



Subject card

Subject name and code	Methods of analysing remote sensing imagery, PG_00069053						
Field of study	Geodesy and Cartography						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2026/2027		
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		7.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Department of Geodesy -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Anna Sobieraj-Żłobińska				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	30.0	15.0	0.0	105
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	105		0.0		0.0	105
Subject objectives	Acquisition of knowledge and skills in the field of advanced processing methods for images obtained from aerial and satellite platforms, as well as the analysis and interpretation of multispectral and multitemporal remote sensing studies						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U04] can use the techniques of digital image processing in digital photogrammetry and remote sensing	He is capable of using digital processing methods for remote sensing images to create orthophotos, perform filtering, calibration, classification, calculate indices, and generate thematic maps and spatial databases.	[SU4] Assessment of ability to use methods and tools
	[K7_W04] has knowledge of the digital image processing basics; knows advanced models of geodetic surveying, theoretical foundations of non-standard estimation methods, free and multi-step equations (sequential) adjustment methods	He possesses the ability to analyze and interpret raw and processed remote sensing data obtained from aerial and satellite platforms. He is capable of preparing multitemporal studies in the form of thematic maps, index maps for selected parameters, and conducting information analysis based on the prepared products.	[SW1] Assessment of factual knowledge
	[K7_U05] can choose, depending on the nature of the study, methods for assessing the quality of photogrammetric and remote sensing products and elaborations.	He possesses the skills to analyze the accuracy and quality of remote sensing data based on the geometric and radiometric parameters of images and is capable of selecting the appropriate source data specifications to achieve optimal results in remote sensing studies	[SU2] Assessment of ability to analyse information
	[K7_W03] has knowledge of the basic physical remote sensing; knows the available photographic materials and satellite data as well as their potential uses; knows the basics of digital image processing and analysis of aerial and satellite image; has deep knowledge of remote sensing applications including knowledge of the usage of remote-sensing methods and technologies of data acquisition for the construction of topographic and thematic databases purpose	He has advanced knowledge of remote sensing and its applications in the visible, infrared, and microwave ranges. He is familiar with advanced methods for processing remote sensing images and correcting geometric and radiometric distortions. He is also knowledgeable in technologies for creating thematic maps and databases based on remote sensing data.	[SW1] Assessment of factual knowledge
	[K7_U03] can make the interpretation of aerial and satellite photos and develop products based on remote sensing data	He possesses the ability to analyze and interpret raw and processed remote sensing data obtained from aerial and satellite platforms. He is capable of preparing multitemporal studies in the form of thematic maps (land cover/use, changes in selected environmental factors), index maps for selected parameters (vegetation, soil, temperature, etc.), and performing extraction and analysis of information based on the prepared products.	[SU4] Assessment of ability to use methods and tools

Subject contents	Course content – lecture Advanced Methods for Visualization and Interpretation of Remote Sensing Data theoretical and practical aspects of creating color composites (RGB, CIR) and spectral indices (NDVI, NDWI, NDBI); methodology for visual and quantitative interpretation of derivative images for identifying environmental objects and phenomena. Thematic Classification Algorithms for Multispectral Images methods of unsupervised and supervised classification using machine learning algorithms; systematic approaches for validation and accuracy assessment of classification results using confusion matrices and statistical metrics. Object-Based Image Analysis (GEOBIA Geographic Object-Based Image Analysis) Cloud-Based Processing of Large Remote Sensing Datasets in Google Earth Engine (GEE) architecture and functionality of the GEE platform as a tool for spatiotemporal analysis; practical applications of GEE for implementing complex remote sensing projects using global data archives. Processing and Analysis of Radar Data (SAR) physical principles of radar remote sensing and characteristics of SAR images; methods for calibration, filtering, and analysis of radar data (Sentinel-1) for monitoring soil moisture, surface deformation, and object detection. Advanced Remote Sensing Applications in Environmental Monitoring methodology for detecting land cover and land use changes (Change Detection) using time series; time series analysis (Time Series Analysis) for modeling the dynamics of natural phenomena. Course content – exercises Creating Color Composites and Spectral Indices RGB and CIR composites from Sentinel-2 / Landsat 8 imagery; calculating NDVI, NDWI, NDBI indices; visual interpretation of environmental objects: water, vegetation, urban areas. Thematic Classification of Multispectral Images Unsupervised classification (K-means, ISODATA); supervised classification (Random Forest, SVM); classification validation using confusion matrices and basic statistical metrics. Object-Based Image Analysis (GEOBIA) Image segmentation and creation of thematic objects; integration of results with vector data; comparison of object-based and pixel-based classification results. Google Earth Engine Basics and Data Processing Downloading satellite data (Sentinel-2, Landsat); creating RGB/CIR composites and spectral indices; visual analysis of land cover changes. Radar Data Analysis (SAR) Introduction to Sentinel-1 images; preprocessing: calibration, filtering, noise reduction; basic interpretation: water bodies, urban areas, surface deformations. Environmental Change Analysis and Time Series Detecting land cover changes (Change Detection); NDVI/NDWI time series analysis for monitoring vegetation and water bodies. Course content – laboratory Creating thematic maps and reports with visual analysis; comparative analysis of different color composites. Advanced Thematic Classification Comparing results of supervised and unsupervised classification; detailed validation using confusion matrices, F1 score, Kappa, and overall accuracy. Object-Based Image Analysis (GEOBIA) Image segmentation using Orfeo Toolbox; object-based classification using spectral and textural features; comparison of object-based and pixel-based classification with accuracy assessment. Large-Scale Data Processing in GEE Scripts for processing and analyzing large datasets; creating time series of land cover changes; exporting results to GeoTIFF/shapefile for further GIS analysis.
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	Advanced Radar Data Analysis (SAR) InSAR analysis for detecting surface deformation; creating maps of soil moisture and surface changes.		
	Course content – project		
	Land Cover Change Monitoring Analysis of land use changes in a selected urban or rural area using time series of Sentinel-2 or Landsat imagery; comparison of pixel-based and object-based classification results; presentation of change maps and statistical indicators.		
	Assessment of Vegetation Status and Ecosystem Health Analysis of seasonal vegetation changes using NDVI and EVI indices; identification of areas affected by plant stress or environmental degradation.		
	Surface Water Detection and Moisture Analysis Analysis of water level changes in lakes, rivers, or wetlands using the NDWI index; mapping flood hazards or hydrological changes.		
	Urbanization and Built-Up Area Expansion Analysis Detection of land cover changes in cities using the NDBI index and classification analysis; creation of urban expansion maps and identification of areas at risk of environmental fragmentation; presentation of results in reports and thematic maps.		
Time Series Analysis of Environmental Dynamics Creating temporal analyses for phenomena such as deforestation or water level changes; using Google Earth Engine to automate calculations and visualize results.			
Prerequisites and co-requisites	Students should possess basic knowledge of remote sensing, including concepts related to data acquisition from satellite and aerial sensors, and the fundamentals of imaging across different spectral ranges.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Assessment Test	51.0%	35.0%
	Report 2	60.0%	15.0%
	Report 1	60.0%	10.0%
	Report 4	60.0%	15.0%
	Report 3	60.0%	10.0%
	Report 5	60.0%	15.0%

Recommended reading	Basic literature	- Adamczyk J., Będkowski K.: Digital methods in remote sensing. Wydawnictwo SGGW. Warszawa 2005. - Sanecki J. (red): Remote Sensing: Data Acquisition. WNT, 2006. - Jensen J. R.: Remote Sensing of the Environment. An Earth Resource Perspective. Prentice Hall, 2000. - Lillesand, T., Kiefer, R., & Chipman, J. (2015). Remote Sensing and Image Interpretation. 7th Edition. Wiley - Blaschke, T. (2010). Object-Based Image Analysis: Spatial Concepts for Knowledge-Driven Remote Sensing Applications. Springer. - Gorelick, N., Hancher, M., Dixon, M., Ilyushchenko, S., Thau, D., & Moore, R. (2017). Google Earth Engine: Planetary-scale geospatial analysis for everyone. Remote Sensing of Environment, 202, 1827. - Adamczyk J., Będkowski K.: <i>Digital Methods in Remote Sensing</i>. SGGW Publishing House, Warsaw 2005. - Kurczyński Z.: <i>Aerial and Satellite Imaging of the Earth</i>; Publishing House of Warsaw University of Technology, Warsaw 2006. - Michałowska, K.; Pirowski, T.; Głowienka, E.; Szypuła, B.; Malinverni, E.S. Sustainable Monitoring of Mining Activities: Decision-Making Model Using Spectral Indexes. Remote Sens. 2024, 16, 388. - Sanecki J. (Ed.): <i>Remote Sensing: Data Acquisition</i>. WNT, 2006. - Jensen J. R.: Remote Sensing of the Environment. An Earth Resource Perspective. Prentice Hall, 2000. Lillesand T.M., Kiefer R.W.: Remote Sensing and Image Interpretation. John Wiley & Sons, 2004
	Supplementary literature	Mularz S.: <i>Fundamentals of Remote Sensing. Introduction to GIS</i>. PK Publishing House, 2004. Pirowski T.: <i>Ranking of Methods for Integrating Remote Sensing Images of Different Resolutions Evaluation of Photointerpretation Qualities of LANDSAT TM and IRS-PAN Data Fusion, Archives of Photogrammetry, Cartography, and Remote Sensing</i>; 2010. Google Earth Engine Documentation & Tutorials https://developers.google.com/earth-engine Sentinel Hub & Copernicus Open Access Hub https://scihub.copernicus.eu/ QGIS Tutorials & Training Manual https://docs.qgis.org/latest/en/docs/training_manual/ Orfeo Toolbox (OTB) Documentation https://www.orfeo-toolbox.org/CookBook/
	eResources addresses	
Example issues/ example questions/ tasks being completed	- Calculation of indices based on multispectral and SAR data: vegetation, moisture, backscatter (sigma0, beta0, gamma). Photointerpretation and analysis of satellite and aerial images. - Supervised and unsupervised image classification, object-based classification analysis of results along with accuracy assessment. - Spatio-temporal analyses based on optical and SAR radar images application of "change detection" algorithms.	
Practical activities within the subject	Not applicable	

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