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Department of Geodesy and Surveying

Theory and Application of GNSS

BMEEOAFMF-1

Detailed course plan for the Spring semester in 2023

Lecturer: Szabolcs Rózsa, DSc, associate professor, (rozsa.szabolcs@emk.bme.hu)

Practicals: Bence Ambrus, MSc, teaching assistant, (ambrus.bence@emk.bme.hu)

Lecture 1 Feb 27 Sz.R.	Global navigation satellite systems (NAVSTAR GPS, GLONASS, Galileo, Beidou, etc.). The history of global positioning and navigation systems. Reference systems (WGS-84, ITRS, ETRS, etc.)
<i>Practical 1</i> Feb 27 B.A.	<i>Introduction of practicals. Coordinate systems (geographical, cartesian, Earth-centered Earth fixed, horizontal), transformations between coordinate systems. (HW1: transformations between reference systems)</i>
Lecture 2 Mar 6. Sz.R.	GNSS time systems. Broadcasted signals and information. The coordinates of the satellites at the epoch of the observation (orbit calculation and orbit integration).
Lecture 3 Mar 13 Sz.R.	The principle of code and phase observations. Absolute and differential positioning using pseudoranges. Standard data and file formats of GNSS observations, navigation messages and coordinate solutions. (RINEX, SINEX, SP3, RTCM, NMEA).
<i>Practical 2</i> Mar 13 B.A.	<i>Computation of satellite positions from almanach. Prediction of satellite geometry. Observation planning. (HW2: Assignment of the topics of student presentations)</i>
Lecture 4 Mar 20 Sz. R.	Error sources of satellite positioning – 1: orbit and clock error, relativistic effects, effect of satellite geometry. Systematic effects in signal propagation: the effect of ionosphere, ionospheric corrections.
Lecture 5 Mar 27. Sz. R.	Error sources of satellite positioning – 2: Systematic effects of signal propagation: the effect of the neutral atmosphere, tropospheric corrections. Error sources related to signal reception (cycle slips, phase center offset and variation, multipath). GNSS positioning techniques. Properties of static and kinematic observations. Post-processing techniques.
<i>Practical 3</i> Mar 27 B.A.	<i>Computation of satellite positions from broadcast ephemerides. (HW3: orbit computation).</i>
Lecture 6 Apr 3 Sz.R.	<i>Mathematical models of satellite positioning: the absolute positioning and differential positioning using pseudoranges. Precise Point Positioning. Linear combinations of observations and their applications.</i>
Lecture 7 Apr 17 Sz.R.	<i>The principle of differentiation accurate positioning. Phase ambiguities and their resolution. Mathematical solution of positioning.</i>





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Lecture 8 Apr 24 Sz.R.	<i>Transformation of 3D cartesian coordinates to separated horizontal and vertical reference systems. The generations of the national and international GNSS infrastructure. GNSS Augmentation Systems. State Space Representation vs. Observation Space Representation. (MH 7.5-7.6)</i>
<i>Practical 4</i> Apr 24 B.A.	<i>Computation of ionospheric and tropospheric effects. (HW4 Computation of propagation error)</i>
Lecture 9 May 5 (Friday!) Sz. R.	Assessment 1: Assessment from the topics discussed in Lectures 1-8. <i>The activities of the International GNSS Service.</i>
Lecture 10 May 8 Sz. R.	<i>Future trends in GNSS positioning and their applications (e.g. precise orbit determination, atmospheric remote sensing, radiooccultation, etc.)</i>
<i>Practical 5</i> May 8 B.H.	<i>Calculation of absolute positioning using pseudoranges (SPP - single point positioning). (HW5: Calculation of single point positioning)</i>
Lecture 11 May 15 Sz.R.	<i>Applications of GNSS: geodesy, surveying, geodynamics, geophysics, meteorology, Earth observation. Students' presentations (HW2)</i>
Lecture 12 May 22 Sz.R.	<i>Precise GNSS observation processing. Receiver clock synchronization, preprocessing and screening of phase observations, float solution, phase ambiguity resolution techniques, network adjustment.</i>
<i>Practical 6</i> May 22 Sz.R.	<i>Precise GNSS observation processing. Introduction to the Bernese GNSS Software. Data acquisition, preprocessing, orbit determination.</i>

February 19, 2023
Budapest,

Dr. Szabolcs Rózsa
Lecturer

