

**AGH**AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY

Module name: Inverse Problem In Geophysics

Academic year: 2015/2016 Code: BGF-2-209-AG-s ECTS credits: 3

Faculty of: Geology, Geophysics and Environmental Protection

Field of study: Geophysics Specialty: Applied Geophysics

Study level: Second-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 2

Course homepage: —

Responsible teacher: dr hab, prof. AGH Cichy Adam (cichy@agh.edu.pl)

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Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student owns the ability of cooperation and self-education	GF2A_K01, GF2A_K02	Presentation
Skills			
M_U001	Student is able to design the method of the solution of inverse problem	GF2A_U04, GF2A_U10	Examination, Test
M_U002	Student is able to apply in practice ready procedures of optimization	GF2A_U01	Examination, Test
Knowledge			
M_W001	Student is able to define the forward and inverse problems for individual methods in geophysics	GF2A_W07, GF2A_W02, GF2A_W01	Examination, Test
M_W002	Student knows the methods of local and global optimization	GF2A_W07, GF2A_W06	Examination, Test
M_W003	Student is able to apply the proper method for solving concrete inverse problem	GF2A_W07, GF2A_W02	Examination, Test
M_W004	Student understands the ununambiguity of the solutions of inverse problems	GF2A_W07, GF2A_W02	Examination, Test

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Social competence												
M_K001	Student owns the ability of cooperation and self-education	-	-	+	-	-	-	-	-	-	-	-
Skills												
M_U001	Student is able to design the method of the solution of inverse problem	-	-	+	-	-	-	-	-	-	-	-
M_U002	Student is able to apply in practice ready procedures of optimization	-	-	+	-	-	-	-	-	-	-	-
Knowledge												
M_W001	Student is able to define the forward and inverse problems for individual methods in geophysics	+	-	+	-	-	-	-	-	-	-	-
M_W002	Student knows the methods of local and global optimization	+	-	+	-	-	-	-	-	-	-	-
M_W003	Student is able to apply the proper method for solving concrete inverse problem	+	-	+	-	-	-	-	-	-	-	-
M_W004	Student understands the unambiguity of the solutions of inverse problems	+	-	+	-	-	-	-	-	-	-	-

Module content**Lectures**

1. Forward and inverse problem In geophysics
2. Analytical and numerical solutions of forward problem for individual methods in geophysics
3. Problem of ununambiguity and ill- conditionality of inverse problem
4. Parameters of the model
5. Classification of methods of solving the invers problem
6. Maximum likelihood and least squares methods
7. L1 and L2 norms
8. Statistical formulation of the inverse problem
9. Estimation of uncertainty of the solution of the inverse problem
10. Bayesian inversion

11. Local and global optimization methods
12. Backus-Gilbert method

Laboratory classes

1. Analytical and numerical solutions of forward problem for individual methods in geophysics
2. Presentation by students the abstracts concerning methods of local and global optimization (in 4-5 persons groups)
3. Applying local and global optimization methods for solving the inverse problem for chosen geophysical methods
4. Bayesian inversion for chosen geophysical methods

Method of calculating the final grade

Final result = 50% exam + 50% laboratory.

Prerequisites and additional requirements

1. Passing courses of mathematics, physics and basic geophysical methods.
2. Fluent programming in C++ language.

Recommended literature and teaching resources

1. Sen M., Stoffa P.L. - Global Optimization Methods in Geophysical Inversion. - Elsevier 1995
2. Boas M.L - Mathematical Methods in the Physical Sciences. - John Wiley & Sons 1983
3. M. S. Zhdanov. Geophysical Inverse Theory and Regularization Problems. Methods in Geochemistry and Geophysics, 36. Elsevier, Amsterdam, 2002.
4. R. L. Parker. Geophysical Inverse Theory. Princeton University Press, New Jersey, 1994.

Scientific publications of module course instructors related to the topic of the module

Additional scientific publications not specified

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	28 h
Examination or Final test	7 h
Realization of independently performed tasks	15 h
Preparation for classes	8 h
Participation in laboratory classes	28 h
Summary student workload	86 h
Module ECTS credits	3 ECTS