Name and surname:	**Witold Rohm**
Academic Degree:	prof. dr hab. inż. (Prof.)
Institute/Department:	Institute of Geodesy and Geoinformatics
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ORCID:	https://orcid.org/0000-0002-2082-6366
UPWr Base of Knowledge - link:	https://bazawiedzy.upwr.edu.pl/info/author/UPWr4d682756bd1243c58f310f8e07f263af/
Researchgate:	https://www.researchgate.net/profile/Witold-Rohm
Personal website / Working group website:	https://spaceos.igig.upwr.edu.pl
Participation in projects in last 5 years (chronological; with distinction into PI (kierownik) and RF (wykonawca)):	EPOS – European Plate Observing System. Principal Investigator at UPWr: start date 01-09-2016, end date 31-12-2021, GNSS observation as a numerical weather prediction data source, a way forward to enhanced forecasts quality. Principal Investigator, start date 14-08-2014, end date 13-08-2018, finished, finally settled Commercialization of the result of the project: GNSS tomography as an important source of the meteorology data. Principal Investigator, start date 01-09-2015, end date 31-10-2019, Column water vapour content (PWAT) as a predictor of extreme weather events in Poland in the light of high resolution multi-source measurement data.Principal Investigator at UPWr, start date 27-04-2016, end date 26-04-2020, Three-dimensional integrated observations of the troposphere using ground-based and satellite GNSS observations. Principal Investigator at UPWr, start date 10-01-2021, end date 30-09-2025, in progress
Do you plan to engage support of second supervisor or auxiliary supervisor?	YES
	Auxiliary supervisor
Name and surname:	Freek van Leijen
Academic Degree:	dr (Dr.)
Faculty, Institute/Department:	Faculty of Civil Engineering and Geosciences, TU Delft
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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):	Reinders, K. J., Hanssen, R. F., van Leijen, F. J., & Korff, M. (2021). Augmented satellite InSAR for assessing short-term and long-term surface deformation due to shield tunnelling. Tunnelling and Underground Space Technology, 110, 103745. Van Natijne, A. L., Bogaard, T. A., van Leijen, F. J., Hanssen, R. F., & Lindenbergh, R. C. (2022). World-wide InSAR sensitivity index for landslide deformation tracking. International Journal of Applied Earth Observation and Geoinformation, 111, 102829. Mulder, G., Van Leijen, F. J., Barkmeijer, J., De Haan, S., & Hanssen, R. F. (2022). Estimating Single-Epoch Integrated Atmospheric Refractivity From InSAR for Assimilation in Numerical Weather Models. IEEE Transactions on Geoscience and Remote Sensing, 60, 1-12.
Researchgate:	https://www.researchgate.net/profile/Freek-Van-Leijen
Personal website / Working group website:	https://www.tudelft.nl/citg/over-faculteit/afdelingen/geoscience-remote-sensing/staff/researchers/drir-fj-freek-van-leijen
Projects in last 5 years (chronological; with distinction into PI (kierownik) and RF (wykonawca)):	Integration of Geodetic and imAging TecHniques for monitoring and modelling the Earth's surface defoRmations and Seismic risk (GATHERS). RF, start date 01-12-2019, end date 31-08-2023, in run
PhD topic:	New DInSAR method for precise determination of deformations of technical infrastructure.
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):	The extraction of mineral and energy resources by underground mining sets in motion a cause-and-effect sequence reflected in changes in the terrain on the Earth's surface. This happens as a result of the formation of voids after the hollowing out of material, which causes changes in the rock mass above the mined deposit. These changes manifest themselves through, among other effects, subsidence (continuous changes), sinkholes and fissures (discontinuous changes), but also induced seismicity (called "tremors"), particularly dangerous for miners working underground. Mining companies are obliged to monitor each stage of the excavating process, its influence on the changes and stability of the terrain and infrastructure. The goal is to maintain sustainable production, while preventing the workers, infrastructure and population from critical impact. This also includes paying compensation for damaged infrastructure and houses. A breakthrough for these purposes seems to be remote sensing monitoring, which allows detection of even subtle changes on the surface using satellite technologies, like the Interferometric Synthetic Aperture Radar (InSAR) method, characterized by incomparably better temporal and spatial resolution while maintaining centimeter or even millimeter accuracy in comparison to classical geodetic methods of measurement (Global Navigation Satellite Systems (GNSS), usage of total stations, leveling). In addition with the development of the European system for Earth' monitoring Copernicus, that also includes a radar dedicated mission Sentinel-1, the access to these data highlights the favorable economic and manpower saving values of the usage of radar satellite data and techniques for ground deformation monitoring. Several advanced applications of InSAR have been developed in the last decades, such as Persistent Scatterer Interferometry (PSI) or Small BAseline Subset (SBAS), aiming to overcome some limitations of the InSAR technique, mainly related to the quality of the radar data. The power of the reflected radar signal is influenced by the characteristics of the illuminated terrain objects. The advanced techniques minimize the contribution of the low-quality data by applying different statistical models. In the case of fastly changing terrain in the areas of underground mining these methods have limited applications due to in some cases linearity of the applied models against more complex behavior of the terrain. In other cases the need for suitable ground points with high reflectivity cannot be fulfilled in vegetated areas. The specific weather conditions with very local scale also cannot be properly modeled and removed from the deformation maps created with the advanced InSAR. These circumstances force the monitoring of the deformations in the underground-mining areas to rely on the classical Differential InSAR, which exploits separate interferometric pairs that contain the entire raw information gathered by the radar sensor. This information includes the full scale of the deformation but also suffers from defects due to weather and vegetation parameters. These defects have the biggest influence on the most crucial stage in DInSAR processing is the so-called phase unwrapping to gain the deformation range. Deformation values are determined based on the difference between the phases of the radar waves for a given area during the initial and repeated measurement periods. The range of the wave is between -π and π so to estimate the full range of deformation a phase unwrapping is required. This involves counting the full changes in phase ranges that have occurred between two points to determine the actual value of the deformation between them (unlimited by the value of the interval from the span of 2π). The unwrapped phase values are then converted to deformations in the metric system using the geometry components of the measurement taken. The phase unwrapping process discussed for the DInSAR method using local path-based methods is the reason for the errors resulting from the estimation of the algorithm for the probability of paths following slope lines determined by phase cycles in areas with low signal coherence. Coherence is a measure of the correlation between two images taken at almost the same position of the SAR satellite. A low value of it causes a change in the trajectory of the path developing the phase. This situation degrades the quality of the final solution. The aforementioned problem is currently posed as the biggest obstacle to the development of the DInSAR method. So far, attempts have been made to deal with it through appropriate selection of pairs of SAR images (maximizing the observed coherence between them) or Goldstein filtering and masking with the help of coherence. The last solution, however, can result in multiple areas with no data or the formation of clusters that are not connected to each other by any phase inversion path. Therefore, it is important to develop an algorithm to solve this problem by automatically filtering low-coherent areas and synthesizing phase data on them characterized by a high probability of their correctness. In addition, it is important to allow the algorithm to work without the use of external data, which will make it easy to apply regardless of the location of the area of interest and the type of satellite data. This solution will significantly increase the applicability of the DInSAR method for precise determination of deformations of technical infrastructure.
Professional skills for PhD candidate (e.g. master program, specializations, softwares, language, analytical techniques, minimum 500 characters):	-Master in Geodesy, Geoinformatics, Geography, Computer Science, Physics or Mathematics, -Experience in InSAR processing using open source (eg. SNAP) or commercial software (SARScape) -Fluent English in writing and speaking -Able to clearly present scientific concepts at the conferences, workshops and internal meetings, -Programming skills in Python, Matlab or R, -Keen to dig into complex scientific concepts related to InSAR processing, -Open for prolonged internships to external partners in and outside Europe
a) Project title:	Integration of Geodetic and imAging TecHniques for monitoring and modelling the Earth's surface defoRmations and Seismic risk (GATHERS)
b) Agreement number:	857612
c) Number of months in the project to support PhD (in months; starting from 1st of October 2022):	8
Project website:	www.gathers.eu