

Theory and Application of GNSS

BMEEOAFMF-1

Detailed course plan for the Spring semester in 2022

Lecture 1 Feb 14 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 14 B.H.	<i>Introduction of practical. Coordinate systems (geographical, cartesian, Earth-centered Earth fixed, horizontal), transformations between coordinate systems. (HW1: transformations between reference systems)</i>
Lecture 2 Feb 21. 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 Feb 28 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> Feb 28 B.H.	<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 7. 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 21. 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. – part 1.
Lecture 6 03.26. 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>



<p><i>Practical 3</i> 03.26. B.H.</p>	<p><i>Computation of satellite positions from broadcast ephemerides. (HW3: orbit computation).</i></p>
<p>Lecture 7 Mar 28. Sz.R.</p>	<p><i>The principle of differentiation accurate positioning. Phase ambiguities and their resolution. Mathematical solution of positioning.</i></p>
<p><i>Practical 4</i> Mar 28 B.H.</p>	<p><i>Computation of ionospheric and tropospheric effects. (HW4 Computation of propagation error)</i></p>
<p>Lecture 8 Apr 4 Sz.R.</p>	<p><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></p>
<p>Lecture 9 Apr 11 Sz. R.</p>	<p><i>Assessment 1: Assessment from the topics discussed in Lectures 1-8. The activities of the International GNSS Service.</i></p>
<p><i>Practical 5</i> Apr 11. B.H.</p>	<p><i>Calculation of absolute positioning using pseudoranges (SPP - single point positioning). (HW5: Calculation of single point positioning)</i></p>
<p>Lecture 10 Apr 25 Sz. R.</p>	<p><i>Future trends in GNSS positioning and their applications (e.g. precise orbit determination, atmospheric remote sensing, radiooccultation, etc.)</i></p>
<p><i>Practical 6</i> Apr 25 Sz.R.</p>	<p><i>Precise GNSS observation processing. Introduction tot he Bernese GNSS Software. Data acquisition, preprocessing, orbit determination.</i></p>
<p>Lecture 11 May 2 Sz.R.</p>	<p><i>Applications of GNSS: geodesy, surveying, geodynamics, geophysics, meteorology, Earth observation</i></p>
<p>Lecture 12 May 9 Sz.R.</p>	<p><i>Precise GNSS observation processing. Receiver clock synchronization, preprocessing and screening of phase observations, float solution, phase ambiguity resolution technikuséi, network adjustment.</i></p>



Practical 7 May 9 Sz.R.	<i>Establishment and operation of permanent GNSS stations. The NTRIP protocol.</i>
Lecture 13 05.16. Sz.R.	<i>Students' presentations</i>

February 6, 2022
Budapest

Dr. Szabolcs Rózsa
Lecturer

