Scholarship position, PhD student type

at

Nalecz Institute of Biocybernetics and Biomedical Engineering Polish Academy of Sciences, Warsaw, Poland

in

Project funded by National Science Center Poland

Project title: Optimization of vasopressor dose in severe traumatic brain injuries using pulse-wave propagation modeling

Application deadline: 9th September 2019

Duration/funding level: 4500 PLN per month, paid for 36 months

Requirements:

- MSc in biomedical engineering or another technical science, mathematics, computer science, physics, or other related to the project's scope;
- familiar with methods of mathematical and computational modeling;
- good programming skills (preferably MATLAB and C++ knowledge);
- experience in applications in medicine or biology is welcome but not necessary;
- very good level of written and oral English language;
- team work skills.

In addition to the above requirements, a candidate is expected to represent high degree of motivation, communicativeness, creativity, reliability, diligence, punctuality, the ability to work both independently and in a team, and the ability to critically evaluate the obtained results. Moreover, we expect from a candidate an active participation in conferences, festivals and other forms of dissemination of project's results and preparation of scientific publications in English at a high, international level.

Successful applicant will take active part in development and implementation of mathematical model, sensitivity analyses, investigation of possible vasopressor optimization schemes, and data collection.

Application submission:

Applications should be submitted by 9th September 2019 via e-mail to jpoleszczuk@ibib.waw.pl (project's PI) and jwaniewski@ibib.waw.pl, with a subject: "PhD student – TBI PWA".

Required documents:
1) Application letter (with some motivational part);
2) Curriculum vitae with a list of achievements (including the list of publications and description of skills useful in the project, in which the candidate has experience);
3) Scan of master's degree diploma (a copy will be needed by the end of September2019);
4) OPTIONAL: Short and concise 'portfolio' illustrating the previous research experience (part of conference/seminar/poster presentation);
5) OPTIONAL: At least one recommendation letter and/or opinion on the candidate from the

previous supervisor (of MSc thesis) or former directors with whom the applicant has previously cooperated with the contact details;

All required documents should be saved in one PDF file. The competition will be settled by the end of September 2019 or early in November 2019.

Project description:

Each year in European Union around 1.5 million people suffer from traumatic brain injury with about 55 thousand traumatic brain injury accounted deaths. Traumatic brain injury is the leading cause of mortality and morbidity among young individuals in high- and middle-income countries.

Precise control of systemic blood pressure in severe traumatic brain injury is of utmost importance. The most common method applied by the clinicians to keep systemic pressure levels above certain levels is to administer vasopressor agents, such as norepinephrine (noradrenalin). The increased concentration of vasopressors in blood results normally, among others, in increased heart rate and narrowing of small blood vessels (also in the brain), ultimately leading to increased systemic blood pressure. Vasopressors overdose can have, however, severe side effects such as hypertension resulting in cerebrovascular hemorrhage or cardiac ischemia. In the intensive care units clinicians try to avoid those side effects through continuous monitoring of patient's cardiovascular function and manual adjustments of the vasopressor dose. In a typical scenario, when the patient's blood pressure drops below the prescribed threshold, attending clinician increases the dose of vasopressor by a certain amount and observes the response. Vasopressor dose needs to be subsequently decreased and the procedure reiterated in the case of undesirably large increase in the blood pressure or other adverse events. Most importantly, patients' response to drug dose is not instantaneous. Therefore, the above described procedure obviously requires a lot of time and attention from medical staff and it is conceivable that during the drug adjustment period not optimal state of the patient is obtained, what can contribute to increased mortality rates.

The project will propose and evaluate new methods for optimizing vasopressors usage in patients with severe traumatic brain injuries. In particular, we hypothesize that the in-depth analysis of the pressure pulse wave shape at various locations of cardiovascular system augmented with already collected clinical data will allow to decipher what will be the patient-specific response to a given dose of the vasopressor. We will utilize a novel approach based on the mathematical pulse wave propagation modeling that will be used for computer simulations investigating influence of various doses of the drug. The model will allow to quantitatively and qualitatively describe the most important aspects of the influence of the vasopressor on the cardiovascular system. We plan also to gather clinical data in a group of patients with severe traumatic brain injuries that are treated at the intensive care unit. This will allow us to collect information necessary to validate the proposed model. We expect that the project results could be used in the future for better management of traumatic brain injury patients leading to increased survival rates.

Related literature:

1. Poleszczuk J, Debowska M, Waniewski J, et al., Patient-specific pulse wave propagation model identifies cardiovascular risk characteristics in hemodialysis patients, PLOS Computational Biology, 2018, doi.org/10.1371/journal.pcbi.1006417

2. Poleszczuk J, Debowska M, Dabrowski W, et al., Subject-specific pulse wave propagation modeling: Towards enhancement of cardiovascular assessment methods, PLOS One, 2018, doi.org/10.1371/journal.pone.0190972.