
OPEN SOURCE SOFTWARE FOR GEOSCIENCES AT UNIVERSITY OF WEST BOHEMIA

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Abstrakt. Geografické informační systémy (GIS) postavené na bázi free a open source software začaly být zejména v poslední době respektovaným způsobem řešení. Tento druh software také představuje vynikající příležitost pro univerzity, jak realizovat projekty, které nejsou přímým zájmem softwarových firem, ale které mohou být užitečné a mají potenciál být využívány širokou obcí uživatelů.

Cílem toho příspěvku je popsat vývoj otevřeného software, do kterého je zapojeno oddělení Geomatiky na Západočeské Univerzitě v Plzni. Popsána bude obecná vývojářská infrastruktura a také stručná charakteristika dílčích projektů zaměřených na open source software na kterých v současnosti spolupracujeme. Jde o následující projekty: Transformace referenčních souřadnicových systémů pro GeoTools and uDig (CRS), Delaunayho triangulace pro GeoTools (DiMoT), Geomorfologický informační systém (GmIS) a Otevřený katastr (OC).

Klíčová slova: geografický informační systém, svobodný a otevřený software, vývoj.

Abstract. Open source software for geosciences at the University of West Bohemia. Free and open source software for GIS has been becoming one of respected solutions in the recent years. This kind of software also represents an excellent opportunity for universities to realize projects which are not in area of interest of software companies, but which are helpful and usually often used by end users all around the world.

The aim of this paper is to describe such a development that takes place at the University of West Bohemia in Pilsen (Department of Geomatics). Common development tools and procedures will be described as well as examples of projects that we are working on: Coordinate Reference System Transformations for GeoTools and uDig (CRS), Delaunay Triangulation for GeoTools (DiMoT), Geomorphologic Information System (GmIS) and Open Cadastre (OC).

Keywords: geographic information system, free and open source software, development.

1 Introduction

The Open Source GIS software products include tools to fill every level of complex GIS stack. Existing products are now entering a phase of rapid refinement and enhancement, using the core software structures that are already in place. Open Source software can provide a feature-complete alternative to proprietary software in most system designs.

There are also a lot of projects (dissertation, diploma and bachelor thesis) focused on software development that take place on section for Geomatics (see more in Geomatics 2007a) at the University of West Bohemia (see UWB 2007 for more). We decided to publish these projects under Open Source licenses (most often based on GPL or LGPL – see GNU 2007) and also to use Open Source practices during the working on these projects. Our motivation to do this is:

- To get interested students involved in Open Source as much as possible and to encourage them in such activities.
- To learn also related practices in software development projects (tools of software engineering).
- To take software development seriously and to build infrastructure for maintaining and sharing students work across longer period and to wider audience.

2 Technical infrastructure for software development

Free software projects rely on technologies that support the selective capture and integration of information. The more skilled you are at using these technologies, and at persuading others to use them, the more successful your project will be. This only becomes more true as the project grows, Fogel 2005. Main tools that help us to establish development infrastructure are solved in these ways:

- **Web site** – we use MediaWiki (see MediaWiki 2007 for more) engine. Currently hosted at <http://git.zcu.cz>. Wiki based sites enables collaborative approach for creation and maintenance.
- **Version Control** – each project has its own version control mechanism. Most of them are using Subversion (see SVN 2007 for more) engine hosted at our department server.
- **Bug tracking** – to track the working progress we are going to use some of common bug tracking tool. The final decision of concrete tool hasn't been made yet.
- **Mailing list** – communication forum of the project and also the "medium of record."
- **Real-time chat** – quick and lightweight discussion. Usually not archived completely.

However we have to admire that our projects are not yet so huge so it is not necessary to use all of these tools. The meaning of using it consists in learning how to exploit them and also to take even small development project seriously from the scratch. Nowadays we typically maintain documentation of a project at wiki based web pages and develop source codes using support of Subversion software. Our teams are still small, thus it is not necessary to use official mailing lists or real time chats, but the environment is set up for using it in the future.

3 Description of concrete projects

We can generally divide software projects into two types: standalone applications and extensions to already existing open source or proprietary software products. Even if some of subsequently presented projects can be understood as a standalone application, the final goal

is usually to incorporate them into large projects (see details below). Next chapters introduce four projects which have been initially involved into the open source software development at the University of West Bohemia at the server <http://git.zcu.cz>. Projects are introduced in alphabetical order.

3.1 Coordinate reference system transformations for GeoTools and uDig

The main goal of this project is to extend current state of GeoTools library (see GeoTools 2007 for more) – especially its referencing module, by set of functions to enable precise transformations with respect to specific needs of reference systems used in the Czech Republic.

This project can be divided into two parts. One part of the work is extending the GeoTools library and the other presents the user interface for such functionality that is being realized through uDig plug-in (see uDig 2007 for more).

In more details - this project adds other algorithms for coordinate system transformations that help to calculate transformation coefficients and apply various kind of coordinate system transformations (linear as well as warping methods) and also to make a simple GUI for uDig to apply these new functions (the example of can be seen at the figure 1). All these functions are made with respect to the specific needs of coordinate system transformation used in the Czech Republic (especially the transformation from local system S-JTSK and WGS-84).

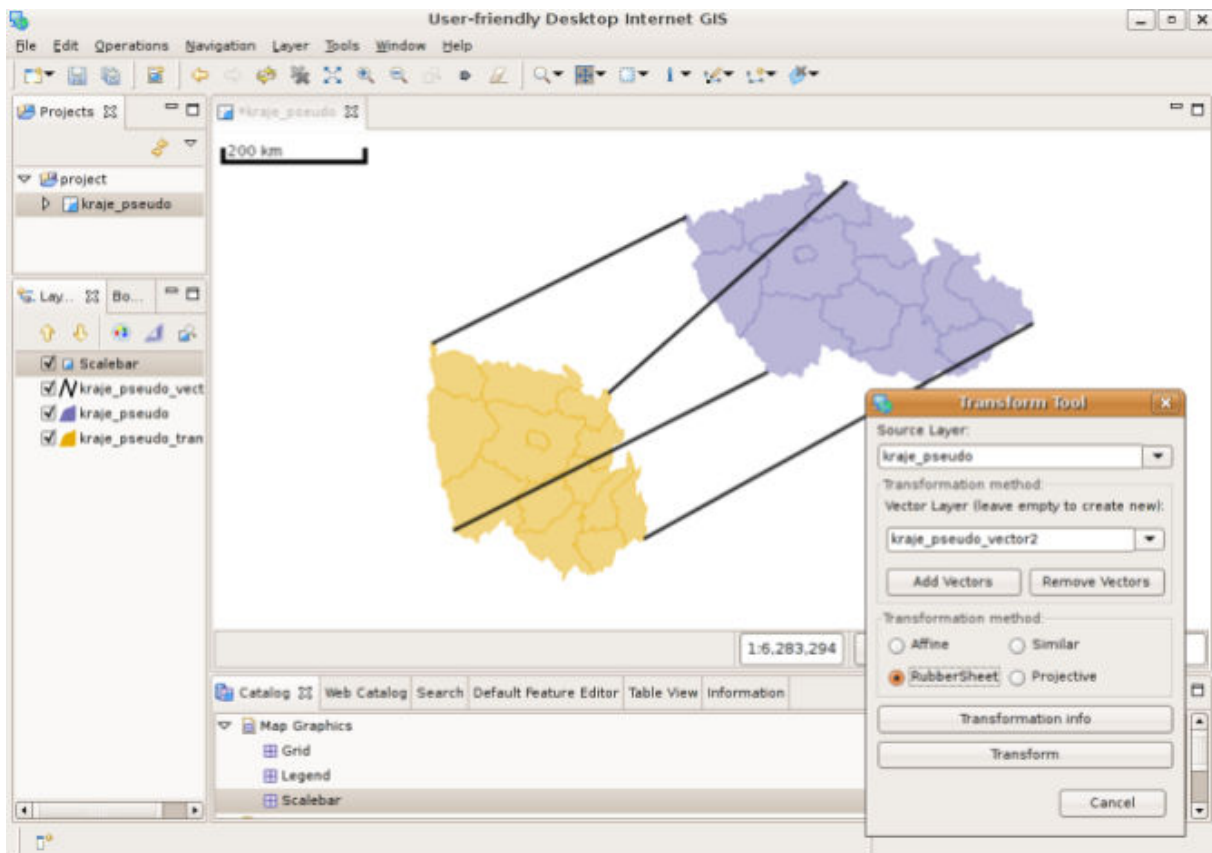


Fig. 1. Plug-in for applying transformations – the example of warp function. Adopted from uDig, 2007

This project brings the following functionality:

- Math Transform Builders that let users to calculate various kinds of transformations from known control points. It is possible to calculate constants for these methods:
 - Linear transformation (similar, affine, projective, bursa wolf) using least square method.
 - Warping transformations based on interpolated grid of shifts (similar to NADCON transformation as described in NADCON 2007). These grid can be calculated using various kinds of interpolation (inverse distance weighted, thin plate spline).
 - Piece wise method also known as Rubber Sheeting. This method combines triangulation and affine transformation.
- Simple GUI realized as uDig plug-in that let users to calculate and apply described methods. First draft of this plug-in is available from uDig community update site. For details how to install this plug-in see uDig 2007.

The project is being developed together with partners from CTU Prague (Faculty of Civil Engineering, Department Mapping and Cartography). This work was sponsored by the Google Summer of Code (see Google 2007 for more) project during the summer year 2006 as well as 2007. Detailed description can be found in Geomatics 2007b.

3.2 Delaunay Triangulation for GeoTools

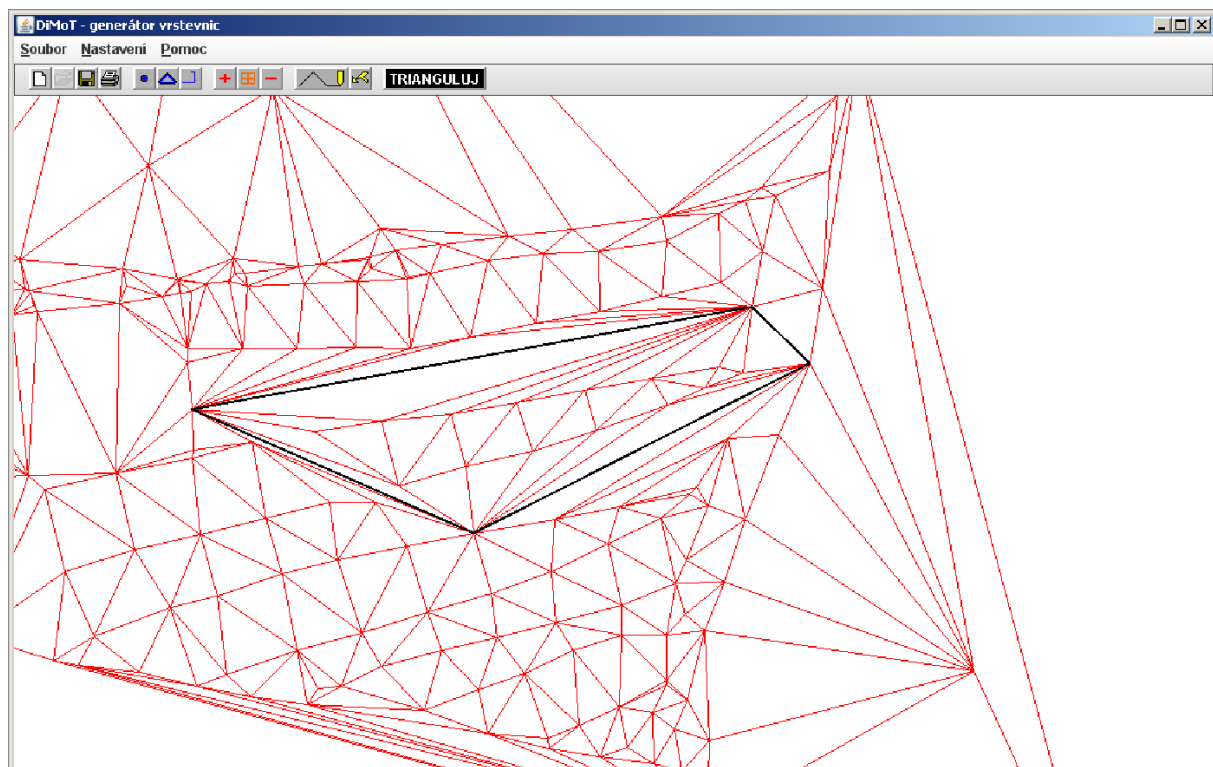


Fig. 2. Standalone GUI for demonstrating the calculation of TIN using fixed edges (the black ones). Adopted from Bezděk 2007.

The aim of this project is to implement the tool for building TIN (Triangulated Irregular Network) compliant with Delaunay criterion with strong emphasis on algorithm optimization and robustness. The work is conceived as an extension to GeoTools library. The project is closely related to bachelor thesis (see Bezděk 2007 for more) of Josef Bezděk,

which was focused on description and usage of GeoTools library. This project enables following functionality:

- Generate the TIN from an input point layer (each point consist of a set of XY coordinates).
- Generate the TIN from an input point layer and another layer which consist of fixed edges that must to be kept after triangulation (see fig. 2).

The next work of the project is focused to use the TIN as a source for generating isolines.

3.3 Geomorphologic Information System

The Geomorphologic Information System (GmIS) is a special type of Geographic Information System (GIS), which can be helpful to geomorphologist in various situations in research. It can be understood as a specific type of GIS, focused on geomorphologic data. GmIS provides useful geomorphologic tools and techniques, which can be used in various situations. First is a field survey, where GmIS can work as a mobile GIS solution for data collection. Next necessary activity is to store the collected data to the structure of *geomorphologic database (GmDB)*. GmDB consist of both collected data and other fundamental data (topography, geology, hydrology, etc.). But the core of its functionality is in geomorphologic analysis, where GmIS can offer efficient *geomorphologic tools (GmT)* to process geomorphologic methods in computer environment. Last but not least it of course can serve tools for presentation of created outputs, such maps, graphs, etc.

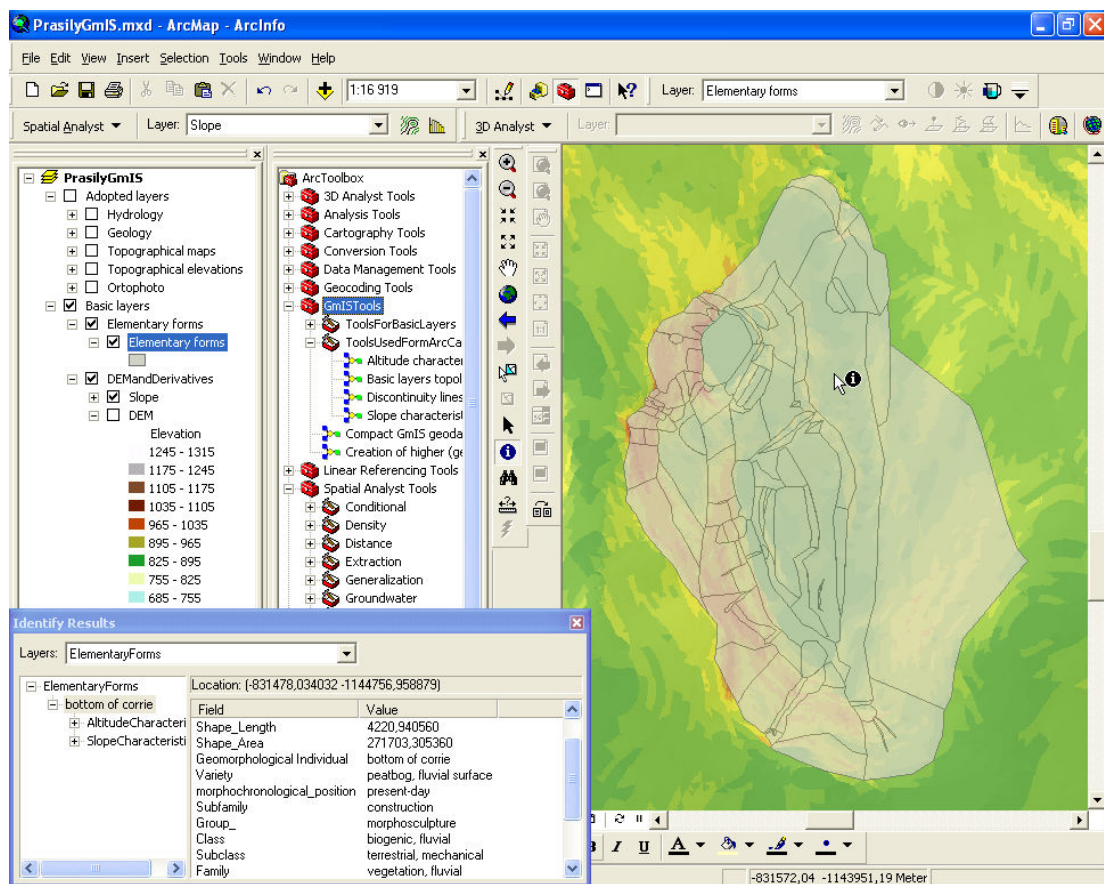


Fig. 3. Early version of GmIS plugged in ArcGIS. Adopted from Mentlík et al. 2006.

The GmIS is a system technologically based on [ESRI](#) technologies. It consists of a *Geomorphologic Database (GmDB)* and *Geomorphologic Tools (GmT)* whose can handle

(collect, process, analyze, present) data stored there. It can be understood as a plug-in to ESRI software [ArcGIS](#). The GmIS plug-in is published and distributed under the [General Public License \(GPL\)](#). Of course that ESRI products are not included, they have their own licensing. The GPL applies only on a source code developed by the GmIS team.

Geomorphologic information system (GmIS) is being developed in a team of professional geomorphologists and geoinformatics from the Comenius University in Bratislava and the University of West Bohemia in Pilsen. The team described the GmIS visions in Minár et al. 2005, Mentlík et al. 2006, Jedlička 2007 and Jedlička 2008.

3.4 Open Cadastre

Open Cadastre (OC) is a project which is dealing to create an open source interface to data of real estate in the Czech Republic. The realization consists of development of couple tools. The first toolset is used for import of real estate data from specifically formatted text exchange format to spatial database PostGIS. Next tools are used for the data publishing, using UMN MapServer technology. Crucial is the way of real estate attribute information acquisition that is necessary for the Ownership Certificate construction (see fig 4). The project solves Czech real estate data, thus the further documentation is in Czech language only.

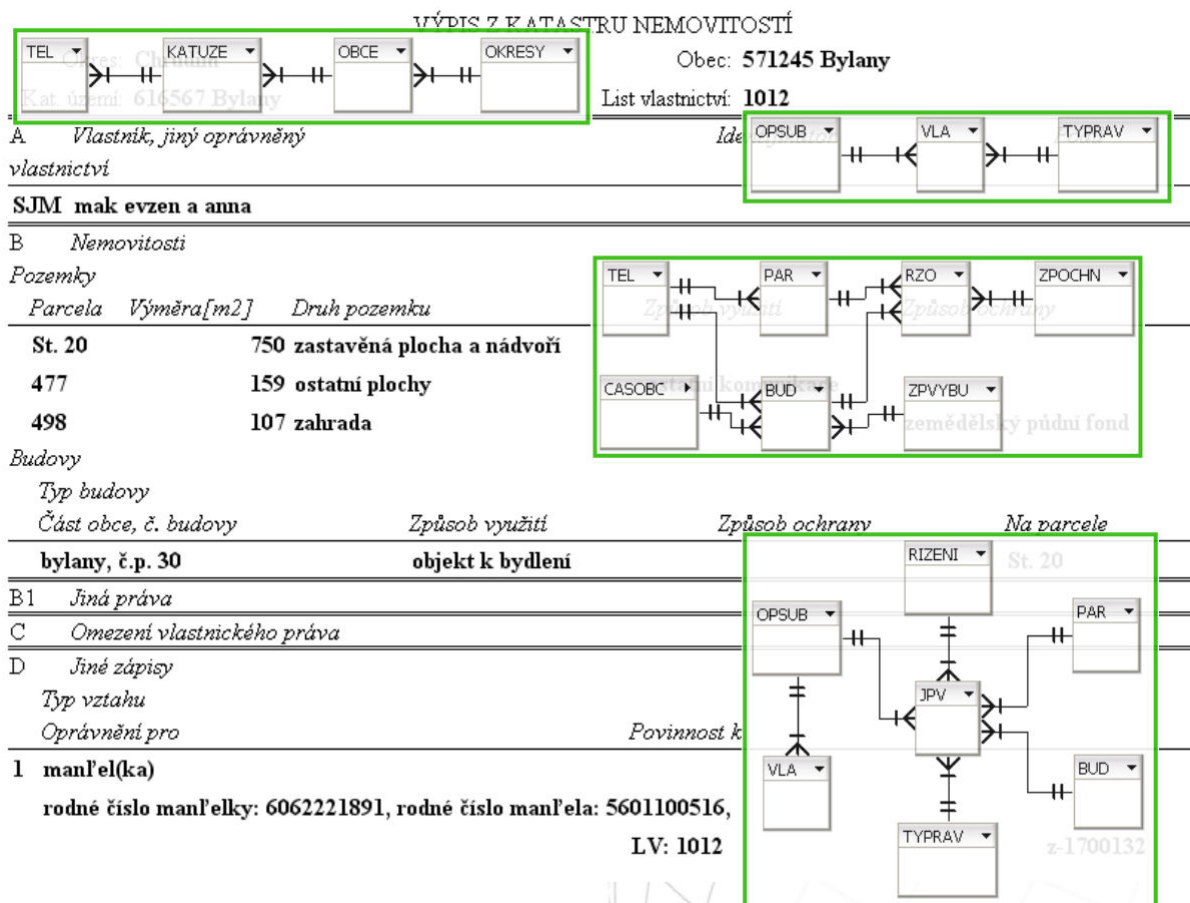


Fig. 4. OC – Ownership certificate (in Czech only). Green outlines show the tables necessary to query to get the result. Adopted from Petrák 2007.

The Open Cadastre takes advantage of following open source technologies: [Python](#) for scripting, [PostgreSQL](#) and its spatial extension [PostGIS](#) for data storage, [UMN MapServer](#), [PHP](#) and of course [HTML](#) for data publishing. Source codes of tools which have been

developed can are maintained by [Subversion \(SVN\)](#) and are available at <http://git.zcu.cz/svn/OtevrenyKatastr/>.

Open Cadastre is being developed in a team containing of professional geomaticians and students of the University of West Bohemia in Pilsen. The team described the Open Cadastre mainly in Petrák 2007 and Jedlička, Ježek and Petrák 2007.

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- Geomorphologic Information System (GmIS) – Research Plan MSM 4977751301, Czech-Slovak project of AIP no. 116: GmIS as a base of environmental applications.
- Open Cadastre (OC) – Research Plan MSM 4977751301.

5 Conclusion

The open source software focused on geosciences has grown a lot in recent the years and it has been proved that it presents alternative solutions that must be seriously taken into account. We see it as very important to get interested students involved not just as passive users but also to give them an opportunity to look deeper behind the user level of open source. By taking their software development projects seriously from the beginning, we expect to get better control and overview on working progress especially in longer time period and in this way we wish to establish better collaborative environment as well. Centralizing the projects information into one wiki web site also should bring us better dissemination of results of already running projects.

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