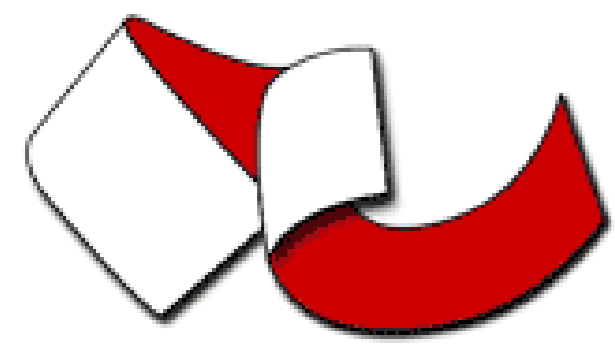


UDig and GeoTools in the Summer of Code 2006



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Abstract

GOOGLE Summer of Code 2006 is a program that offers student developers stipends to create new open source programs or to help currently established projects. Google is working with a variety of open source, free software, and technology-related groups to identify and fund several hundred projects over a three-month period.

This year it is the first time when there are also project focused on the Geoinformatics. The organization that offers such projects is called Refraction Research. The aim of this paper is to describe Summer of Code itself and also the projects that have been in progress this year (with respect to geoinformatics). More attention will also be given to the author's project "Coordinate system transformations". This project is focused on uDig and Geotools.

1. Google Summer of Code

Google Summer of Code 2006 global statistic:

- 6338 Applications
- 3044 Applicants
- 1260 Mentors
- 102 Open Source Organizations
- 90 Countries
- 630 Applications accepted

Refractions Research received 12 applications and 9 application were selected as doable. Finally the Google chose three that were funded. These projects are described below.

2. GDAL ImageIO integration

(by Daniele Romagnoli, mentored by Simone Giannecchini)

THIS project realized a framework to use most of GDAL (Geospatial Data Abstraction Library) capabilities behind Java Image I/O plugins. Since GDAL allows to manage a great number of data formats, the project essentially allows users to perform Image I/O operations on several data formats (Mainly, any GDAL supported format) by implementing specific format plugins. To implement a plugin, the user essentially needs to extend two main classes: GDALImageReader and GDALImageReaderSpi (which extend the ImageReader and ImageReaderSpi Image I/O base classes) which already provide implementation for the most common Image I/O operations. Furthermore, such a framework allows users to exploit Java Advanced Imaging (JAI) features and capabilities during Image I/O operations. This allows the GeoTools developer to access many coverage formats by implementing the proposed solution for Image I/O plugins and wrapping them inside GeoTools grid coverage plugins. Actually, writing capabilities are not yet provided. Planned future work will provides this.

3. uDIG GPS Record Import and Spatial Report Processing

(by Dan Eslinger, mentored by Cory Horner)

THIS project created a GPS coordinate/attribute import plug-in. It uses the NMEA format with a focus on the \$GP (global positioning) sentences.

The plug-in takes a previously logged file and imports the following NMEA sentences:

- \$GPGGA - PVT (Position Velocity Time)
- \$GPGLL - Position data
- \$GPRMC - PVT minimum sentence
- \$GPGST - GPS quality of Fix statistics
- \$GPZDA - Date and Time
- \$GPVTG - Velocity and Track information
- \$GPGSA - Overall satellite availability per the system Almanac
- \$GPGSV - Satellites used in tracking/navigation

The NMEA sentences are then time-normalized such that all information reported for a single epoch is stored in concert. This means that for all sentences received indicating time "t", both Geographic (Latitude, Longitude, Height) and Attribute (all other) data are stored as a single record. Planned future work includes supporting other manufacturer proprietary data formats (Garmin, Magellan, etc) and connecting to a GPS receiver via serial or USB in order to provide live positioning information to uDig.

4. Coordinate System Transformations

(by Jan Jezek, mentored by Jesse Eichar)

THE aim of this project was to implement new modules into the Geotools and uDig software and to improve geographic coordinate system transformation operations, with respect to already available functions. The new functions that have been implemented are described below.

The project is usable when the user has two datasets that should fit to each other but they don't (unknown coordinate reference system should be the reason). When the user specifies the points that are the same on both datasets he should be able to transform his data by various ways. So the new functions that have been implemented are:

• Transformations parameters calculator

The tool for calculating the transformation parameters for several transformation methods (similar (figure 1), affine (figure 2), rubber sheet (figure 3) and bursa wolf. Parameters are calculated from coordinates of identical points specified by user (using least square method). This part of the project should become part of the GeoTools library.

• uDig plugin

uDig plugin that represents the user interface to apply these transformations on datasets (figure 4).

4.1 Similar Transformation

Similar transformation is a special case of affine transformation where $a_2 = -b_1$ in the equation (1). It means that the result is similar to the original. The parameters of similar transformation can be expressed by rotation, scale and translation.

$$\begin{pmatrix} x' \\ y' \\ 1 \end{pmatrix} = \begin{pmatrix} a_1 & a_2 & a_0 \\ b_1 & b_2 & b_0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ 1 \end{pmatrix}. \quad (1)$$

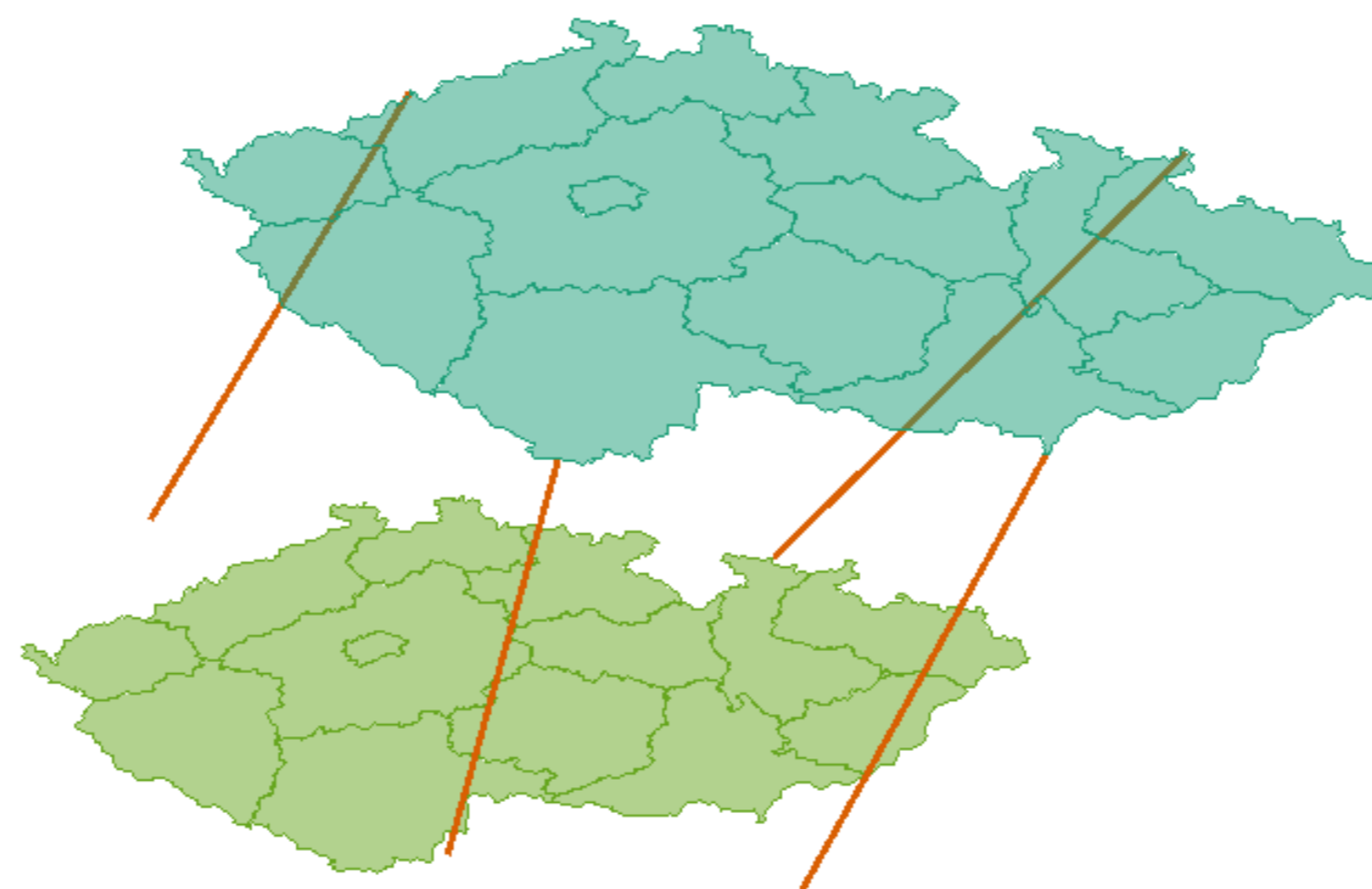


Figure 1: Similar transformation

4.2 Affine Transformation

Affine transformation is expressed by equation [1]. Using affine transformation we can transform 3 points on other 3 points with zero deltas. When there are more identical points specified the least square method for the deltas is used.

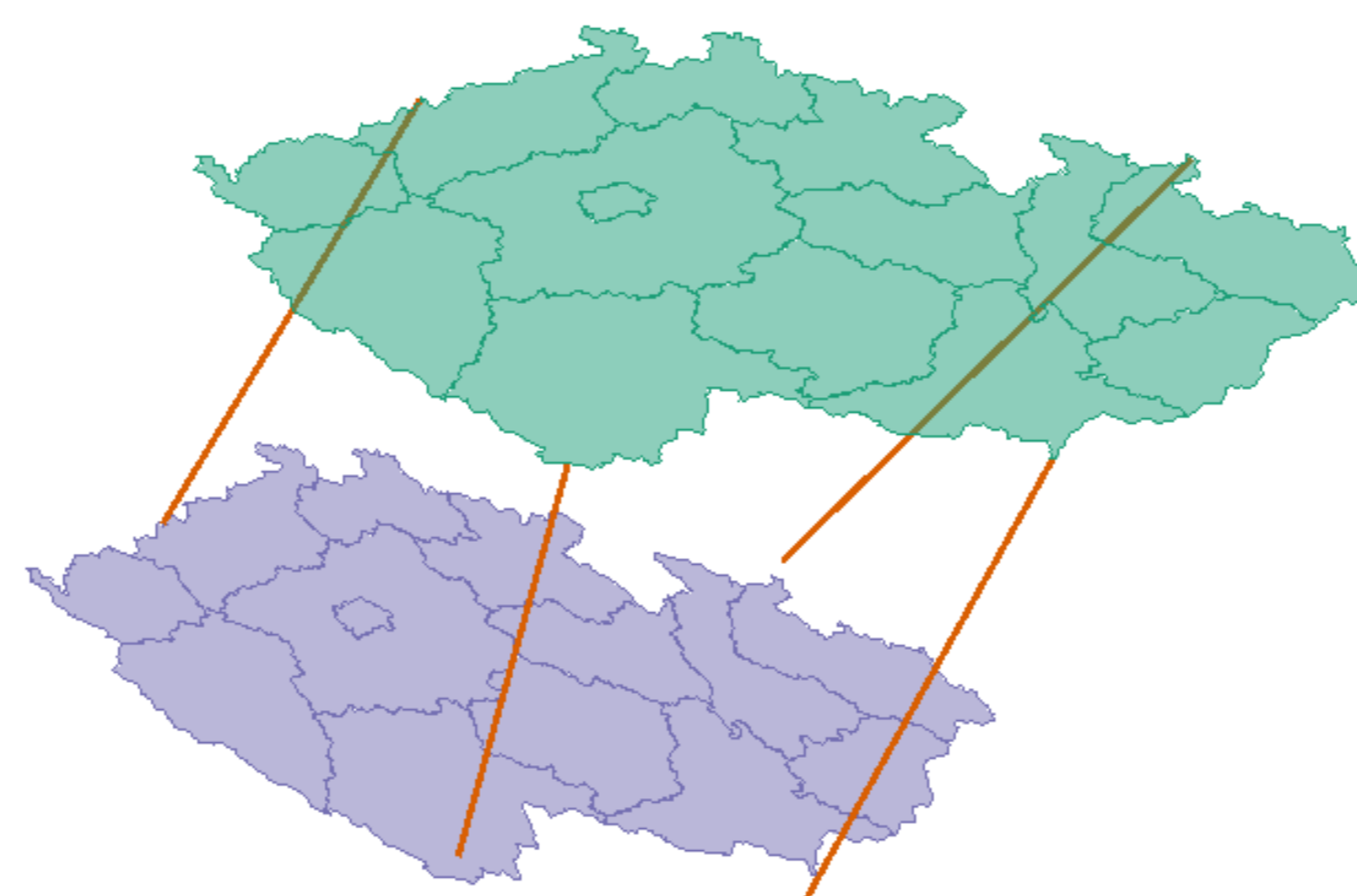


Figure 2: Affine transformation

4.3 Rubbersheeting Transformation

Rubbersheeting transformation is no residual method (it means that there are no deltas on identical points independently on the number of them). The transformation is made in these steps:

- The bounding box of the source dataset is divided into triangles where the specified points are the vertices of this triangles. The delaunay triangulation has been implemented for this. These triangles are mapped to the triangles made by destination points.
- There is affine transformation applied on each triangle. The result is that the points on the edge of the triangle are calculated twice, but the result is the same because of the properties of affinity.

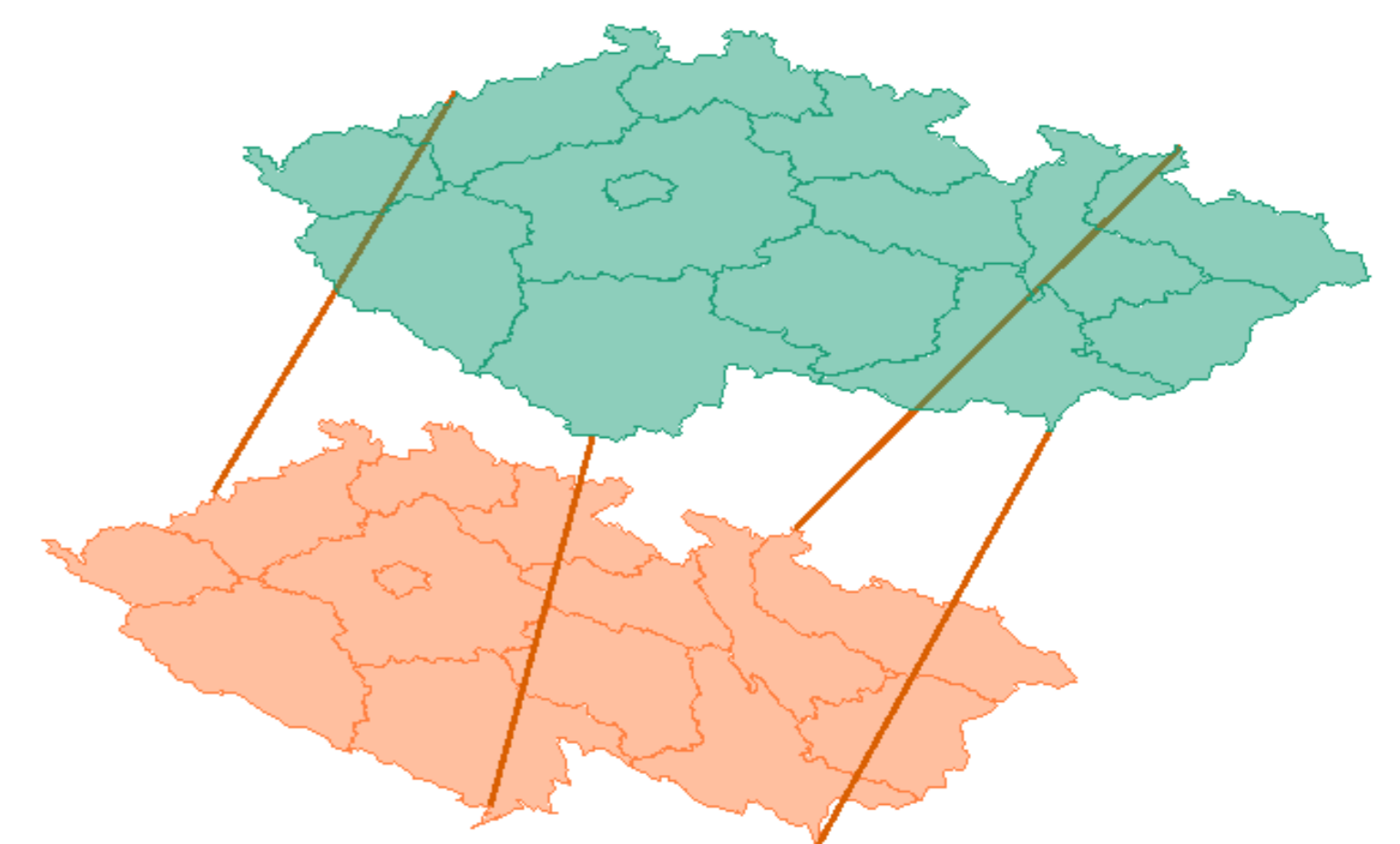


Figure 3: Rubber Sheet transformation

4.4 uDig plugin

uDig plugin design can be seen on figure 4. The vector that represents the identical points are made as normal LineString layer. The advantage of this approach is that the user can save and edit it comfortably. It is also possible to generate these vectors from database of identical points. The dialog also shows info about transformation that is used (standard deviation and transformation parameters).

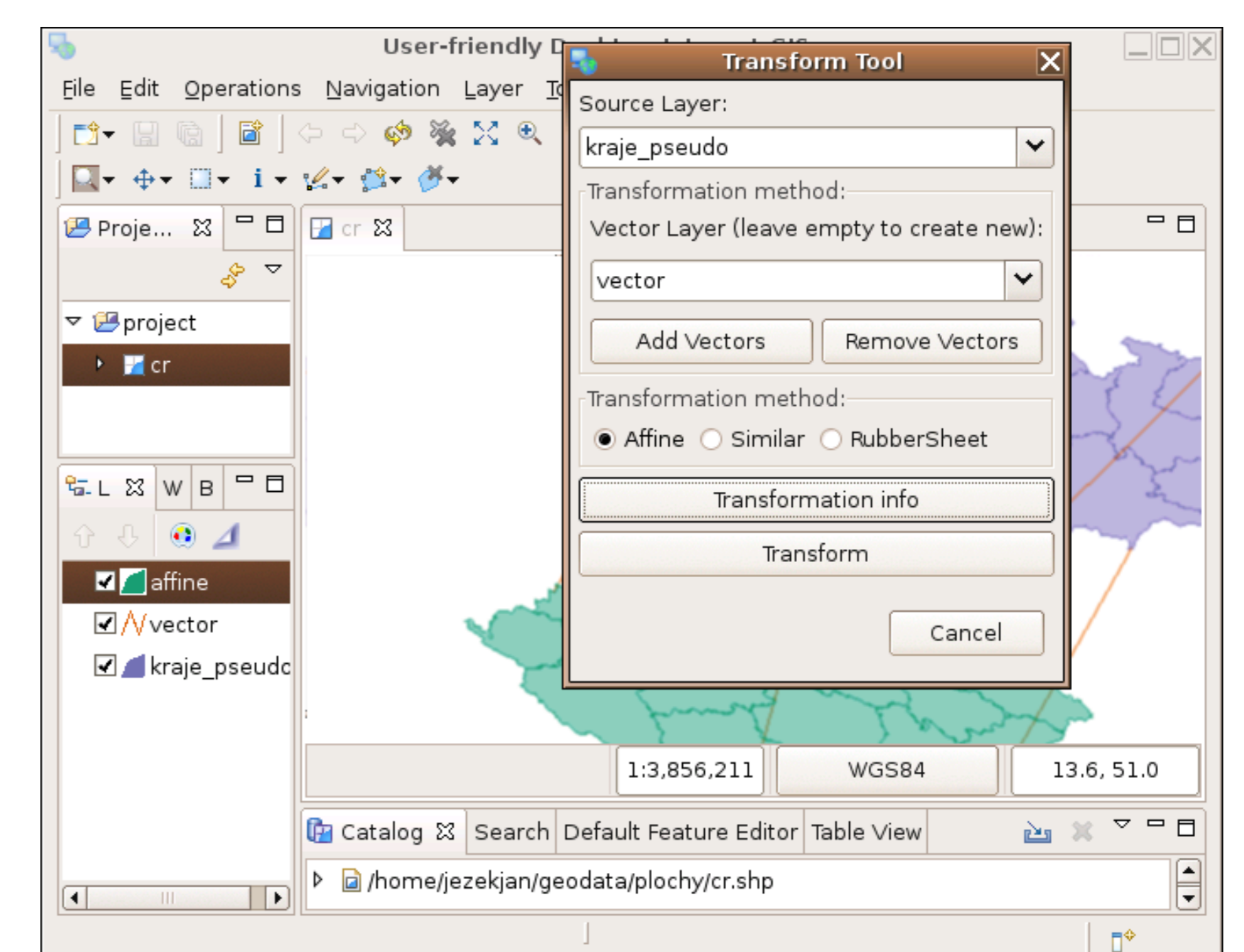


Figure 4: uDig Plugin

5. Conclusion

SUMMER of Code is an excellent opportunity for students interested in open source to start contributing and get financial support at the same time. Summer of Code officially ends 21. August. It is too early to say if the projects are able to survive and what benefits it will bring to mentoring organization and users. The projects source code, that has been worked on this year in Refraction Research, can be found at community repository (<http://svn.geotools.org/udig/community/>).

Reference

[1] Dan Eslinger, Daniele Romagnoli, Jan Jezek <http://code.google.com/soc/refract/about.html>. Summer of Code project proposals.