Reasoning of dissertation topic and competency of potential supervisor for admission onto joint LSU and TU doctoral studies in 2021

Area of research (title and code)	**Natural Science**
Field of research (title and code)	**Biology**
Topic of research	**Exercise Physiology**
Institution	**Lithuanian Sports University**

Potential supervisor

Pedagogical and scientific degree	**Name, surname**	**Academic position**
Doctor	Sigitas Kamandulis	Head researcher

Short reasoning of proposed dissertation topic

Title

MAXIMISING POWER UNDER A RANGE OF VELOCITIES: INDIVIDUAL APPROACH USING NOVEL MOTORISED DEVICE ALEX1

Short research description (including aims and objectives) (maximum 1500 characters).

Different methods are used to enhance power of muscle contraction ranging from high magnitude loads at low velocities to unloaded assisted sprinting, such as using elastic cords, bungees, or a pulley (Upton, 2011; Petrakos et al., 2016; Tufano and Amonette, 2018; Lahti et al., 2020). These two opposite training modalities induce specific neural and muscular adaptations which can be measured and expressed in the force-velocity relationship. The intercepts of this relationship characterize the maximum capacity of the neuromuscular system; it also can provide insight into a number of factors underlying performance (Morin and Samozino, 2016; Cross et al., 2018). It is important to note that for power production, some athletes are more sensitive to force oriented training, while others benefit more from speed training. Indeed difficulties arise to obtain valid data of athletes' force-velocity profile for sport specific multi-joint movements, especially in case of distinctive environment such as water in the swimming pool.

An innovative multifunctional system has been developed recently by MB "Inosportas" in cooperation with Kaunas University of Technology for speed, strength and power training, and the assessment of force-velocity parameters. This device provides resistance when the cable does not allow running at full speed or provides assistance with velocity even surpassing maximal during sprinting. The main idea to create such a device takes back to 2012. The late Aleksas Stanislovaitis was the main author of this idea, therefore the system is named Alex1, in memory of the coach A. Stanislovaitis.

Given the novelty of the equipment, it is projected to focus first on establishing reliability and validity of measures obtained using Alex1 device. The reliability assessment will be performed on the land using it with a combination of 20-m running system equipped with optical sensors working at a frequency of 1000 Hz, detecting the relevant space and time parameters (MICROGATE, Bolzano, Italy). Reliability assessment in the water will be performed for 50 m race combining measures of Alex1 device and data obtained by the AIM race analysis system (AIMSys Sweden AB, Lund, Sweden). This system consists of five underwater and five above-water cameras at a side of a pre-calibrated pool perpendicular to the swimming direction to obtain the mean head velocity in each stroke cycle, stroke cycle duration and frequency as well as stroke length.

Secondly, we aim to establish the effectiveness of training programs designed according to the individual load-velocity profile in runners and swimmers. Load-velocity characteristics will be assessed using multiple sprint method, comprising habitual, resisted and assisted trials using Alex1 system in conditions specific to sport. The training programs will mainly focus on the increase in pure movement velocity and in strength at high movement velocity with a special interest to loading components (duration, intensity), and fatigue (resting periods, session rate). It is expected that results of this PhD project can be related not only to runners and swimmers but to a wide range of athletic population who require speed and power in their sports.

Relevance of the problem, its novelty at national and international level (maximum 1500 characters).

Resisted and assisted towing training are needed for athletes' conditioning to develop power and speed. For decades, a sled was used to create resistance due to surface friction during running while athletes pulled each other using rubbers for resistance facilitation. Control of such techniques is challenging and requires skills. This is even more challenging during swimming due to unsteady flow (Formosa et al., 2012, Gonjo et al., 2020). Therefore, application of motorized devices in training sessions may serve for the determination of a more accurate load magnitude. Currently, there are some devices employed in assessment and training to provide resistance or assisted motorized towing such as ATM (Motor Power Company, Norway) or 1080 Sprint (1080 Motion AB, Sweden) but the search is performed further in order to develop an innovative product more adjustable under varying environmental conditions. It is even more important to increase common knowledge searching for valuable methods to individualize athlete's training. Force-velocity profiling and emphasis on neuromuscular qualities of an athlete can provide adequate training stimulus for gains in physical performance (Morin and Samozino, 2016; Manson et al., 2021).

Main references:

Cross MR et al. Training at maximal power in resisted sprinting: Optimal load determination methodology and pilot results in team sport athletes. PLoS One. 2018 Apr 11;13(4):e0195477.

Gonjo T, Eriksrud O, Papoutsis F, Olstad BH. Relationships between a load-velocity profile and sprint performance in butterfly swimming. Int J Sports Med. 2020 Jun;41(7):461-467. doi: 10.1055/a-1103-2114.

Manson SA et al. Vertical force-velocity profiling and relationship to sprinting in elite female soccer players. Int J Sports Med. 2021 Feb 18. doi: 10.1055/a-1345-8917.

Morin JB, Samozino P. Interpreting power-force-velocity profiles for individualized and specific training. Int J Sports Physiol Perform. 2016; 11(2):267±72.

Petrakos G et al. Resisted sled sprint training to improve sprint performance: a systematic review. Sports Med. 2015, 46, 381–400.

Tufano, J.J.; Amonette, W.E. Assisted versus resisted training. Strength Cond. J. 2018, 40, 106–110.

Upton, D.E. The Effect of Assisted and Resisted Sprint Training on Acceleration and Velocity in Division IA Female Soccer Athletes. J. Strength Cond. Res. 2011, 25, 2645–2652.

Research methods and possibilities for conducting these studies (maximum 1500 characters).

The outcome measures will include tests for the evaluation of exercise performance (sprints and jumps in the field settings, assessment of force parameters by Biodex dynamometer), functional recovery (heart rate, samples of blood and saliva), neuromuscular properties (EMG, rate of force development) and biomechanical analyses of sprinting technique. LSU has the necessary equipment. The reliability and validity assessment of the training device (Alex1) in the water will be performed at the Norwegian School of Sport Sciences (Oslo, Norway) because only they have the needed AIM race analysis system.

Please indicate the links between the proposed topic for the doctoral thesis and biomechanics / physical therapy / sports study programs.

This study will provide knowledge about the adaptation of athletes in different sports to

prescribed personalized training, therefore the outcomes can be shared with students involved in Sports Coaching study program.
Is the proposed topic for the doctoral thesis related to currently funded research projects? Please indicate the links between the proposed topic for the doctoral thesis and funded research projects Proposed topic is not related to any currently funded research project.
Is the proposed topic for the doctoral thesis related to joint research with a foreign institution? Please indicate the links between the proposed topic for the doctoral thesis and research with a foreign institution Dr. Bjørn Harald Olstad (Institute of Physical Performance, Norwegian School of Sport Sciences, Oslo, Norway) will be directly involved in this project. His participation is necessary since part of studies are planned to perform at the Norwegian School of Sport Sciences.

Currently I am supervisor of 2 doctoral students.

Supervisor  Sigitas Kamandulis

(signature) (Name, surname)

Date 2021 04 30