

I. Tantárgyleírás**1. Alapadatok***1.1 Tantárgy neve***ADJUSTMENT CALCULATIONS MSC***1.2 Azonosító (tantárgykód)***BMEEOAFMSFGG01-00***1.3 Tantárgy jellege*

Kontaktórás tanegység

1.4 Óraszámok

Típus	Óraszám / (nap)
Előadás (elmélet)	1
Gyakorlat	2

1.5 Tanulmányi teljesítményértékelés (minőségi értékelés) típusa

Vizsga

1.6 Kreditszám

5

1.7 Tárgyfelelős

név	Dr. Tóth Gyula Károly
beosztás	Egyetemi docens
email	toth.gyula@emk.bme.hu

1.8 Tantárgyat gondozó oktatási szervezeti egység

Általános- és Felsőgeodézia Tanszék

1.9 A tantárgy weblapjaepito.bme.hu<https://edu.epito.bme.hu/course/view.php?id=5086>*1.10 Az oktatás nyelve*

magyar

1.11 Tantárgy típusa

Kötelező a Földmérő- és térinformatikai mérnök (MSc) szakon

*1.12 Előkövetelmények**1.13 Tantárgyleírás érvényessége*

2025. szeptember 1.

2. Céltűzések és tanulási eredmények

2.1 Céltűzések

The aim of the course is to provide the student with knowledge of modern procedures for solving common measurement processing tasks in the field of surveying and geoinformatics. Students will be able to choose the appropriate methods for their own tasks and apply the computer tools learned in the subject in a creative way. The course also aims to introduce students to the specifics of each measurement processing procedure through some specific examples.

2.2 Tanulási eredmények

A tantárgy sikeres teljesítése után a hallgató

A. Tudás

1. know the most important metrics (mean, mode, median, most common value, standard deviation, uncertainty, dihesion, interquartile and intersextile half-width) used to describe the characteristic value and uncertainty of measurement data, 2. be familiar with methods of determining the distribution of measurement data, the concepts and significance of statistical efficiency, robustness and resistance of estimates, 3. is familiar with the relationship between the standard error in geodesy and the uncertainty of measurement in metrology, and with the principles and tools for determining uncertainty of measurement according to the GUM (Guide to the Expression of Uncertainty in Measurement), 4. understand the basic concept of Kalman filtering and its potential applications in geodesy, 5. understand the basic concept of RANSAC (random sample consensus) estimation and the main steps of the procedure, 6. is familiar with the main cases of function definition and its applications in the processing of geodetic measurements, 7. is familiar with the main methods of adjustment of deformation analysis of geodetic networks and is able to interpret the results correctly, 8. be familiar with the main procedures for the precision design of geodetic networks.

B. Képesség

1. be able to determine the most characteristic value of data and the most important metrics characterising the uncertainty of the data (mean, mode, median, most frequent value, standard deviation, uncertainty, dihesion, interquartile and intersextile half-width), 2. be able to examine the type of distribution of any data system and correctly interpret the result of a statistical test, 3. be able to determine the uncertainty of measurement in simple cases according to the GUM specifications, using appropriate software for the task, 4. be able to perform independently the adjustment of a simple deformation detection network using appropriate software and to make a statistical analysis of the results, 5. be able to perform independently the Kalman filtering using a simple system model, 6. be able to determine simple models from point cloud data using the RANSAC procedure, 7. be able to carry out the precision design of geodetic measurements and networks in some simple cases, 8. be able to determine functions for linear and non-linear cases based on geodetic measurements.

C. Attitűd

1. seek to assess the advantages and disadvantages of different adjustment and data processing procedures the advantages and disadvantages 2. is open to the use of information technology tools, 3. is receptive to learning and applying modern, efficient data processing techniques, 4. tries to perform his/her tasks to the best of his/her ability and to a high standard.

D. Önállóság és felelősség

1. independently analyse simple tasks and problems in geodetic and geoinformatics data processing, and solve them on the basis of given sources and patterns, 2. is open to well-founded critical comments, 3. uses cognitive skills to make decisions and to move logically from one idea to another. 4. independently makes professional decisions in simple design, construction, maintenance-operations, contracting and technical tasks in the field of civil engineering.

2.3 Oktatási módszertan

Lectures, computational exercises, written and oral communication, use of IT tools and techniques, self-completion of computational exercises and interactive web-based verification of the same. Exploring the topic using notes, online and offline materials - at home; interpreting and relating knowledge to other previous areas in contact lessons - with tutor guidance; exploring the application of knowledge.

2.4 Részletes tárgyprogram

1. Determination of most characteristic value and measurement uncertainty 2. Examination of the distribution of

measured data, application of statistical tests 3. Monte-Carlo procedures, measurement uncertainty based on GUM 4. Kalman filtering in the linear case 5. Kalman filtering in the non-linear case 6. Concepts and role of robustness and resistance 7. Outlier filtering procedures 8. Data processing with RANSAC 9. Determination of functions, processing of point cloud data 10. Adjustment of free networks 11. Baarda S-transformation 12. Adjustment of deformation detection networks 13. Precision design of geodetic measurements 14. Processing of continuously varying quantities

A félév közbeni munkaszüneti napok miatt a program csak tájékoztató jellegű, a pontos időpontokat a tárgy honlapján elérhető "Részletes féléves ütemterv" tartalmazza.

2.5 Tanulástámogató anyagok

a) Downloadable materials: Manuals for applied programs, web help, forums ... etc. Interactive workbooks on the subject's github page (https://github.com/gyulat/adjustment_computations) b) presentations, descriptions, tasks in the educational framework c) other materials: Vanicek P., Krakiwsky E. J.: Geodesy: The Concepts, Part III: Methodology (North-Holland, 1986) Steiner F. (ed.): The most frequent value. Introduction to a modern concept of statistics. Akadémiai Kiadó, Budapest, 1991. ISBN-10: 9630556871 Steiner F. (ed.): Optimum Methods in Statistics. Akadémiai Kiadó, Budapest, 1997. ISBN 10: 963057439X

2.6 Egyéb tudnivalók

We only use free software to teach and learn the subject

2.7 Konzultációs lehetőségek

As indicated on the department's website, or by prior arrangement in person or by e-mail:

toth.gyula@emk.bme.hu, foldvary.lorant@emk.bme.hu

Jelen TAD az alábbi félévre érvényes:

II. Tárgykövetelmények

3. A tanulmányi teljesítmény ellenőrzése és értékelése

3.1 Általános szabályok

The assessment of the learning outcomes in 2.2 is based on one midterm test and two homework assignments, and a written examination.

3.2 Teljesítményértékelési módszerek

Assessment Name (Type)	Code	Assessed Learning Outcomes
written exam (summary performance evaluation)	EX	A.1-8; B.1-8; C.1-4; D.1-4
midterm test (partial performance evaluation)	MT	A.1-4; B.1-3; C.3-4; D.1-3
homework 1. (small homework, partial performance evaluation)	HW1	A.4; B.5; C.2-4; D.2
homework 2. (small homework, partial performance evaluation)	HW2	A.7; B.4; C.2-4; D.2

A szorgalmi időszakban tartott értékelések pontos idejét, a házi feladatok ki- és beadási határidejét a "Részletes féléves ütemterv" tartalmazza, mely elérhető a tárgy honlapján.

3.3 Teljesítményértékelések részaránya a minősítésben

Code	Weight
EX	50%
MT	30%
HW1	10%
HW2	10%
Total	100%

3.4 Az aláírás megszerzésének feltétele, az aláírás érvényessége

In order to obtain a signature, the student must complete all the tasks to be completed during the semester according to point 3.3 at least at the satisfactory level (50%). We do not prescribe a condition for the success of the midterm test.

3.5 Érdemjegy megállapítása

Grade	Score (P)
excellent (5)	$80 \leq P$
good (4)	$70 \leq P < 80\%$
satisfactory (3)	$60 \leq P < 70\%$
pass (2)	$50 \leq P < 60\%$
fail (1)	$P < 50\%$

3.6 Javítás és pótlás

1) Homework - in addition to paying the fee specified in the regulations - can be submitted late until 16:00 on the last day of the delayed submission week or sent electronically until 23:59. 2) The submitted and accepted homework can be corrected free of charge till the deadline and in the manner specified in point 1. 3) The midterm test has a retake possibility.

3.7 A tantárgy elvégzéséhez szükséges tanulmányi munka

Activity	Hours/Semester
participation in contact classes	$14 \times 3 = 42$
preparation for test	20
preparation of homeworks	$5 \times 2 = 10$

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Activity	Hours/Semester
preparation for the exam	48

3.8 A tárgykövetelmények érvényessége

2025. szeptember 1.

Jelen TAD az alábbi félévre érvényes: