Name and surname:	**Grzegorz Jóźków**
Academic Degree:	dr hab. inż. (DSc.)
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UPWr Base of Knowledge - link:	https://bazawiedzy.upwr.edu.pl/info.seam?id=UPWr3719fc45efdc4a24ae17f595857b47a9
Researchgate:	
Personal website / Working group website:	
Participation in projects in last 5 years (chronological; with distinction into PI (kierownik) and RF (wykonawca)):	EPOS-PL RF, GATHERS RF, WATERAGRI RF, EPOS-PL+ RF
Do you plan to engage support of second supervisor or auxiliary supervisor?	YES
	Auxiliary supervisor
Name and surname:	Małgorzata Jarząbek-Rychard
Academic Degree:	dr inż. (Dr. Eng.)
Faculty, Institute/Department:	Institute of Geodesy and Geoinformatics
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UPWr Base of Knowledge - link or most important publications from last 3 year (JCR) / patents from last 3 years (maximum 5):	https://bazawiedzy.upwr.edu.pl/info.seam?id=UPWr55c3407e2f4c49f79c4875976a49a252&affil=&lang=en
Researchgate:	https://www.researchgate.net/profile/Malgorzata-Jarzabek-Rychard
Personal website / Working group website:	https://tu-dresden.de/bu/umwelt/geo/ipf/photogrammetrie/die-professur/beschaeftigte/Malgorzata_Rychard
Projects in last 5 years (chronological; with distinction into PI (kierownik) and RF (wykonawca)):	Development of algorithms for 3D building modeling using point clouds from dense image matching (PI), Development of methods for the automatic reconstruction of indoor BIM models based on geospatial data fusion (PI)
PhD topic:	Automatic reconstruction of smart building indoor 3D models based on SLAM LiDAR data.
Research discipline in Doctoral School:	Civil Engineering, Geodesy and Transport
Short description of the research problem to be solved in the PhD (minimum 1000 characters):	Building Information Models (BIMs) are widely used in many applications, such as building maintenance and inspection, preservation, or emergency response. The backbone of the BIM is the 3D model of the building, created for complex new facilities along with the building construction process. Generation of as-build 3D models for existing buildings is more challenging, since the documentation is often missing or outdated. To deal with this issue we can collect up-to-date information using typical surveying techniques (e.g. range finders, total stations) or acquire 3D data with terrestrial laser scanning or photogrammetric methods. Unfortunately both approaches have their drawbacks such as time consuming data collection or processing. These problems can be solved by collecting the data in the kinematic mode and processing it in the automatic manner. Laser scanning, also known as LiDAR (Light Detection and Ranging), seems to be the fastest method for data acquisition because of its capability to provide 3D point clouds without complex processing. In addition, during the same kinematic survey additional sensors may be used, that collect the data which are essential for semantic enrichment of the constructed geometric models. This approach does not only save the time, but also benefits in direct connection between geometrical and semantic data collected by the sensor fusion. The major challenge of the proposed solution is the kinematic data acquisition that requires accurate information about sensor trajectory (position and orientation). In the kinematic mapping with LiDAR sensors the information about trajectory is obtained from GNSS and INS data. Due to unavailability of GNSS signal in the indoor environment, the problem of the accurate trajectory reconstruction needs to be solved in different manner because INS data tends to drift. One of the possible solutions is SLAM (Simultaneous Localization And Mapping) that in the same time allows to collect 3D data and use it in the estimation of the sensor trajectory. Acquired LiDAR point clouds should be processed automatically to create a 3D model which can be used during the same survey to improve the trajectory (e.g. by loop closures). Consequently, the improvement in the trajectory will affect the model resulting in its update. In this PhD project a multi beam lightweight and inexpensive laser scanner (e.g. Velodyne) is proposed to be used in the SLAM, with optional support of inertial sensors and/or cameras. The main research problem to be solved in the PhD is the development of the method that allows to automatically create 3D indoor models based on SLAM LiDAR data collected with inexpensive laser scanners. The proposed PhD project consists of the following parts: 1. Developing a prototype of the SLAM hardware system by integrating sensors available in IGiG (Institute of Geodesy and Geoinformatics) (e.g. Velodyne HDL-32E). This part includes necessary sensor calibration and tests of data stream for SLAM purposes. 2. Developing or implementing SLAM algorithm based on LiDAR and optional data from other sources, followed by performing indoor tests. 3. Developing and implementing automatic 3D modeling algorithms.
Professional skills for PhD candidate (e.g. master program, specializations, softwares, language, analytical techniques, minimum 500 characters):	MSc in the field of geoinformatics, computer science, civil engineering or related engineering discipline. Knowledge of laser scanning technology, photogrammetry, 3D modeling from point clouds. Recommended knowledge of inertial navigation. Good programming skills in Python and/or C++, recommended programming skills in Matlab. Skills in implementing open source codes. Recommended experience in working with inexpensive laser scanners (e.g. Velodyne), thermal cameras, and inertial navigational sensors. Scientific achievements, e.g. publications, participation in research projects. English language skills: fluent speaking, scientific text reading, technical text writing. Motivation to publish results of the research in scientific journals.
a) Project title:	
b) Agreement number:	
c) Number of months in the project to support PhD (in months; starting from 1st of October 2022):	
Project website:	