



Univerza v Mariboru



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Fakulteta za naravoslovje in
matematiko

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Stohastični procesi
Course title:	Stochastic processes

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Fizika 2. st.		1	2
Physics 2 nd degree		1	2

Vrsta predmeta / Course type izbirni/optional

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
30		60			210	10

Nosilec predmeta / Lecturer: Matjaž Perc

Jeziki / Languages:	Predavanja / Lectures:	slovenski/Slovenian
	Vaje / Tutorial:	slovenski/Slovenian

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:

Osnove teorije verjetnosti, teorije dinamičnih sistemov in programiranja v poljubnem jeziku.

Prerequisites:

Basic knowledge of probability theory, dynamical system's theory, and programming skills in an arbitrary language.

Vsebina:

Stohastične spremenljive, Naključni dogodki in verjetnost, Stohastični procesi, Markovianski procesi, Master enačba, Fokker-Planckova enačba, Langevinski pristop, Stohastične diferencialne enačbe, Stohastične navadne diferencialne enačbe, Stohastične parcialne diferencialne enačbe, Levijeji leti.

Content (Syllabus outline):

Stochastic variables, Random events and the probability, Stochastic processes, Markov processes, Master equation, Fokker-Planck equation, Langevin approach, Stochastic difference equations, Ordinary stochastic differential equations, partial stochastic differential equations, Levy flights.

Temeljni literatura in viri / Readings:

N. G. Van Kampen, Stochastic processes in physics and chemistry (Elsevier, Amsterdam, 1992). J. Honerkamp, Stochastic dynamical systems (VCH, New York 1994). H. Risken, The Fokker-Planck equation (Springer, Berlin, 1984). C. W. Gardiner, Handbook of Stochastic Methods (Springer, New York 2004).

Cilji in kompetence:

Podati koncepte in metode, ki služijo za analizo in pridobitev razumevanja stohastičnih procesov v realnem svetu.

Objectives and competences:

Students gain methods and concepts of key conceptual approaches and methods, which can be used to analyse and gain understanding of stochastic processes in the real world.

Predvideni študijski rezultati:

Znanje in razumevanje: Obvladovanje osnovnih konceptov in metod, ki služijo za analizo in pridobitev razumevanja stohastičnih procesov v realnem svetu.

Prenesljive/ključne spretnosti in drugi atributi: Sposobnost prepoznati in analizirati stohastične procese kjerkoli se pojavijo, in torej imeti možnost prosperirati v različnih znanstvenih disciplinah kot so ekonomija, kemija, fizika, medicina, itd..

Intended learning outcomes:

Knowledge and Understanding: Mastering key conceptual approaches and methods, which can be used to analyse and gain understanding of stochastic processes in the real world.

Transferable/Key Skills and other attributes: The ability to recognize and analyse stochastic processes wherever they may occur, and thus have the potential to prosper in diverse scientific disciplines such as: economy, chemistry, physics, medicine, etc..

Metode poučevanja in učenja:

Predavanja, seminarske vaje in individualno raziskovalno delo.

Learning and teaching methods:

Lectures, coursework and individual research work.

Načini ocenjevanja:

Delež (v %) /
Weight (in %)

Assessment:

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Ustni izpit	80%	Oral exam
Projektna naloga	20%	Written project

Reference nosilca / Lecturer's references:

Multiple firing coherence resonances in excitatory and inhibitory coupled neurons, Qingyun Wang, Honghui Zhang, Matjaž Perc and Guanrong Chen, Commun. Nonlinear Sci. Numer. Simulat. 17, 3979-3988 (2012)

Spatial coherence resonance in delayed Hodgkin-Huxley neuronal networks, Qingyun Wang, Matjaž Perc, Zhisheng Duan and Guanrong Chen, Int. J. Mod. Phys. B 24, 1201-1213 (2010)

Delay-aided stochastic multiresonances on scale-free FitzHugh-Nagumo neuronal networks, Chunbiao Gan, Matjaž Perc and Qingyun Wang, Chin. Phys. B 19, 040508 (2010)

Delay-induced multiple stochastic resonances on scale-free neuronal networks, Qingyun Wang, Matjaž Perc, Zhisheng Duan and Guanrong Chen, Chaos 19, 023112 (2009)

Stochastic resonance on paced genetic regulatory small-world networks: Effects of asymmetric potentials, Matjaž Perc, Eur. Phys. J. B 69, 147-153 (2009)

Pacemaker-guided noise-induced spatial periodicity in excitable media, Marko Gosak, Marko Marhl and Matjaž Perc,

Physica D 238, 506-515 (2009)

Stochastic resonance on Newman-Watts networks of Hodgkin-Huxley neurons with local periodic driving, Mahmut Ozer, Matjaž Perc and Muhammet Uzuntarla, Phys. Lett. A 373, 964-968 (2009)

Stochastic resonance on weakly paced scale-free networks, Matjaž Perc, Phys. Rev. E 78, 036105 (2008)

Stochastic resonance in soft matter systems: Combined effects of static and dynamic disorder, Matjaž Perc, Marko Gosak and Samo Kralj, Soft Matter 4, 1861-1870 (2008)

Delay-enhanced coherence of spiral waves in noisy Hodgkin-Huxley neuronal networks, Qingyun Wang, Matjaž Perc, Zhisheng Duan and Guanrong Chen, Phys. Lett. A 372, 5681-5687 (2008)

Pacemaker-driven stochastic resonance on diffusive and complex networks of bistable oscillators, Matjaž Perc and Marko Gosak, New J. Phys. 10, 053008 (2008)

Spatial coherence resonance on diffusive and small-world networks of Hodgkin-Huxley neurons, Xiaojuan Sun, Matjaž Perc, Qishao Lu and Jürgen Kurths, Chaos 18, 023102 (2008)

Stochastic resonance on excitable small-world networks via a pacemaker, Matjaž Perc, Phys. Rev. E 76, 066203 (2007)

Proximity to periodic windows in bifurcation diagrams as a gateway to coherence resonance in chaotic systems, Marko Gosak and Matjaž Perc, Phys. Rev. E 76, 037201 (2007)

Noise-guided evolution within cyclical interactions, Matjaž Perc and Attila Szolnoki, New J. Phys. 9, 267 (2007)

Spatial coherence resonance in excitable biochemical media induced by internal noise, Marko Gosak, Marko Marhl and Matjaž Perc, Biophys. Chem. 128, 210-214 (2007)

Periodic calcium waves in coupled cells induced by internal noise, Matjaž Perc, Marko Gosak and Marko Marhl, Chem. Phys. Lett. 437, 143-147 (2007)

Effects of small-world connectivity on noise-induced temporal and spatial order in neural media, Matjaž Perc, Chaos, Solitons & Fractals 31, 280-291 (2007)

Coherence resonance in a spatial prisoner's dilemma game, Matjaž Perc, New J. Phys. 8, 22 (2006)

Thoughts out of noise, Matjaž Perc, Eur. J. Phys. 27, 451-460 (2006)

Spatial decoherence induced by small-world connectivity in excitable media, Matjaž Perc, New J. Phys. 7, 252 (2005)

Persistency of noise-induced spatial periodicity in excitable media, Matjaž Perc, Europhys. Lett. 72, 712-718 (2005)

Spatial coherence resonance in excitable media, Matjaž Perc, Phys. Rev. E 72, 016207 (2005)

Noise-induced spatial periodicity in excitable chemical media, Matjaž Perc, Chem. Phys. Lett. 410, 49-53 (2005)

Amplification of information transfer in excitable systems that reside in a steady state near a bifurcation point to complex oscillatory behavior, Matjaž Perc and Marko Marhl, Phys. Rev. E 71, 026229 (2005)