Technical University of Moldova

United Nations/Croatia Workshop on the Applications

of Global Navigation Satellite Systems,

21 - 25 April 2013

Technical University of Moldova

GNSS Applications in the Educational System of the Technical University of Moldova

Ass. prof. dr. Livia Nistor- Lopatenco
Head of Geodesy, Cadastre and Geotechnics Department

United Nations/Croatia Workshop on the Applications

of Global Navigation Satellite Systems,

21 - 25 April 2013

SUBJECTS

- HISTORY;
- MISSIONS;
- STRUCTURE;
- THE BOLOGNA PROCESS;
- ISO CERTIFICATION;
- DEPARTMENT OF GEODESY, CADASTRE AND GEOTECHNICS;
- INTERNATIONAL PROJECTS;
- GNSS CURRICULUM DEVELOPMENT;
- EQUIPMENT;
- INITIATIVES AND TRENDS.

HISTORY

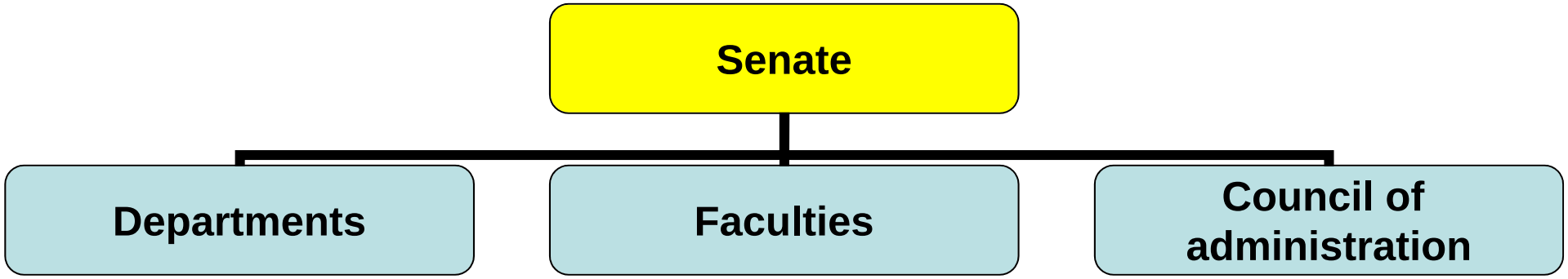
- **Founded in 1964, with the name "The Polytechnic Institute of Chisinau" on the basis of some engineer and economical specialties within the State University of Moldova;**
- **At present TUM has a contingent of more than 16800 students, 80 specialties and specializations within 10 faculties;**
- **At TUM there are also organized postgraduate studies: Master's degree studies and PhD postgraduate studies.**
- **During about 49 years there were prepared over 85000 specialists.**

MISSIONS

The principal missions of the Technical University Moldova are the following:

- **to foster excellent teaching, research and service for education;**
- **to offer qualitative studies by the combining of education, research and innovation;**
- **to form the personality of a creative and insightful student.**

STRUCTURE



Power engineering

Engineering and management in mechanics

Engineering and management in machine building

Computers, Informatics and micro electronics

Radio-electronics and telecommunication

Technology and management in food Industry

Textile Industry

Cadastre Geodesy and Constructions

Urban planning and Architecture

Economy and business

ISO CERTIFICATION

SIMTEX-OC
ORGANISMUL DE CERTIFICARE
Organism acreditat de Asociatia de Acreditare din Romania pentru Certificarea Sistemelor de Management al Calitatii - SR EN ISO/CEI 17021:2007

Acreditat pentru CERTIFICARE
ROMÂNIA
RENAR
SR EN ISO/CEI 17021:2007
CERTIFICAT DE ACREDITARE
Nr.: SM 007/2010

CERTIFICAT

S.C. SIMTEX - ORGANISMUL DE CERTIFICARE S.R.L.

Certifica in urma auditului efectuat (Raport de Audit Nr. RA-3387/13-04-2011) ca:

UNIVERSITATEA TEHNICA A MOLDOVEI
Sediu social: B-dul Stefan cel Mare si Sfant, Nr. 168, Chisinau, REPUBLICA MOLDOVA.

Domeniile si locatiile sunt prezentate in Anexa.

Invatamant superior universitar. Doctorat in inginerie si stiinte economice. Formare continua postuniversitara. Activitati de formare initiala si continua psihopedagogica. Activitati de perfectionare in specialitate. Cercetare - dezvoltare in inginerie. Cercetare - dezvoltare in stiinte economice.

a implementat si mentine in prezent un

Sistem de Management al Calitatii

care indeplineste cerintele standardului:

SR EN ISO 9001:2008

Numarul certificatului: C.3399.1/19-04-2011

Certificare initiala: 19-04-2011
Expirare certificare: 19-04-2014*)

*) Valabilitatea prezentului certificat este conditionata de realizarea auditurilor de supraveghere anuale confirmate prin viza anuala:

VIZAT SIMTEX-OC | LOC VIZA. | LOC VIZA.

Ing. Maria STANCU
Director Executiv

SOCIETATEA COMERCIALA SIMTEX ORGANISMUL DE CERTIFICARE S.R.L. 7 BUCURESTI - ROMANIA

Valabil pana la: 2012 Aprilie | 2013 Aprilie | 2014 Aprilie

Falsificarea acestui certificat se pedepseste conform legilor -

S.C. SIMTEX-OC S.R.L., Bucuresti, str. Ramuri Tei, nr. 10A, sect. 2, Romania, Tel./Fax: (021) 619.03.53; 619.06.51; 619.06.54
Sediu social: Str. Zambilelor 96, sector 2, Bucuresti. E-mail: office@simtex.ro; www.simtex.ro

In April 2011 the University was certificated with SR EN ISO 9001:2008 by SIMTEX-OC

THE BOLOGNA PROCESS

Starting from 2005 University adapted three cycles system of education:

- **Bachelor Degree – 3/4 years (240/180 ECTS)**
- **Master Degree – 2/1.5 years (120/90 ECTS)**
- **PhD – 3 year (240 ECTS).**

University ccurricula tend to become compatible with European Universities curricula in order to support students and teachers mobility;

New Curriculum for the specialty of Geodesy, Topography and Cartography was approved in August 2011.

DEPARTMENT OF GEODESY, CADASTRE AND GEOTECHNICS

- **The Department of *Geodesy, Cadastre and Geotechnics* (GCG) is a component part of the Faculty of Cadastre, Geodesy and Construction of Technical University of Moldova;**

- **In 1995 were started a new specialty - *Geodesy, Topography and Cartography* with assistance of Technical University of Civil Engineering Bucharest, Romania.**

- **Department GCG was founded in 1997 on the basis of the Department of *Engineering geology and foundations.***

DEPARTMENT OF GEODESY, CADASTRE AND GEOTECHNICS

The Department ensures the educational process at the following specialties:

- **Geodesy, Topography and Cartography;**
- **Mine exploitation;**
- **Masters program "Cadastre and real estate development"**

- **The staff of the Department is also responsible for teaching of subjects regarding the following fields - geotechnics, foundations, geology, protection of towns and villages, etc., which are taught in Romanian and Russian.**

- **They also elaborate didactic materials, organize laboratory works and practices according to the curriculum.**

DEPARTMENT OF GEODESY, CADASTRE AND GEOTECHNICS

Four years of study of the following disciplines:

Topography,

Geodesy (elipsoidal, physical, GNSS),

Geoinformatics,

Photogrammetry,

Remote Sensing,

Cadastre,

Surveying Engineering,

Survey,

GIS,

Cartography,

Law,

Management,

etc…

DEPARTMENT OF GEODESY, CADASTRE AND GEOTECHNICS

Main objectives - to prepare surveying engineers for:

- **Development and maintaining the Geodesic Networks;**
- **Mapping of different scales (creating of maps), of topographic plans, cadastral maps, etc;**
- **Surveying and buildings monitoring;**
- **Exploitation and operation of geoinformational systems.**

INTERNATIONAL PROJECTS

- **2001-2003 Cooperation in the frame of Project "Modernization of educational System in Cadastre" Sweden International Development Assistance (SIDA;**

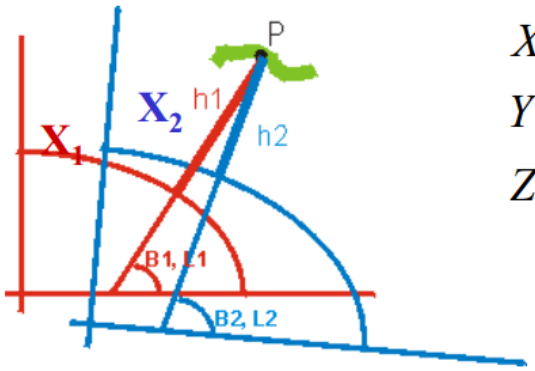
- **2004–2006 Project "Education in Geographical Information Technology" supported by EU, TEMPUS in cooperation with:**
  - **KTH Department of Geodesy and Geoinformatics, Sweden**
  - **Special School for Public works, Paris, Surveying Department**

- **2010** **Project "Development of a High Capacity Real-Time GNSS Positioning Service for Moldova (MOLDPOS)" – University of Applied Sciences, Karlsruhe, Germany;**

- **2010-2013** **511322-TEMPUS-1-2010-SE-JPCR «Geographic Information technology for sustainable Development in Eastern neighbouring Countries (GIDEC)»;**

- **2012-2013** **EEGS2 Project «EGNOS Extension to Eastern Europe. Applications». In the Frame of FP7 Program.**

Reference Datum Transformation



$$X = (N+h)\cdot\cos B\cdot\cos L$$
$$Y = (N+h)\cdot\sin B\cdot\sin L$$
$$Z = (N-Ne^2+h)\cdot\sin B$$

3D Transformation

$$\begin{bmatrix} X_2(B_2,L_2,h_2) \\ Y_2(B_2,L_2,h_2) \\ Z_2(B_2,L_2,h_2) \end{bmatrix} = s\cdot R\cdot \begin{bmatrix} X_1(B_1,L_1,h_1) \\ Y_1(B_1,L_1,h_1) \\ Z_1(B_1,\ldots) \end{bmatrix} + v$$

Reference datum transformation (Karlsruhe Solution)

Observation equations for measured point positions $(B,L,h)_i$ in two reference systems (1,2)

$$\begin{bmatrix} B \\ L \\ h \end{bmatrix}_2 - \begin{bmatrix} \Delta B_{(a,b)_1,(a,b)_2} \\ \Delta L_{(a,b)_1,(a,b)_2} \\ \Delta h_{(a,b)_1,(a,b)_2} \end{bmatrix} - \begin{bmatrix} B \\ L \\ h \end{bmatrix}_1)_i + \begin{bmatrix} v_B \\ v_L \\ v_h \end{bmatrix}_i = R_{1i}\cdot \begin{bmatrix} \varepsilon_x \\ \varepsilon_y \\ \varepsilon_z \\ \Delta s \\ t_x \\ t_y \\ t_z \end{bmatrix},$$

1D-,2D-,3D-, WTRANS were ellipsoid transition corrections are:

$$\begin{bmatrix} \Delta B_{(a,b)_1,(a,b)_2} \\ \Delta L_{(a,b)_1,(a,b)_2} \\ \Delta h_{(a,b)_1,(a,b)_2} \end{bmatrix} = \begin{bmatrix} B(a_2,b_2\,|\,(X,Y,Z)_1) - B(a_1,b_1\,|\,(X,Y,Z)_1) \\ 0 \\ h(a_2,b_2\,|\,(X,Y,Z)_1) - h(a_1,b_1\,|\,(X,Y,Z)_1 \end{bmatrix},$$

and R_{1i} is a Molodensky matrix for each control ground point with position B_i,L_i,h_i:

$-\sin(L)\cdot\frac{a\cdot W+h}{M+h}$	$\cos(L)\cdot\frac{a\cdot W+h}{M+h}$	0	$\frac{-\sin(B)\cdot\cos(B)\cdot N\cdot e^2}{M+h}$	$\frac{-\sin(B)\cdot\cos(L)}{M+h}$	$\frac{-\sin(B)\cdot\sin(L)}{M+h}$	$\frac{\cos(B)}{M+h}$
$\frac{\sin(B)\cdot\cos(L)\cdot(N\cdot(1-e^2)+h)}{(N+h)\cdot\cos(B)}$	$\frac{\sin(B)\cdot\sin(L)\cdot(N\cdot(1-e^2)+h)}{(N+h)\cdot\cos(B)}$	−1	0	$\frac{-\sin(L)}{(N+h)\cdot\cos(B)}$	$\frac{\cos(L)}{(N+h)\cdot\cos(B)}$	0
$-N\cdot e^2\cdot\sin(B)\cdot\cos(B)\cdot\sin(L)$	$N\cdot e^2\cdot\sin(B)\cdot\cos(B)\cdot\cos(L)$	0	$h+a\cdot W$	$\cos(B)\cdot\cos(L)$	$\cos(B)\cdot\sin(L)$	$\sin(B)$

Project “Development of a High Capacity Real-Time GNSS Positioning Service for Moldova (MOLDPOS)”

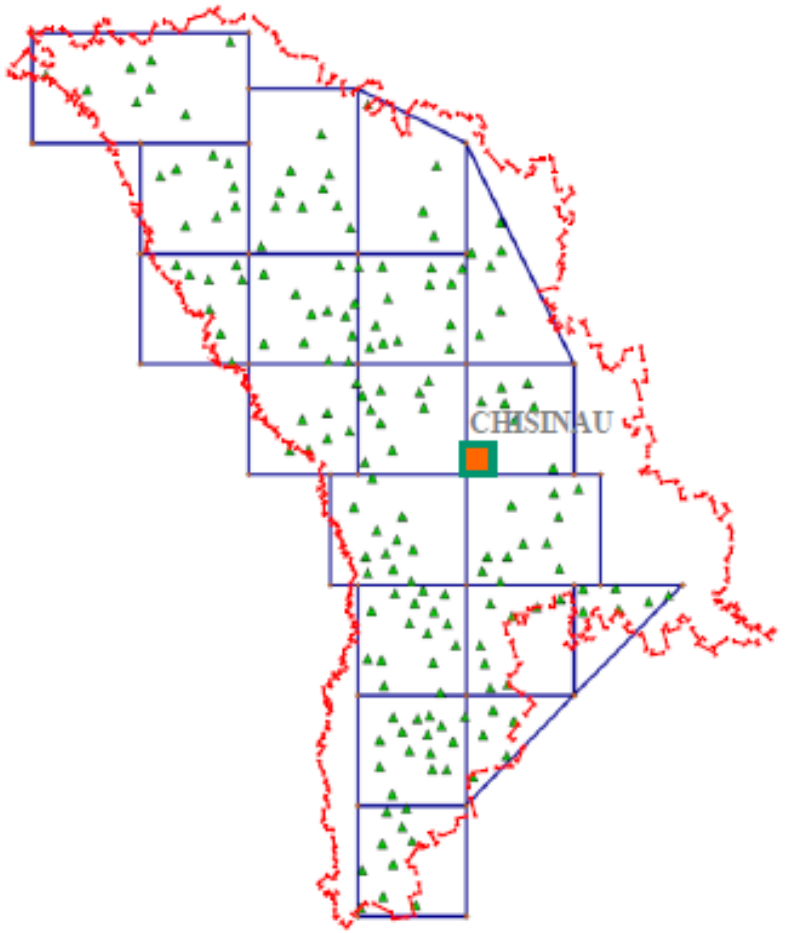
(Karlsruhe Solution)

COPAG =
Continuously
Patched
Georeferencing

Continuity along the Mesh Borders!

Combined Old Classical Triangulation and ETRS89 Control Points from GNSS measurements

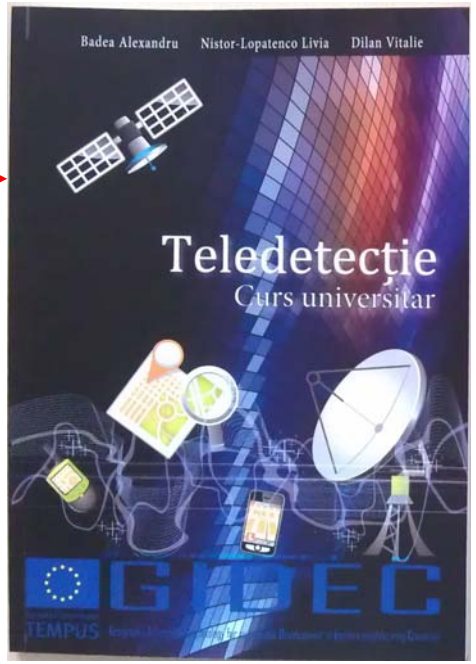
Meshes = “Patching“ for ETRS89 and Classical Datum-systems of Moldova

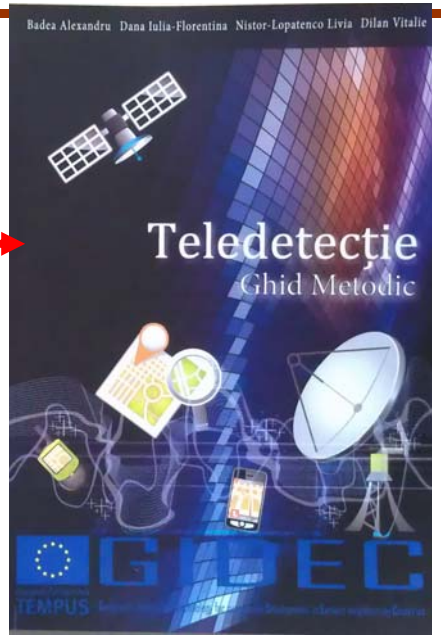


(1 – 4) cm accuracy transformation parameter Databases for Classical and ETRS89 Datum-systems

TEMPUS Project (GIDEC)

- **Develop new GIT teaching materials:**
  - **Remote Sensing (guide for laborators applications);**
  - **Remote sensing (university course).**





- **In process:**
  - **Geodetic satellites (university course)**
  - **Advanced GIS (university course).**

TEMPUS Project (GIDEC)

- **Student exchange between EU and partner countries:**

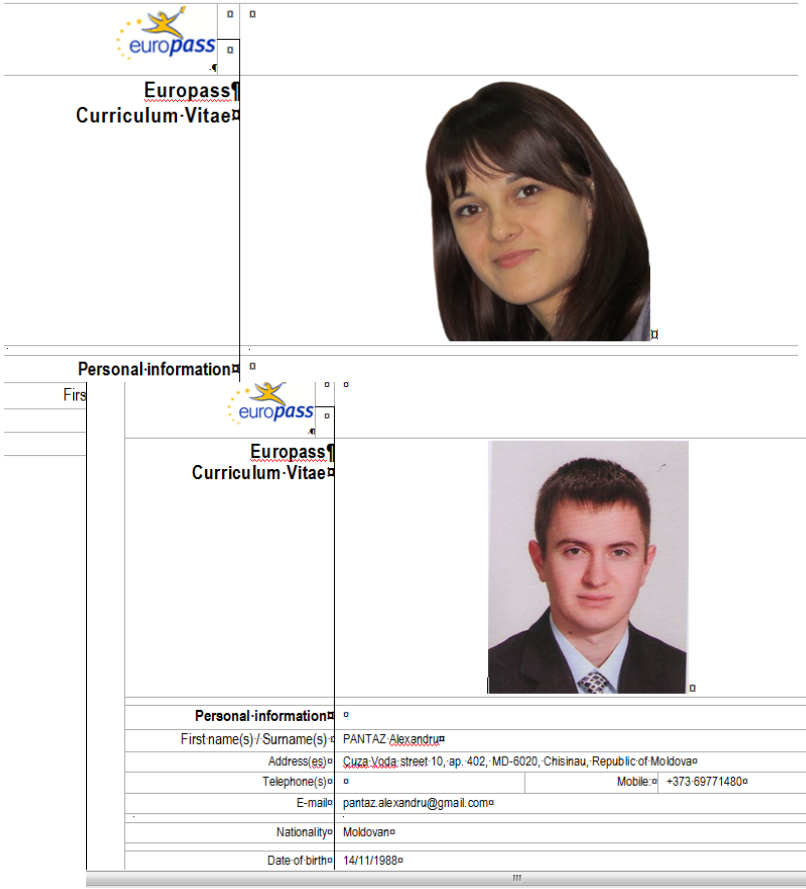
Procedure successfully completed:

– **Students from European countries in Moldova**

1. **Veronica Wendlik from HFT, Stuttgart at TUM and UST, September 01 – November 30, 2012;**
2. **Lucía Martínez from UPV, Valencia atTUM and UST, September 24 – December 24, 2012.**

- Students from Moldova in European countries at UPV, Spain:

1. **Panainti Mariana from TUM, at UPV, October 14 –December 22, 2012**
2. **Pantaz Alexandru from TUM, at UPV, October 14 –December 22, 2012.**


europass

Europass Curriculum Vitae

Personal information

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Europass Curriculum Vitae

Personal information	
First name(s) / Surname(s)	PANTAZ Alexandru
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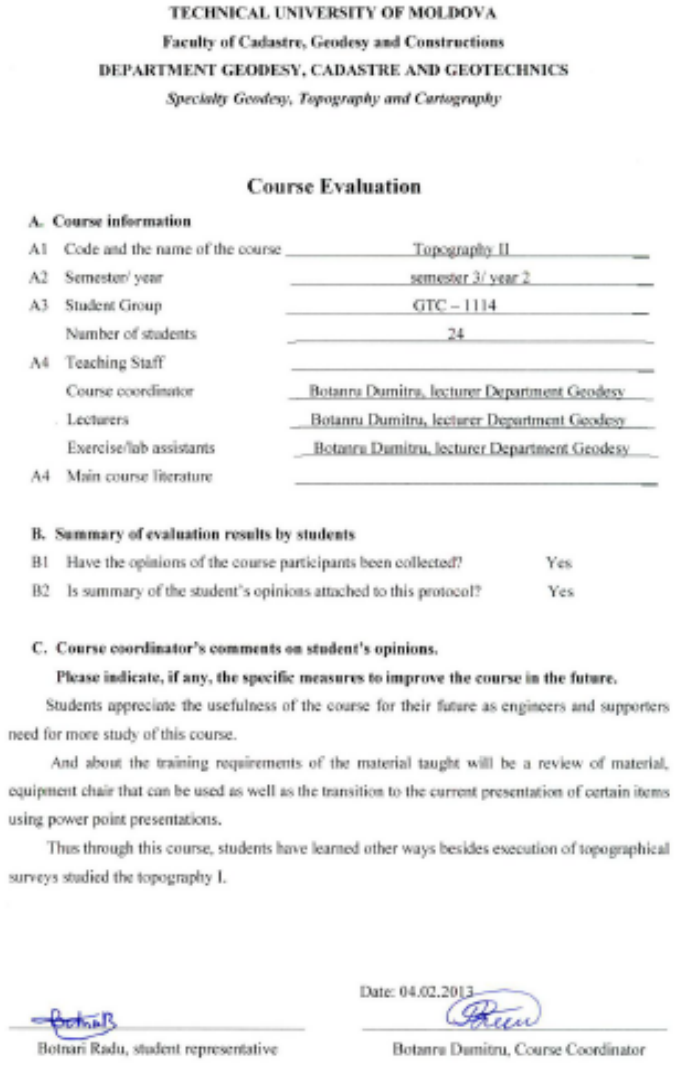
Telephone(s)	Mobile: +373 69771480
E-mail	pantaz.alexandru@gmail.com
Nationality	Moldovan
Date of birth	14/11/1988

TEMPUS Project (GIDEC)

- **Implementation of quality assurance mechanism in GIT education:**

  Made the questionnaires for all specialized disciplines of the specialty Geodesy, Topography and Cartography, years I-IV. First year in the first semester not have specialized disciplines.

  In total, this assessment was made for 12 disciplines.



TECHNICAL UNIVERSITY OF MOLDOVA
Faculty of Cadastre, Geodesy and Constructions
DEPARTMENT GEODESY, CADASTRE AND GEOTECHNICS
Specialty Geodesy, Topography and Cartography

Course Evaluation

A. Course information

A1	Code and the name of the course	Topography II
A2	Semester/ year	semester 3/ year 2
A3	Student Group	GTC – 1114
	Number of students	24
A4	Teaching Staff	
	Course coordinator	Botanru Dumitru, lecturer Department Geodesy
	Lecturers	Botanru Dumitru, lecturer Department Geodesy
	Exercise/lab assistants	Botanru Dumitru, lecturer Department Geodesy
A4	Main course literature	

B. Summary of evaluation results by students

B1	Have the opinions of the course participants been collected?	Yes
B2	Is summary of the student's opinions attached to this protocol?	Yes

C. Course coordinator's comments on student's opinions.

Please indicate, if any, the specific measures to improve the course in the future.

Students appreciate the usefulness of the course for their future as engineers and supporters need for more study of this course.

And about the training requirements of the material taught will be a review of material, equipment chair that can be used as well as the transition to the current presentation of certain items using power point presentations.

Thus through this course, students have learned other ways besides execution of topographical surveys studied the topography I.

Date: 04.02.2013

Botnari Radu, student representative

Botanru Dumitru, Course Coordinator

TEMPUS Project (GIDEC)

- **Introduction of project-oriented Problem-Based Learning (PBL). In process:**

  PBL Project Course: Organizing activities:

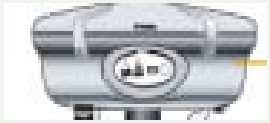
  – **Students will be split in groups of 4-5 members**
  – **Each group will have a real project with specific tasks**
  – **At the end of project, team will present their vision and solutions for specific issue.**
  – **At III year in present are exists 24 students, divided in 5 groups on fields:**
    - **Local Government**
    - **Environmental Management**
    - **Public Safety**
    - **Real Estate**
    - **Health and Human Services.**

EEGS2 Project «EGNOS Extension to Eastern Europe. Applications»

Tablet PC

L1GPS antenna

L1/L2 GNSS Receiver
Trimble 5800



BlueTooth

Trimble ACU Controller

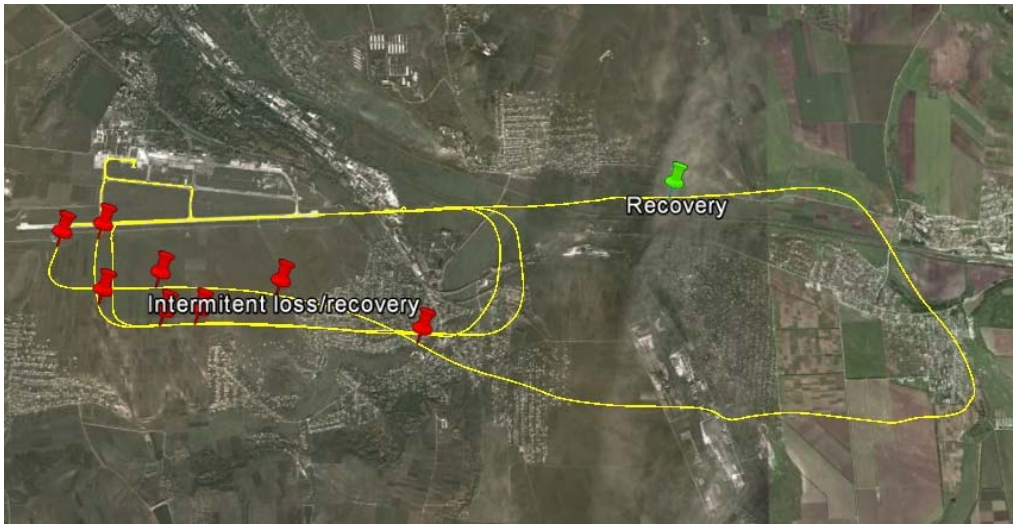
Wi-Fi

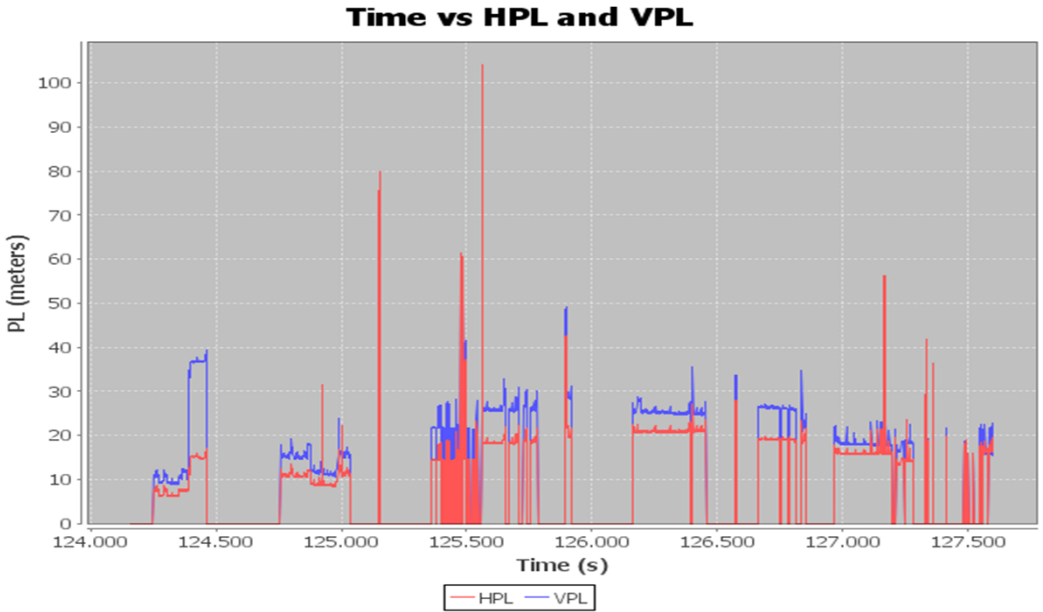
From Ground Radio antenna

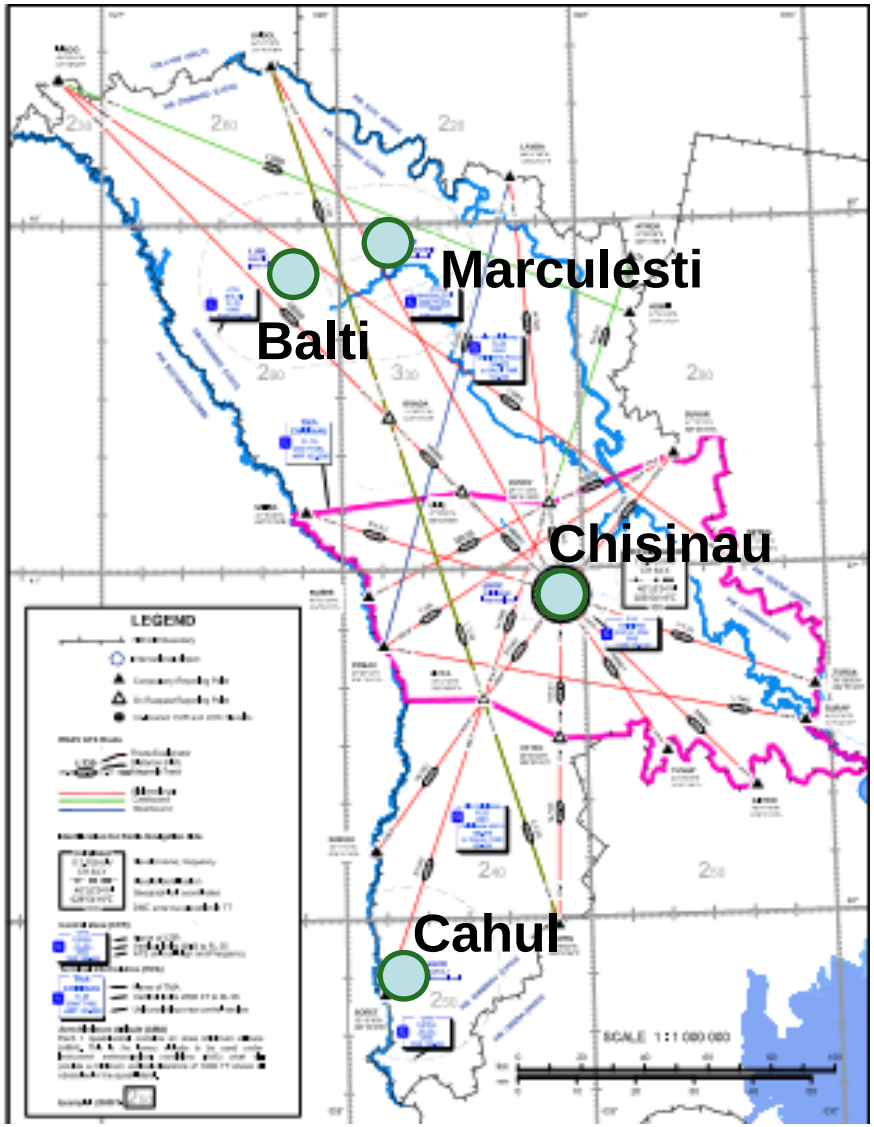
-Power station
-Receiver radio modem
-GPS L1 receiver
-USB-NET adapter
-Wi-Fi access point

EEGS2 Project «EGNOS Extension to Eastern Europe. Applications»

Flight trials in Moldova

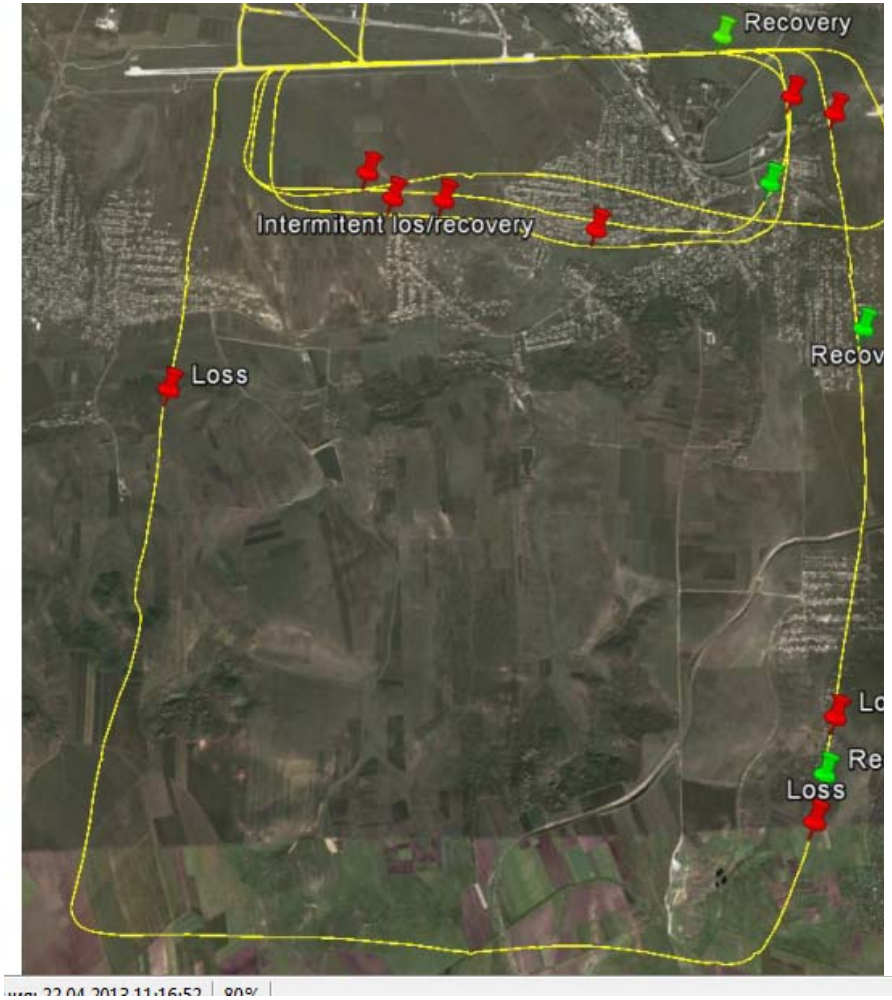


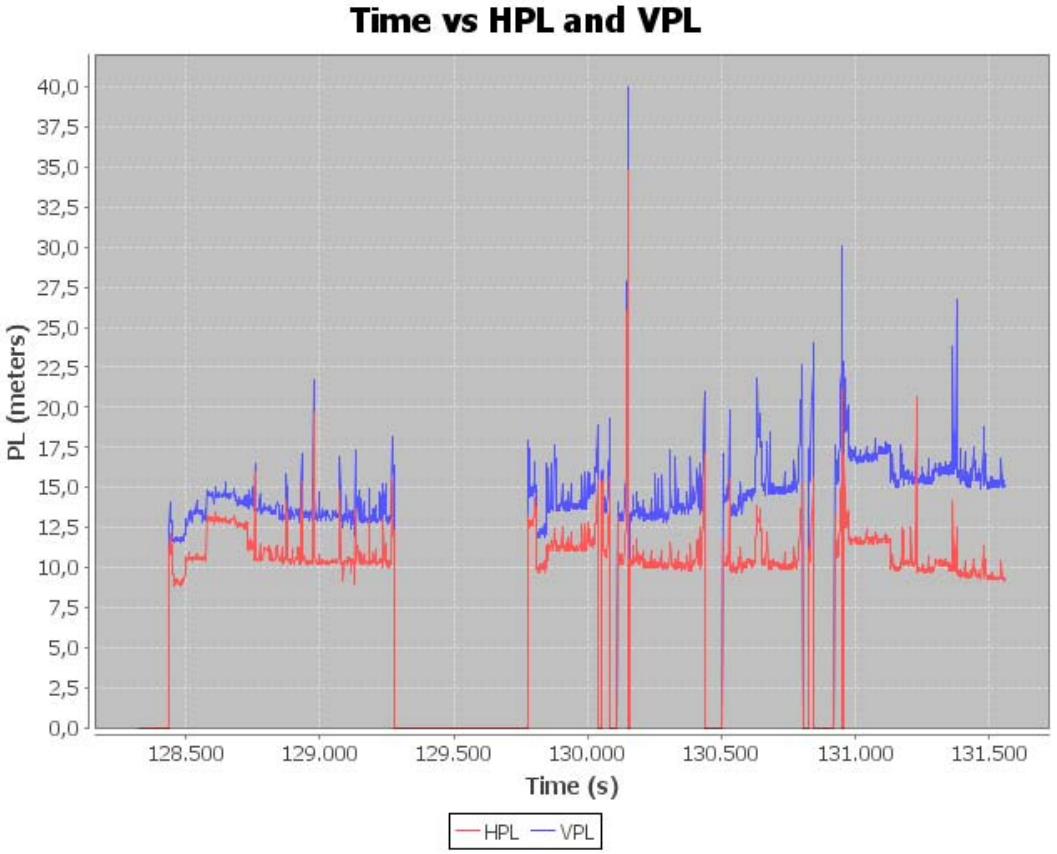




EEGS2 Project «EGNOS Extension to Eastern Europe. Applications»

Flight trials in Moldova





GNSS CURRICULUM DEVELOPMENT

Course code	**S.07.O.042**
Course name	**Satellite Geodesy**
Semester	**7**
ECTS credits	**5 c**
Class hours	**Lectures: 30 hrs. Practical works 30 hrs. Laboratory works: 15 hrs.**
Learning outcomes (aims/objectives)	**Definitions of geodetic reference systems and practical skills of coordinate transformations. Acquire basic knowledge on GNSS technique, GNSS equipment and software. Field GNSS measurements and processing. GNSS applications.**

GNSS CURRICULUM DEVELOPMENT

LECTURES (30 hours)

1. Introduction in satellite geodesy: conventional navigation, background, concepts and evolutions of Global Navigation Satellite Systems (GPS, GLONASS, Galileo, BeiDou/COMPASS) and Regional Positioning Systems (IRNSS, QZSS). Comparison of GNSS with other navigation systems. - 2 (h)
2. Reference systems: terrestrial, celestial and orbit coordinate reference system. Height systems. Geoid. Time systems, synchronization and data conversion - 4 (h)
3. Satellite orbits: Orbital parameters, Orbital motion representation, Determination of satellite position, visibility and ground tracks, Orbits dissemination - 4 (h)
4. GNSS Receivers architecture: technology, Antennas and propagation channels, signal - processing system hardware and software techniques - 4 (h)
5. GNSS positioning techniques: GNSS measurements (pseudoranges and carrier phase), absolute single position determination technique, differential position determination methods. Errors in GNSS measurements 4 (h)
6. GNSS measurements and processing: Planning data collection with GNSS. Conducting GPS Field Survey. Post-Processing of differential GNSS measurements. GNSS Network adjustment - 4 (h)
7. Satellite Based Augmentation Systems: Wide Area Augmentation System (WAAS), European Geostationary Navigation Overlay Service (EGNOS), System of Differential Correction and Monitoring (SDCM) - 4 (h)
8. GNSS Networks: Global, regional and local GNSS Permanent Networks and geodetic infrastructure for real positioning services (IGS, EUREF-IP, EUPOS, MOLDPOS) – 4 (h)

GNSS Curriculum development

PRACTICAL WORKS (30 hours)

1. Coordinate transformations between International Terrestrial Reference System (ITRS) and European Terrestrial Reference System (ETRS) - Practical works 8 (h)
2. Time and data conversion - Practical works 6 (h)
3. Satellite coordinates calculation - Practical works 8 (h)
4. GNSS applications: GIS/mapping, surveying, natural hazards management, earth sciences, natural resources, precise agriculture, infrastructure – Seminar 8 (h)

LABORATORY WORKS (15 hours)

1. GNSS receivers configuration. LCD display and key function. Principles of display. Data input and output - 3 (h)
2. GNSS measurements (Static, Fast static and RTK) using Trimble R8 GNSS receiver - 4 (h)
3. GNSS measurement processing using specialised software- 4 (h)
4. GNSS network adjustment using specialised software- 4 (h)

EQUIPMENT

- GNSS permanent station
- Pentium PCs (desktop/laptop, server/WS)
- Network accessories for internet connection + Email server
- Plotter, printers, scanners, LCD projectors
- ArcGIS licenses
- Trimble geodetic GPS receivers
- Leica TTC
- Leica Digital level NA 3003
- Digital photogrammetric WS from Geosystem, Ukraine
- WebCamera

INITIATIVES AND TRENDS

- organization of training courses for specialists in production in collaboration with Moldavian Geodetic Union;
- Development of GNSS laboratory;
- development of national and international educational and research projects;
- development of national relations and international collaboration etc.

THANK YOU FOR ATTENTION!

For more information please visit:
www.utm.md
Email: nistor.livia@gmail.com

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of Global Navigation Satellite Systems,

21 - 25 April 2013