UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Robotski vid
Course title:	Robot Vision

Študijski program in stopnja Study programme and level	Modul Module	Letnik Academic year	Semester Semester
Informacijske in komunikacijske tehnologije, 3. stopnja	Inteligentni sistemi in robotika	1	1
Information and Communication Technologies, 3rd cycle	Intelligent Systems and Robotics	1	1

Vrsta predmeta / Course type Izbirni / Elective

Univerzitetna koda predmeta / University course code: IKT3-621

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Druge oblike	Samost. delo Individ. work	ECTS
15	**15**			**15**	**105**	**5**

**Navedena porazdelitev ur velja, če je vpisanih vsaj 15 študentov. Drugače se obseg izvedbe kontaktnih ur sorazmerno zmanjša in prenese v samostojno delo. / This distribution of hours is valid if at least 15 students are enrolled. Otherwise the contact hours are linearly reduced and transfered to individual work.*

Nosilec predmeta / Lecturer: Prof. dr. Aleš Ude

Jeziki / Languages:		
	Predavanja / Lectures:	slovenščina, angleščina / Slovene, English
	Vaje / Tutorial:	

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits:**
Zaključen študij druge stopnje s področja informacijskih ali komunikacijskih tehnologij ali zaključen študij druge stopnje na drugih področjih z znanjem osnov s področja predmeta. Potrebna so tudi osnovna znanja matematike, računalništva in informatike.	Completed second cycle studies in information or communication technologies or completed second cycle studies in other fields with knowledge of fundamentals in the field of this course. Basic knowledge of mathematics, computer science and informatics is also requested.

Vsebina:

Robotski vid je v osnovi računski proces, katerega cilj je interpretacija scen in dogodkov v prostoru. Za robotski vid je še posebej pomembna obdelava slik v realnem času, kar omogoča zaprtozančno vodenje in hitro odločanje. Pri predmetu robotski vid bomo obravnavali naslednje teme in metode:

- osnovne metode računalniškega vida (detekcija robov, segmentacija, analiza gibanja, razpoznavanje, lokalizacija in zasledovanje objektov);
- vodenje s pomočjo robotskega vida (pozicijsko vodenje v kartezičnem prostoru, vodenje s

Content (Syllabus outline):

Robot vision is essentially a computational process whose goal is to interpret the observed scenes and events. Especially important for robot vision is the real-time processing of incoming images, which enables closed-loop control and timely decision making. This class will introduce the students to the following areas and methodologies:

- fundamental techniques of computer vision (edge detection, segmentation, motion analysis, object recognition, localization and tracking);
- visual surveying (position-based visual servo control, image-based visual servo control);

pomočjo dvodimenzionalnih slikovnih podatkov); • aktivni vid in manipulacija objektov v prostoru; • biološki in humanoidni vid (očesni gibi, vizualna pozornost, humanoidne glave).	• active vision and vision-based manipulation; • biological and humanoid vision (oculomotor behaviors, visual attention, humanoid heads).

Temeljni literatura in viri / Readings:

Izbrana poglavja iz naslednjih knjig: / Selected chapters from the following books:

- Corke, P. Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer-Verlag, Berlin, Heidelberg, 2013, ISBN: 978-3642201431.
- Szeliski, R. Computer Vision Algorithms and Applications, Springer, London, Dordrecht, Heidelberg, New York, 2011, ISBN: 978-1-84882-934-3.
- R. B. Fisher (Ed.), http://homepages.inf.ed.ac.uk/rbf/CVonline/, CVonline: The Evolving, Distributed, Non-Proprietary, On-Line Compendium of Computer Vision.
- Siciliano, B. and Khatib, O. (Eds.), Springer Handbook of Robotics, Springer-Verlag, Berlin Heidelberg, 2008, ISBN: 978-3-540-23957-4.

Cilji in kompetence:	**Objectives and competences:**
Cilj predmeta je pridobiti znanja s področja umetnega vida in še posebej robotskega vida. Pri tem se bodo študentje spoznali z osnovnimi metodami, ki se uporabljajo pri obdelavi digitalnih slik, in z njihovo uporabo pri vodenju robotskih sistemov. Študent, ki bo uspešno končal ta predmet, bo pri dani nalogi sposoben sam izbrati primerne metode za obdelavo digitalnih slik in uporabiti pridobljene informacije za vodenje robotskih sistemov.	The goal of this course is to acquire basic knowledge of computer vision, especially robot vision. The students will become familiar with image processing methods and their application for the control of robotic systems. Students who will successfully complete this class will be able to independently select suitable image processing techniques for a given task and apply the acquired information for the control of robotic systems.

Predvideni študijski rezultati:	**Intended learning outcomes:**
Študentje bodo zmožni ovrednotiti svojo izbiro metod za pridobivanje informacij iz digitalnih slik. Svojo izbiro bodo znali utemeljiti na podlagi teoretičnih izhodišč in izkušenj, ki so jih pridobili pri izdelavi seminarskih nalog. Pridobljena znanja: • Poznavanje nastanka digitalnih slik in fizikalnih modelov, s katerimi lahko modeliramo ta proces. • Poznavanje tridimenzionalnega vida. • Razumevanje osnovnih problemov računalniškega vida in poznavanje metod, ki se uporabljajo pri njihovem reševanju. • Razumevanje delovanja obravnavanih metod. • Zmožnost uporabe metod računalniškega vida pri odprto- in zaprtozančnemu vodenju robotov.	Students will become able to evaluate their choice of methods for the processing of digital images. Their choice will be based on the acquired theoretical knowledge and also on experience gained from the seminar work. Knowledge and understanding: • Image formation process and physical models, which van be applied to model this process. • Three-dimensional vision. • Understanding of basic computer vision problems and knowledge about techniques that can be used to solve these problems. • Understanding of the basic image processing techniques. • Ability to apply computer vision techniques for open- and closed loop robot control.

Metode poučevanja in učenja:	Learning and teaching methods:
Predavanja, seminar, konzultacije in individualno delo.	Lectures, seminar, consultations and individual work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
• Seminarska naloga • Ustni zagovor seminarske naloge	50 % 50 %	• Seminar work • Oral defense of seminar work

Reference nosilca / Lecturer's references:

- R Bevec, A Ude. Building object models through interactive perception and foveated vision. Advanced Robotics 29, 2015.
- B Ridge, A Leonardis, A Ude, M Deniša and D Skočaj. Self-supervised online learning of basic object push affordances. International Journal of Advanced Robotic Systems 12:24, 2015.
- A Gams, B Nemec, A J Ijspeert, A. Ude. Coupling movement primitives: Interaction with the environment and bimanual tasks, IEEE Transactions on Robotics, 30(4), 816-830, 2014.
- D Schiebener, J Morimoto, T Asfour, A Ude. Integrating visual perception and manipulation for autonomous learning of object representations, Adaptive Behavior, 21(5), 328-345, 2013.
- D Omrčen, A Ude. Redundancy control of a humanoid head for foveation and three-dimensional object tracking: A virtual mechanism approach. Advanced Robotics 24(15), 2171-2197, 2010.