

1. Raziskovalna organizacija (*Research organisation*):

Univerza v Ljubljani, *Fakulteta za matematiko in fiziko*

2. Ime in priimek mentorja (*Name and surname of a mentor*):

Matija Milanič

3. Področje znanosti iz šifranta ARRS (*Primary research field*):

1.02.08 - Naravoslovno-matematične vede / Fizika / Medicinska fizika

4. Kontaktni e-naslov mentorja (*Contact of a mentor*):

matija.milanic@fmf.uni-lj.si

5. Kratek opis programa usposabljanja (*Short description of the program*):

Raziskovalno področje usposabljanja mladega raziskovalca (MR) bo biomedicinska optika (BMO). Področje BMO zajema proučevanje interakcij med svetlobo in biološkimi tkivi. Rezultati BMO raziskav prvenstveno pripomorejo k izboljššanemu razumevanju samih interakcij, sicer pa imajo tudi praktičen vidik v smislu razvoja novih diagnostičnih in terapevtskih metod.

Glavni cilj doktorskega dela bo razvoj sistema in algoritmov za hiperspektralno slikanje (HSI) ter aplikacija razvitega sistema na specifičnem kliničnem problemu. HSI je optična slikovna tehnika, ki omogoča hkratno zajemanje prostorske in spektralne informacije. Kot taka omogoča prostorsko kot spektralno analizo proučevanega objekta. Z ustrezno postavitvijo sistema in primernimi algoritmi, je iz HSI mogoče določiti tako porazdelitve fizikalnih parametrov proučevanih objektov, kot so absorpcijski in sipalni količniki, kot tudi fiziološke, kot so koncentracije krvi, kisika, vode, ipd.

Predvideni koraki na poti do doktorskega dela bodo tako:

- Postavitev in karakterizacija »push-broom« HSI sistema s poudarkom na razvoju LED osvetlitve.
- Nadgradnja obstoječih in razvoj novih algoritmov za določanje fizikalnih oz. fizioloških parametrov tkiv.
- Testiranje razvitega sistema na dobro definiranih tkivnih fantomih.
- Uporaba razvitega sistema za proučevanje relevantnega kliničnega problema v sodelovanju s kliničnimi partnerji.

Doktorski kandidat bo vključen v raziskave programske skupine za medicinsko fiziko, ki vključuje raziskovalce na FMF, IJS, UKCL in OI, ter mednarodna sodelovanja s sorodnimi raziskovalnimi skupinami v Evropi in ZDA.

The research field of the PhD candidate will be biomedical optics (BMO). The main focus of BMO is studying light-tissue interactions revealing both tissue morphology and physiology. Additionally, BMO methods are applied to clinical work as novel therapeutic and diagnostic modalities.

The main objective of the doctoral work will be development of a hyperspectral imaging system (HSI), corresponding HSI analysis algorithms, and applying the developed system to study a relevant clinical problem. HSI is an optical technique providing simultaneously spatial and spectral information. Thus simultaneous spatial and spectral analysis of an inspected object is possible. Using an appropriate HSI system and analysis algorithms, spatial distributions of physical parameters (e.g., absorption and scattering parameters) or physiological parameters (e.g., blood, water, melanin, and oxygen concentrations) could be determined.

The doctoral work will include the following specific tasks:

- Design, construction and evaluation of a “push-broom” HSI system including development of LED light sources
- Improving existing and developing new analysis algorithms for determination of physical and physiological parameters of biological tissues.
- Evaluating the developed system on well-defined tissue phantoms.
- Applying the developed system on to study a relevant clinical problem in collaboration with clinical partners.

The PhD candidate will be involved in research activities of the Medical physics research group, which includes researchers from Faculty of mathematics and physics, Jozef Stefan Institute, University medical center Ljubljana, and Institute of oncology Ljubljana. The PhD candidate will be also involved in research activities with other research groups in Europe and USA.