A Model of Exploiting the Ortho-Photograms for Checking and Receiving the Sporadic Cadastre Works and for Graphical Database Completing

ing. Mircea Băduț, O.C.P.I. Vâlcea
ing. Gabriel Blidaru, O.C.P.I. Vâlcea

***Abstract**: This paper presents a practical model of organizing the digital aero-photograms covering a large area of terrain as well as one for unitarily integrating this raster images collection into the exploitation flow of the graphical data for supporting the cadastre activities deployed in a Cadastre and Real Estate Publishing County Office (OCPI). Here the technical implication and the unified management solutions are showed in a multi-user environment (such as organization, assignment and the format of the vectorial files, the mechanism of protecting graphical content by "external references", dynamically managing the images in the CAD/GIS working session, the effective flow for cadastre works examination and stowing, perspectives, SWAT, etc).*

1. Integrating the ortho-photograms in the OCPI activity

By benefiting from the results of a national project deployed by the National Agency for Cadastre and Real Estate Publishing [ANCPI] – a huge project having its as objective the aero-photographing of the whole territory of Romania – OCPI Vâlcea has received o large collection of raster images, covering a substantial part of the county area (765 pictures, representing ~46% from the whole surface, as part of the "Aero 03 / 2002" project). Because of the high accessibility of this kind of information – while for vectorial cartographic representation man needs some experience and effort, for photographical images understanding is instant and natural – but mostly because of the fact that the aero-photograms entirely cover the area, a decision has been taken concerning putting the image collection in exploitation without delay.

These ortho-photograms, with a raster resolution equivalent to the 1:5000 and 1:2000 scales, have previously passed through photogrammetric operations (stereo-restitution, ortho-rectifying, but by digital processing) so taht the objects represented in images should be placed in the positions corresponding to reality, considered in the "Stereografic 1970" projection/coordinate geodetic system. Due to the fact that – by the contractual specifications – the GeoTIFF file format was chosen (a format well-known for the fact that it includes, or has associated, the information needed for the automated geo-referencing of the incorporated bitmap image), perspectives for facile file collection exploitation were opened, hence the solution currently reached by integrating these ortho-photo-plans in the digital working flow can support most of the graphical tasks concerning cadastre activities.

Because of the big dimensions of the files (each image cover a large area, equivalent to the classical "trapezium" having the same scale, so making a file to have a size of ~80 MB) we have to allocate a large and high-performance hard-disk for the permanent storage of the images, and the receptacle folder has been activated with the sharing option as "read-only", to give access for certain users from the computer network of the organization (closely controlling the access rights).

In the initial deployment, using the AutoCAD environment, we prepared the grid containing the positions and delimitation of all ortho-photograms from the collection (while also overlaying the vectorial image of the administrative boundaries in the county in the graphical composition). Because we originally proposed to geo-reference all the aero-photographic images in two drawings (a graphical composition for 1:2000 scale ortho-photo-plans and another for 1:5000), in this phase we have used the "Autodesk CAD Overlay" software (actually named "Autodesk Raster Design") due to its capabilities for automated geo-referencing the GeoTIFF images (but, we could well use

"Autodesk Map 3D" or "Autodesk Land Development"). This approach (also based on the premise of the correctness ensured by the geo-referencing processes on the part of the supplier) allowed us to bring all images into coordinates in a single step. (If we used the simple AutoCAD, we could geo-reference only one image at a time, manually and with limited precision). We can mention here the fact that *almost all GIS platforms allow the GeoTIFF file direct geo-referencing*, possibly including the datum and projection system information.

[Fig.1 – Joining the 1:2000 and 1:5000 ortho-photograms]

Once geo-referenced, the display of the raster images in the graphical composition was set off (by the corresponding option from "Image Manager"), in order to avoid uselessly loading of the computer memory, with a view for them to be individually re-displayed any time they become necessary .

This approach – through which the drawing-file is not open with all the images activated, but by displaying them on explicit request from user – , in spite of the fact that it involves intense manoeuvre and requests technical abilities from the human operator, has clear exploiting advantages (otherwise the hard-ware should be much over-dimensioned, and one can lose the operational coherence/focus).

Let us mention that, despite the fact that the graphical composition containing the raster images was created with the "Autodesk CAD Overlay", due to saving them in the standard DWG format, they can be used with any AutoCAD platform (which means that we do not have to buy an additional software license for each workstation) or even IntelliCAD.

After obtaining the DWG files which contain the information for automated ortho-photo-plans geo-referencing (for each administrative territory), they were shared by the organization computer network, and respectively assigned as external references ("Xref" mechanism from AutoCAD) to the files constituting the database of the **sporadic cadastre** (a DWG file for any district where in the last six years the estates/lands checked by the Cadastre Office have been collected/stowed). The fact that the raster images file is brought as *external reference* (instead of directly including the ortho-photograms grid in the sporadic cadastral data drawing) offers two distinct advantages:

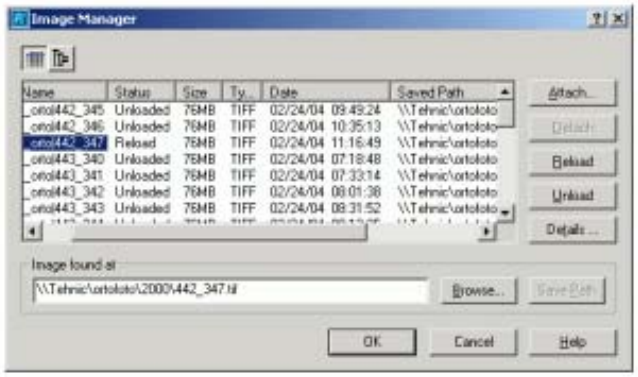
» the possibility of damaging/spoiling the raster image fund by mistake is eliminated;

» every time the drawing is reloaded the raster fund is present with all the images in non-displayed status, unloaded (which is less demanding for the hardware, and does not force the operator to set off the image display at each session end).

[Fig.2 – Ortho-photograms geo-referencing grid]

In essence, the facile working mode (the fact that the user rapidly brings on display only the portion which is currently needed) is due to the couple of commands which switch the "reloaded" and "unloaded" status (in the raster image manage dialog window), and which can by played as the user wishes. (Beware not to confuse with the "attach" - "detach" commands, which are not for displaying/loading, but for permanently assigning and detaching the images.)

For this manipulation of images we use the initial raster file names (listed in the manager window, made up of the prefixes of coordinates pairs), for which the corresponding (homonym) names appear in the corresponding frames from the images grid.



[Fig.3 – "Image Manager" dialog windows]

Once the working manner is properly set up, one can begin the effective exploitation. In order to obtain the visual reference from a location in an administrative territory (needed for a cadastral analysis) the user will estimativelly focalize (doing a "zoom" enough for reading the texts from the images grid) and identify the name of the ortho-photogram which covers the respective area. Then he accesses the raster image manager (the "Insert > Image Manager" menu from AutoCAD) and picks from the list the image which nominally corresponds, for which he establishs the displaying status (loading), and at the end must issue the REGEN command, which will make

the ortho-photogram visible in the current graphical composition. (The explicit view regenerating command issuing is the only disadvantage of using the rasters as external references.)

By using this working manner, the cadastre inspectors can rapidly check PADs (positioning and delimitation plans) or documentation for issuing the permits for removing land from the agricultural circuit, or other specific works, and can do that by unlimited combination of the graphical database (which can be constituted from sporadic cadastre accumulation, from 1:5000 scale trapezium scanning, from parcel plans scanning, etc). In essence, the vectorial material combination (CAD or GIS native) with the raster/bitmap one (aero-photographic or satellitar images) adds to the precision and versatility of the first the advantage of comprehensibility and suggestiveness of the second, and the present-day computer hardware has reached powerful enough to allow generous hybrid raster-vector compositions.

2. Working flow for sporadic cadastre

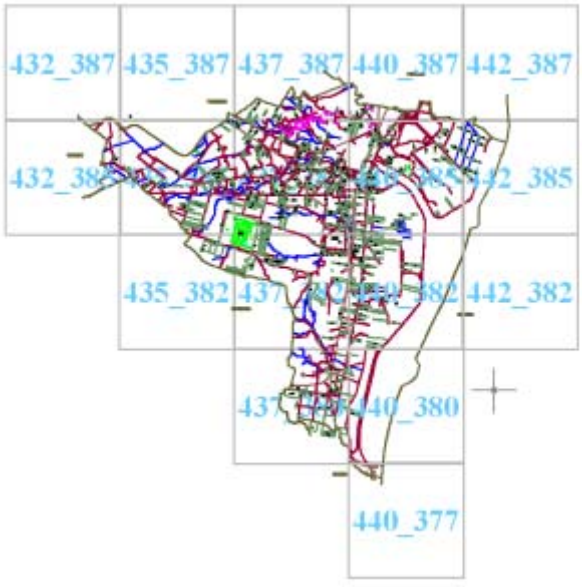
In the specific context of the sporadic cadastre activity – mainly constituted from checking and receiving/stowing cadastral works documentation (PADs, H.G.834 works, urbanistic plans, other specific works) – the aero-photographic images integration has led to the following working flow model:

1. The cadastre inspector to whom a current work documentation was assigned opens the DWG file which contains the sporadic cadaster accumulated until the current time (a vectorial material representing the property bodies, lands, parcels, buildings and other topographical entities, inherited from previously received/stowed cadastral works).

2. The inspector takes the property contour given by the work executant in digital format (the coordinates list as an ASCII file on a diskette) and reports/brings it in the current drawing.

3. The inspector zooms the corresponding part of the drawing (by a convenient closeup viewing) and evaluates the correctness of the under-reviewing work in comparison with the reference graphical material from that area (he checks for overlaying or intersections with other parcels/lands/estates or entities, and for deviations from the working technical norms/rules).

4. According to the evaluation result, the inspector will decide to validate the work under reviewing and hence to save the drawing (which, from now, will also include the new contour in the graphical data base), or to reject or suspend the reception of that work.



[Fig.4 – An administrative territory with assigned ortho-photogram frames]

For effectively checking of that property corpus (estate/immobile) (the 3rd step) – depending on the geo-spatial context and the work complexity – the cadastre inspector can decide to load

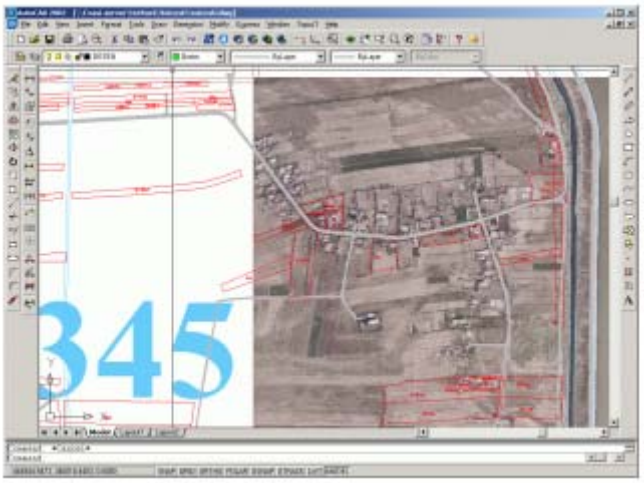
certain (categories of) graphical data, therefore the checking by comparison with previous recorded estates can be completed by bringing additional references (and for areas where in the last years real estate transactions was not recorded this operation becomes mandatory):

_ vectorial material received as urbanistic plans;

_ raster material resulted by scanning plans/maps from the corresponding area and well geo-referenced;

_ ortho-photo-plans obtained by aero-photography or from satellites; etc.

Due to the fact that the GIS or CAD platform offers the possibility to generously maneuver the display(ing) of these graphical material (by freely changing the thematic layers, by exploiting the "into deep" displaying order control mechanism, by engaging the raster image transparency effect, by possible abilities of mosaicking/combining the graphical material, by diverse analyse functions) it grants (the user) the capability to obtain a sure enough and effective working frame in the cadastre activity.



[Fig.5 – Raster-vector mixed working session]

For the technical verification of cadastral documentations we require from executants to also bring a ASCII text file containing the coordinates of the points which outlines the current property body, and subsequently – through an AutoLISP application (running under AutoCAD) at an OCPI office – we will report/bring that contour in the graphical database of the corresponding administrative territory (city, district, commune). This decision was made for the following reasons:

• the property contour is generated in an extremely well controlled and clean manner;

• we gain direct control over the equivalence between the real coordinates of the under reviewing contour and those declared in the printed documentation;

• anybody can later regenerate the contour unconstrained/unconditioned by the context;

• the ASCII format coordinates can be read with many CAD/GIS platforms (including "ArcGIS"), therefore the reusing possibility is opened for diverse contexts.

If we would have required the DXF or DWG files for checking cadastral works, the following disadvantages would have appeared (issues which are not easy to control by bringing specifications or by IT competency of the inspectors):

» these files are dependent on the AutoCAD version used by the executant;

» the direct drawing-file insertion in the sporadic cadastre graphical database causes the transferring of other elements beside those which are visible ("zombie" entities – such as the proxy elements, blocks, layers definitions, text styles, hatching styles – which load the file and the memory, and which are hard to be removed from the main graphical database);

» the database storage would in time have posed certain problems, affecting the reusing potential.

Moreover, due to an innedite software programming solution, the data from the ASCII file are not supposed to be strictly aligned on columns, which makes the labor of cadastre works executants easier.

3. Perspectives and issues to fix

In the implementation of this working model, and later in exploitation, a series of issues appeared (some of them being partially solved by now, others waiting for better solutions in future), such as:

• the limits in computer performance, data network, and in storage solution;

• troubles in periodic storage of the graphical database (such as incremental saving; remote after-disaster-restoring copies; etc);

• the operational security of data: in the AutoCAD environment (as in most of the desktop GIS and CAD solutions) there are no methods to partially protect the graphical content when a data-source is accessed by many users (i.e. so that certain entity categories should be available only for viewing and not for modifying), and neither are there logging mechanisms to journalize who and what changes have been made to the graphical material, in order to limit the operating errors and mis-using;

• there can appear the temptation to exploit the graphical data (which become a valuable asset) outside of the legal working frame;

• there are areas where (probably because of the lack of ground control points in the initial photogrammetry processes) the aero-photographical image geo-referencing proved to be not very precise; etc.

Because the national project whose results constitute this ortho-photograms collection with applicability in the cadastral activities is supposed to eventually cover the whole territory of Romania by aero-phtograpy, the potential and the development necessity of such a working technology appear obvious. The optimistic context raises – in a natural way for a high-level geo-informatic activity – diverse technical and managerial challenges, which must be understood and assimilated by the Cadastre Offices:

_ procuring high-performance computers and equipments able to store and manipulate huge bitmap file collections;

_ upgrading the computer networks in order to allow an intense data flow/traffic (preferably cabled to meet the “Gigabit Ethernet” network standard);

_ procuring GIS/CAD software able to work with aero-photographes, and in a corresponding amount of software licenses to complete the workstation involved in exploiting and developing the OCPI graphical database;

_ training the personnel in order to assimilate the aero-photographic images working particularities; etc.

Bibliography:

Băduț M., "GIS – fundamente practice", Albastra Publishing House, Cluj-Napoca, 2004

Băduț M., "Baze de date CAD", article in the PC REPORT magazine, 9/2000, pp.35-38

* * *, "Autodesk AutoCAD OnLine Documentation", 2002