaznavanje in orientacija v prostoru: senzorni sistemi, senzorna integracija, identifikacija parametrov in stanja, lokalizacija, navigacija v prostoru, gradnja zemljevida. Matematično modeliranje in simulacije: kinematični in dinamični model, model interakcije z okoljem, model interakcije človek-stroj. Vodenje: načrtovanje poti, vodenje pogona, interakcija z okolico, večagentni sistemi, manipulacija. Aktivni varnostni sistemi: nadzor stabilnosti, izogibanje oviram, preprečevanje trkov, sledenje. | | | | | | | |  | | Introduction: a review of autonomous mobile systems with consideration to the type of actuation and usage. Perception and reasoning about space: sensory systems, sensory  integration, parameters and state identification, localization, navigation in the space, map building. Mathematical modelling and simulation: kinematic and dynamic model, environment interaction model, interaction model man/machine. Control: path planning, drive control, interaction control, multiagent systems, manipulation. Active safety systems: stability control, obstacle avoidance, collision avoidance, tracking. | | | | | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Temeljni literatura in viri / Readings:** | | | | | |
| Siegwart R, Nourbakhsh IR, Scaramuza D (2004) Introduction to autonomous mobile robots, MIT Press, Cambridge  Tzafestas S (2013) Introduction to mobile robot control, Elsevier, Amsterdam  Thrun S, Burgard W, Fox D (2005) Probabilistic Robotics, MIT Press, Cambridge  Li L, Wang FY (2007) Advanced motion control and sensing for intelligent vehicles, Springer-Verlag, Berlin  Jazar RN (2009) Vehicle dynamics: Theory and application, Springer-Verlag, Berlin | | | | | |
| **Cilji in kompetence:** | |  | | **Objectives and competences:** | |
| Predmet pokriva področje inteligentnih mobilnih sistemov, vključujoč mobilne robote in avtonomna vozila. Cilj predmeta je pridobiti znanja potrebna za razumevanje principov vodenja, zaznavanja in orientiranja v prostoru, matematičnega modeliranja in simuliranja ter zagotavljanja stabilnosti in varnosti mobilnih robotskih sistemov. | |  | | The subject covers the area of intelligent mobile systems incorporating mobile robots and autonomous vehicles. The aim of the course is to acquire knowledge necessary for understanding priciples of control, perception and reasoning about space, mathematical modelling and simulation, and stability and safety assurance of robotic mobile systems. | |
| **Predvideni študijski rezultati:** | | |  | **Intended learning outcomes:** | |
| Znanje in razumevanje:  Znanje matematičnega opisa lege, gibanja in ravnotežnih pogojev za mobilni sistem. Poznavanje principov zaznavanja in združevanja informacije o okolju. Poznavanje principov vodenja mobilnih sistemov. Uporaba naštetih znanj pri praktičnem delu z mobilnimi roboti. | | |  | Knowledge and understanding:  Knowledge of description of pose, motion and stability parameters for mobile systems. Understanding of environment perception and sensory data fusion. Knowledge of control principles for mobile systems. Usage of learned knowledge in practical work with mobile robots. | |
|  | | |  |  | |
| **Metode poučevanja in učenja:** | | |  | **Learning and teaching methods:** | |
| Na predavanjih so predstavljene teoretične osnove obravnavanih poglavij skupaj s prikazom rešitev enostavnih praktičnih primerov. Študentje opravijo seminarsko delo, pri katerem z lastnimi rešitvami obdelajo kompleksnejši problem. | | |  | Lectures give the theorethical background about presented chapters thematics togehter with demonstration of simple practical examples. Students accomplish an individual seminar work in which with own solutions address more complex problems. | |
| **Načini ocenjevanja:** | Delež (v %) /  Weight (in %) | | | | **Assessment:** |
| Zahtevana je uspešna izvedba seminarskega dela. Študentje pripravijo poročilo in predstavitev dela. Ustni izpit ob zaključku. | 50% seminar work  50 % oral exam | | | | Sucessfull seminar work accomplishment is required. Handouts are work report and presentation. Oral examination at the end. |
| **Reference nosilca / Lecturer's references:** | | | | | |
| Ambrožič L, Goršič M, Geeroms J, Flynn L, Lova M, Kamnik R, Munih M, Vitiello N (2014) Cyberlegs: a user-oriented robotic transfemoral prosthesis with whole-body awareness control. IEEE robot autom mag 21:82-93  Šlajpah S, Kamnik R, Munih M (2014) Kinematics based sensory fusion for  wearable motion assessment in human walking. Comput methods programs biomed 116:131-144  Ambrož M, Prebil I, Kamnik R, Munih M (2012) System for interactive scientific driving simulation with haptic information. Adv eng softw 45:239-251  Činkelj J, Kamnik R, Čepon P, Mihelj M, Munih M (2010) Closed-loop control of hydraulic telescopic handler. Autom constr 19:954-963  Kamnik R, Boettiger F, Hunt K (2013) Roll dynamics and lateral load transfer estimation in articulated heavy freight vehicles. Proc Inst Mech Eng, D J automob eng, 217:985-997 | | | | | |