

GNSS AND GIS APPLICATIONS IN THE EDUCATIONAL SYSTEM OF THE TECHNICAL UNIVERSITY OF MOLDOVA

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***Abstract:** In 2011 TUM in cooperation with Agency for Land Relations and Cadastre of Republic of Moldova and Institute of Applied Research (IAF), University of Applied Sciences (HSKA) Karlsruhe, Germany implemented a project focused on development of a High Capacity Real-Time GNSS Positioning Service for Moldova (MOLDPOS). In the frame of this project geodetic databases were created in order to support services of national positioning system MOLDPOS based on the ETRS89 that will ensure unique and actual geospatial data for whole country territory according to international standards and INSPIRE specifications. For MOLDPOS implementation TUM intended to create a GNSS training centre at TUM for continuing education of surveyors, experts in navigation, precision agriculture, etc. Starting from January 2012 the department is involved in the Project "EGNOS EXTENSION TO EASTERN EUROPE: APPLICATIONS (EEGS2)", SEVENTH FRAMEWORK PROGRAMME (FP7), European GNSS Agency (GSA), Grant Agreement Nr: 287179. The result of the project will be implemented in Master Program.*

***Keywords:** MOLDPOS, EGNOS, TEMPUS, GIDEC, education, geodetic equipment, results*

1. About the university

Technical University of Moldova (TUM) is the only higher technical educational institution in our country, accredited by the state. Since its foundation in 1964 it has trained more than 66600 engineers and economists.

TUM comprises 10 faculties: "Energetics", "Engineering and Management in Machine Building", "Mechanic Engineering and Transports", "Computers, Informatics and Microelectronics", "Engineering and Management in Electronics and Telecommunications", "Technology and Management in Food Industry", "Textile Industry", "Cadastre, Geodesy and Constructions", "Urbanism and Architecture", "Economic Engineering and Business". Within the Faculty of Engineering and Management in Machine Building there is the Technical College. There are also 9 technical colleges affiliated to TUM.

The training of those about 12420 students at the full time and part time sections is supervised by a teaching staff of 800 persons, two thirds of them having scientific degrees of Academician, Professor, Associate Professor, Doctor of Science, and Doctor of Philosophy.

TUM offers courses at about 80 specialties and specializations, preparing engineers for almost all branches of the national economy.

2. 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.

3. The Bologna Process

Starting from 2005 University adapted three cycles system of education:

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

University curricula 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.

4. 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

The Department ensures the educational process at the following specialties:

- Geodesy, Topography and Cartography;
- Mine exploitation;
- Masters program “Cadastre and real estate development“ in good cooperation with the Department of Valuation and Management of Real Estate;
- Masters program “Engineering of construction materials and minerals“.

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.

Four years of study of the following disciplines: Topography, Geodesy (ellipsoidal, three-dimensional, physical, GNSS), Geoinformatics, Photogrammetry, Remote Sensing, Cadastre, Surveying Engineering, Survey, GIS, Cartography, Law, Management, etc.

4.1. International projects

In period 2001-2003 cooperation in the frame of Project “Modernization of educational System in Cadastre” Sweden International Development Assistance (SIDA 2 teachers of the department have received internships in Sweden at KTH.

In 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

In 2010 Project “Development of a High Capacity Real-Time GNSS Positioning Service for Moldova (MOLDPOS)” – University of Applied Sciences, Karlsruhe, Germany (fig. 1). In period 2010-2013 was successfully conducted project 511322-TEMPUS-1-2010-SE-JPCR «Geographic Information technology for sustainable Development in Eastern neighbouring Countries (GIDEC)».

The most important activities were related to development of new GIT teaching materials: Remote Sensing (guide for laboratory applications); Remote sensing (university course); Satellite geodesy (university course); Geometric Fundamentals of photogrammetry; Advanced GIS (university course).

During the project student exchange procedure between EU and partner countries was successfully completed: students from European countries in Moldova; students from Moldova in European countries at UPV, Spain.

TUM introduced a project-oriented Problem-Based Learning (PBL): were student Class was divided in 4 groups of 5 students.

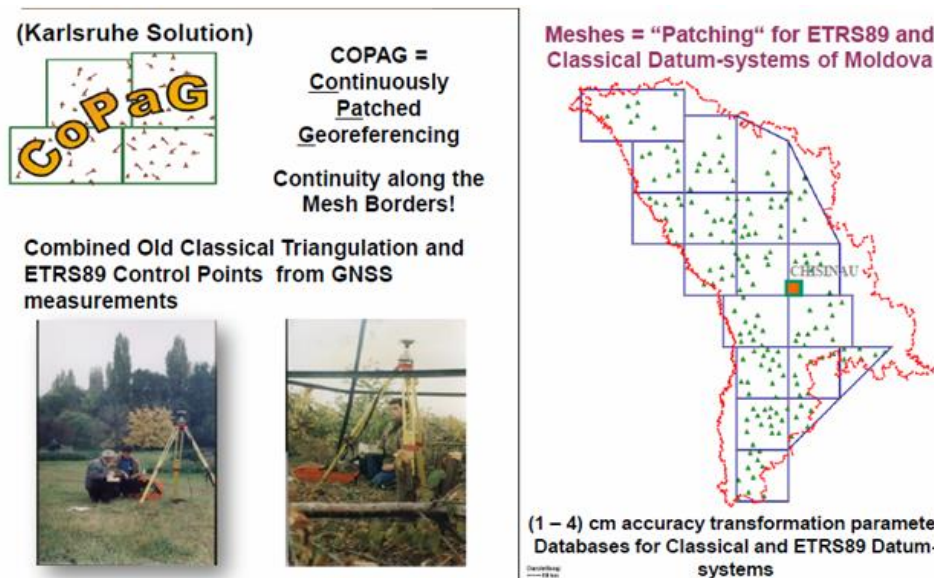


Fig. 1 Final results of MOLDPOS project

Group 1. Topic: Using ArcGIS platform for consolidation of fire rescue service on a voluntary basis in rural areas of the Republic of Moldova.

Group 2. Topic: The importance of demographic data and GIS models in decision making process at local and national level.

Group 3. Topic: Geocoding service development and the importance of this service for emergency services Nisporeni District

Group 4. Topic: Development of Public Transportation Application to inform citizen about Services of Department of Transportation of Chisinau.

Students' opinion is that using such methodology of work is much better and useful. This methodology gave us more opportunities to understand how GIS

- helps the community,
- how to work with different industries and data, and in the end offer them a solution
- how use GIS instrument (desktop, online, mobile)

For future we think to develop this methodology and attracted much more organizations and to help them, using GIS, find solutions.

During the project quality assurance mechanism in GIT education was implemented.

By the end of the project the assessment was done for 12 disciplines. The questionnaires were filled out for specialized disciplines Geodesy, Topography and Cartography (years I-IV). First year in the first semester they not have specialized disciplines.

Remote Sensing, GIS and GNSS curriculum was developed similar to European countries: Germany, Sweden and Spain.

For example GNSS: lectures (30 hours), practical works (30 hours) and laboratory works (30 hours):

Lectures:

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

Practical works:

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

Laboratory works:

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

E-learning implementation for 6 disciplines based on Moodle Platform is in progress (fig 2).

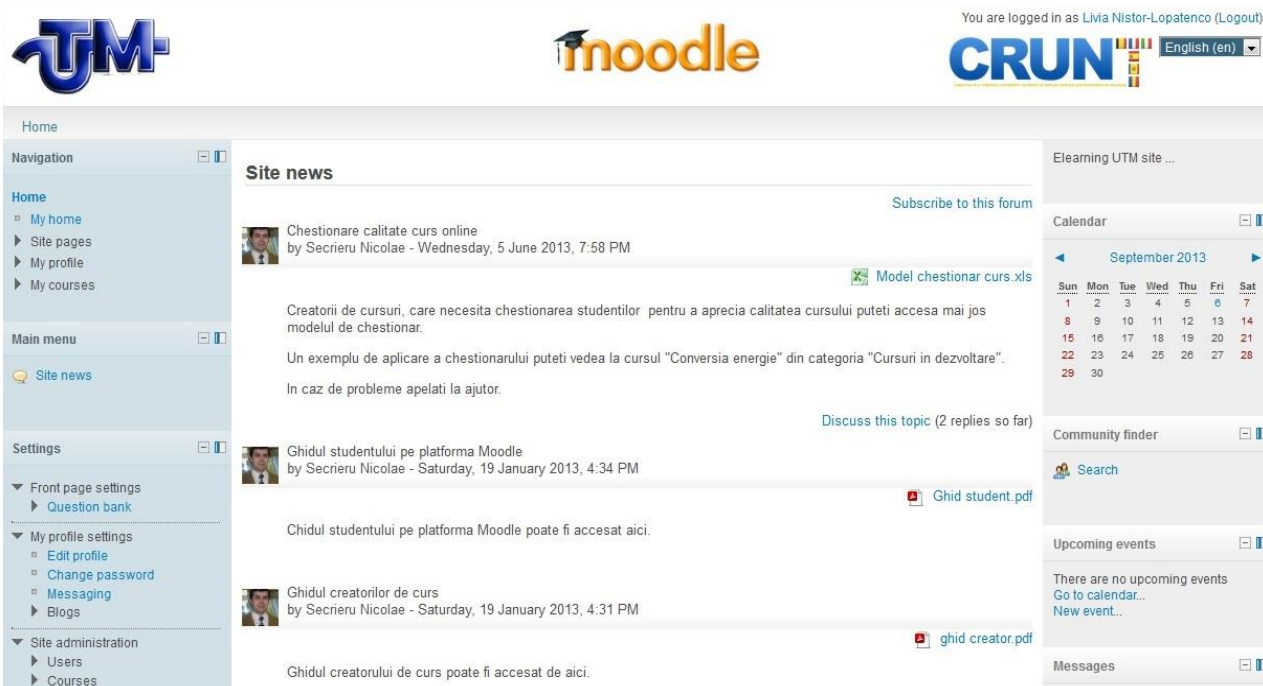


Fig. 2 TUM Moodle Platform

Starting from January 2012, the Technical University of Moldova has been involved, as a partner, in a collaborative FP7 Project EEGS2 «EGNOS Extension to Eastern Europe: Applications» aimed to demonstrate the benefits of EGNOS, EDAS and Galileo through applications in the Eastern countries of Europe (<http://www.eegs2-project.eu/>).

The main objective of the project is to demonstrate possibility of EGNOS extension to Eastern Europe in the field of aeronautics by using the magicSBAS message generated by GMV Aerospace and Defence (fig. 3).

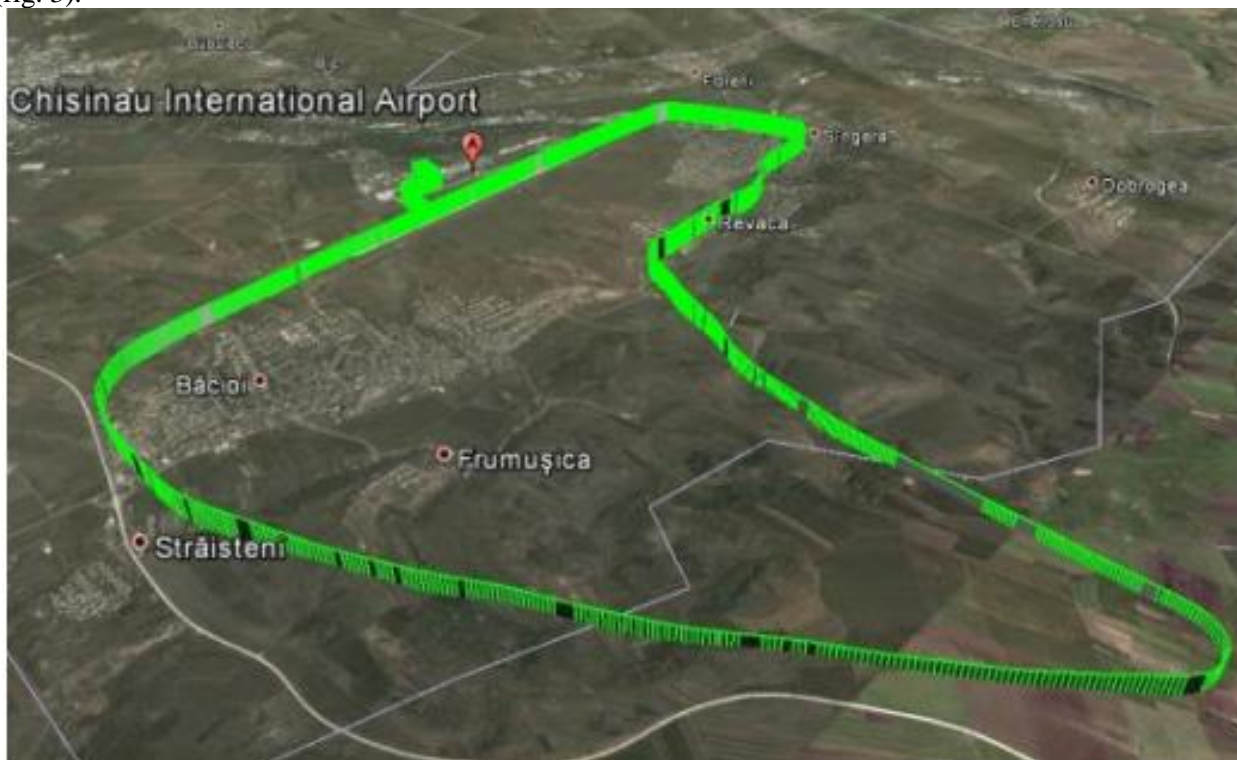


Fig. 3. Trail flights in International Airport Chisinau

5. Main objectives

Main objectives of our Department are to prepare surveying engineers for: development and maintaining the Geodesic Networks; small scale mapping, large scale mapping, creation of cadastral maps, etc; surveying and buildings monitoring; geographic information collection and operation.

6. Equipments

For successful achievement of objectives our department is equipped with following instruments, devices and software:

- 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.

7. Initiatives and trends

In the future we are planning to develop a GNSS laboratory for implementation of new Curriculum and to organize training courses for specialists in production in collaboration with Moldavian Surveyors Union.

One of the main missions of our department is development of educational and research projects in collaboration with national and international organizations.

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