UČNI NAČRT PREDMETA / COURSE SYLLABUS	
Predmet:	Raziskovalne metode in modeliranje v biomehaniki športnih gibanj
Course title:	Research methods and modelling in the biomechanics of sports movements

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Doktorski študij		**1**	**1 ali 2**
Doctoral study program		**1**	**1 or 2**

Vrsta predmeta / Course type izbirni

Univerzitetna koda predmeta / University course code:

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
30	**15**	**15**		**65**		**5**

Nosilec predmeta / Lecturer: prof. dr. Matej Supej

Jeziki / Languages:		
	Predavanja / Lectures:	**Slovenski/Slovene**
	Vaje / Tutorial:	**Slovenski/Slovene**

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

Izpolnjevanje pogojev za vpis na doktorski študij Kineziologija

Prerequisits:

General conditions for enrolment into the Doctoral Programme of Kinesiology

Vsebina:

- Teorija raziskovalnih metod na področju biomehanike človeškega gibanja
- Uporaba merilne tehnologije vezano na različna človeška gibanja in športne zvrsti kot so:
  - hoja
  - tek
  - alpsko smučanje,
  - nordijsko smučanje,
  - igre z loparji,
  - igre z žogo,
  - gimnastika,
  - atletika,
  - konjeništvo,
  - vodni športi,
  - druge.
- Napake pri merjenju:
  - natančnost merilnega sistema,
  - sistematične napake,
  - naključne napake.
- Obdelava izmerjenih podatkov:

Content (Syllabus outline):

- Theory of research methods in the field of biomechanics of human movement
- Use of measurement technology related to human movement and sports such as:
  - walking
  - running
  - alpine skiing,
  - nordic skiing,
  - racquet games,
  - ball games,
  - gymnastics,
  - athletics,
  - equestrian sports,
  - water sports,
  - other.
- Measurement errors:
  - accuracy of the measurement system,
  - systemic errors,

- numerične metode,
- matematično in fizikalno modeliranje,
- osnove filtriranja podatkov.

- Osnove obdelave podatkov v okolju Matlab
  - seznanitev z okoljem
  - skalar, vektor, matrika
  - uporaba funkcij in računanje s podatki
  - izrisovanje grafov
  - »avtomatska« obdelava in osnove programiranja
- Analiza in interpretacija rezultatov.

- random errors.

- Processing of measurement data:
  - numerical methods,
  - mathematical and physical modelling,
  - basics of data filtration.
- Data processing basics in the Matlab environment:
  - learning about the environment,
  - scalar, vector, matrix,
  - use of functions and calculation with data,
  - drawing graphs,
  - 'automated' processing and programming basics.
- Analysis and interpretation of results.

Temeljni literatura in viri / Readings:

Bartlett R., Introduction to Sports Biomechanics – Analysing human movement patterns (2nd ed.). New York: Rouledge 2007

Payton C.J.& Bartlett R., Biomechanical evaluation of movement in sport and exercise, New York: Rouledge 2008

Winter D. A.: Biomechanics and motor control of human movement (4th ed.). New York: J. Willey, 2009.

Zastiorsky V.M.: Kinetics of human motion, Human Kinetics, 2002

Zastiorsky V.M.: Kinematics of human motion, Human Kinetics, 1998

Omladič, V., Uporaba linearne algebre v statistiki. Ljubljana, Fakulteta za družbene vede, 1997

Bohte, Z., Numerične metode. Ljubljana: Društvo matematikov, fizikov in astronomov Slovenije, 1991

Cilji in kompetence:

Cilji

- Spoznati se z raziskovalnimi metodami v biomehaniki.
- Spoznati se z modeliranjem človeških gibanj v povezavi z izmerjenimi podatki.
- Spoznati se z aktualno merilno opremo iz področja biomehanike.
- Osvojiti znanja iz obdelave izmerjenih podatkov v biomehaniki.
- Spoznati se z načini interpretacije različnih biomehanskih parametrov

Objectives and competences:

Objectives

- Learn about research methods in biomechanics
- Learn about human movement modelling in relation to measured data
- Learn about the contemporary measurement equipment in biomechanics
- Gain knowledge of processing of measured data in biomechanics

Splošne kompetence

- Sposobnost iskanja novih dejstev, njihove interpretacije in integracije v kontekst študija
- Sposobnost prepoznavati in preučevati posledice interakcije okolja in človeka in preventivno delovanje s ciljem trajnostnega razvoja
- Sposobnost znanstveno-raziskovalnega dela, na nacionalni in mednarodni ravni, na področju kineziologije in presečnih ved
- Sposobnost kritičnega preverjanja informacij in predvidevanja rešitev in posledic

Predmetnospecifične kompetence

- Poglobljeno poznavanje različnih raziskovalnih pristopov v biomehaniki
- Poglobljeno poznavanje biomehanskih merilnih metod
- Sposobnost abstrahiranja, analize in sinteze izmerjenih in modeliranih podatkov človeškega telesa pri različnih gibalnih nalogah
- Sposobnost interdisciplinarnega povezovanja znanj ved, ki se prepletajo z biomehaniko človeškega gibanja

- Learn about the methods of interpretation of different biomechanical parameters

General competences

- Ability to find new facts, interpret them and integrate them in the study context
- Ability to identify and investigate the consequences of the environment-man interaction and preventive action to achieve sustainable development
- Ability to perform scientific-research work at the national and international levels in the field of kinesiology and related sciences
- Ability to critically assess information and foresee the solutions and consequences

Subject-specific competences:

- In-depth knowledge of different research methods in biomechanics
- In-depth knowledge of measurement methods in biomechanics
- Ability to abstract, analyse and synthesise the measured and modelled data on human body in different motor tasks
- Ability to make inter-disciplinary connections in knowledge gained from sciences that are interrelated with the biomechanics of human movement.

Predvideni študijski rezultati:

Znanje in razumevanje:
Poznavanje in razumevanje temeljnih raziskovalnih metod v biomehaniki v povezavi s koncepti delovanja gibalnega aparata, njegovih obremenitev in zdravstvenih posledic pri nekaterih vsakodnevnih in športnih obremenitvah.
Uporabno znanje rokovanja z različno aktualno merilno opremo na področju biomehanike.
Poznavanje omejitev in prednosti različne merilne opreme omogoča njeno optimalno izbiro v različnih pogojih merjenja.
Spozna se z obdelavo in interpretacijo podatkov ter osnovami avtomatizacije obdelave podatkov.

Uporaba
Pridobljena znanja iz raziskovalnih metod in biomehanskih modeliranj športnih gibanj predstavljajo platformo za delo na raziskovalnem področjih varnega, racionalnega, učinkovitega in uspešnega gibanja, na področju ergonomije in drugih presečnih ved, kjer je potrebno znanje iz

Intended learning outcomes:

Knowledge and understanding:
Knowledge and understanding of the basic research methods in biomechanics related to the concepts of locomotor movement, loading and health consequences in some everyday and sport loadings.
Practical knowledge of operating different modern measurement equipment in the field of biomechanics.
Knowledge of the limitations and advantages of different measurement equipment enables optimal selection in different measurement conditions.
Knowledge of data processing and interpretation as well as the basics of data processing automation.

Application
The acquired knowledge of research methods and biomechanical modelling of sports movements represent a platform for work in research areas of safe, rational, effective and efficient movement, in the area of ergonomics and other related sciences requiring knowledge of human movement in

razumevanja človeškega gibanja v interakciji z okolico, drugimi ljudmi in športnimi ali drugimi rekviziti. *Prenosljive spretnosti:* Študent pridobi tudi nekatera znanja za diagnostično in industrijsko raziskovalno-razvojno delo.	interaction with the environment, other people and sport and other devices. *Transferrable skills:* Students also gain some knowledge of diagnostic and industrial research-development work.

Metode poučevanja in učenja:	**Learning and teaching methods:**
Teoretična predavanja, laboratorijsko in seminarsko delo.	Theoretical lectures, laboratory and seminar work.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	**Assessment:**
Način (pisni izpit, ustno izpraševanje, naloge, projekt) Projekt s seminarjem in ustnim zagovorom.	**100 %**	Type (examination, oral, coursework, project): The project seminar and oral defense.

Reference nosilca / Lecturer's references:

OGRIN, Jan, ŠARABON, Nejc, KJAER MADSEN, Mads, KERSTING, Uwe, HOLMBERG, Hans-Christer, SUPEJ, Matej, et al. Asymmetries in ground reaction forces during turns by elite slalom alpine skiers are not related to asymmetries in muscular strength. *Frontiers in physiology*. 2021, vol. 12, št. 577698, str. 1-11

PELLEGRINI, Barbara, SANDBAKK, O, STÖGGL, Thomas, SUPEJ, Matej, ØRTENBLAD, Niels, SCHÜRER, Axel, STEINER, Thomas, LUNINA, Angelica, MANHARD, Chris, LIU, Hui, OHTONEN, Olli, ZOPPIROLLI, Chiara, HOLMBERG, Hans-Christer. Methodological guidelines designed to improve the quality of research on cross-country skiing. *Journal of science in sport and exercise*. June 2021, vol. , iss. , str. 1-17. ISSN 2662-1371.

ZORKO, Martin, HIRSCH, Karmen, ŠARABON, Nejc, SUPEJ, Matej. The influence of ski waist-width and fatigue on knee-joint stability and skier's balance. *Applied sciences*. 2020, vol. 10, iss. 21, art. 7766, str. 1-13, ilustr. ISSN 2076-3417.

SUPEJ, Matej, SPÖRRI, Jörg, HOLMBERG, Hans-Christer. Methodological and practical considerations associated with assessment of alpine skiing performance using global navigation satellite systems. *Frontiers in sports and active living*. Jan. 2020, vol. 1, art. 74, 7 str. ISSN 2624-9367.

ZORKO, Martin, NEMEC, Bojan, MATJAČIĆ, Zlatko, OLENŠEK, Andrej, TOMAŽIN, Katja, SUPEJ, Matej. Wide skis as a potential knee injury risk factor in alpine skiing. *Frontiers in sports and active living*. Feb. 2020, vol. 2, art. 7, str. 1-9, ilustr. ISSN 2624-9367.

SUPEJ, Matej, SÆTRAN, L., OGGIANO, Lucca, ETTEMA, Gertjan, ŠARABON, Nejc, NEMEC, Bojan, HOLMBERG, Hans-Christer. Aerodynamic drag is not the major determinant of performance during giant slalom skiing at the elite level. *Scandinavian journal of medicine & science in sports*, 2013, vol. 23, no. 1, str. e38-e47

SUPEJ, Matej, HOLMBERG, Hans-Christer. A new time measurement method using a high-end global navigation satellite system to analzye alpine skiing. *Res. q. exerc. sport*, 2011, vol. 82, no. 3, str. 400-411

SUPEJ, Matej, KIPP, R., HOLMBERG, Hans-Christer. Mechanical parameters as predictors of performance in alpine world cup slalom racing. *Scandinavian journal of medicine & science in sports*, 2011, vol. 21, no. 6, str. 72-81

SUPEJ, Matej. 3D measurements of alpine skiing with an inertial sensor motion capture suit and GNSS RTK system. *J. sports sci.*. [Print ed.], 2010, vol. 28, no. 7, str. 759-769