

Pliable Display Technology by Magnification of Images & Maps "In-Context"

The mapping industry has seen an exponential growth in the number of maps, 3D terrain data models and airborne and spaceborne images that are being generated in digital form. Yet all of these high-resolution data sets that are being generated have to be viewed on computer screens that have a limited format size. Indeed, in some application areas, display screens have actually been shrinking in size as a result of user demands for portability so that computers can be used in the field or in vehicles. As an answer to many of the resulting problems, the Canadian firm of IDELIX has introduced its Pliable Display Technology (PDT).

By Prof. Gordon Petrie

Pliable Display Technology (PDT)

PDT is a new viewing technology that allows the magnification of part of a 2D image or a 3D model being displayed on the viewing monitor of a graphics work station or PC or the screen of a hand-held computer - while still retaining its position and its connectivity to the rest of the image being displayed on the screen. This allows the magnified part of the image to be inspected and analyzed in detail, while still allowing the analyst to retain a sense of its location and context within the overall image. This inspection of the magnified partial image can then be accompanied or followed by (i) the measurements needed for photogrammetric purposes; (ii) the extraction and editing of the features required for map production; and (iii) the tasks associated with GIS analysis - all of which require the fine detail and maximum resolution of the image to be displayed on the screen of the display monitor.

Alternative Solutions

Up till now, a number of other techniques and procedures have had to be employed when working with the very large data sets that are generated by airborne or spaceborne images or raster-based maps and need to be displayed within the relatively small space of a computer screen. Current solutions include the widespread use of twin screens - with the one displaying the

overall image at a very reduced resolution, while the other displays the magnified image of the part currently being worked on. But some people find the continual switching from the one screen to the other to be rather confusing. In particular, it may be difficult to locate the position of the magnified partial image on the much lower-resolution overview image. Furthermore the use of twin screens may not be feasible in certain situations - e.g. when laptop machines with limited display formats need to be used during field work.

Alternative solutions using single screens may utilize zooming techniques to reach the appropriate level of detail. However there is then no overview and the user must then zoom back out to see the overview and to be able to move to a new position or area within the overall image [Fig. 1(a) & (b)]. Another solution using single screen displays is to use magnified images within a small inset window that is overlaid on top of the reduced-resolution overview image [Fig. 1(c)]. This obscures the data lying below it and disturbs or loses the context within which it is located. Whereas the new PDT technology offers both an enlarged partial image and preserves the context within which it is located - all on a single display screen [Fig. 1(d)].

PDT Solution

The basis of the PDT solution is shown in Fig. 2. It comprises a geometric



Figure 1: (a) Unmagnified overview map image - the white box indicates the area of interest. (b) Image zoomed 4x - gain in detail, but complete loss of context. (c) Inset view at 4x magnification - the underlying data is hidden from view and the context is disrupted and partially lost. (d) Use of a PDT "lens" with 4x magnification - showing a complete image with the detail of the magnified partial image appearing "in-context".

IDELIX

transformation that emulates a pliable or elastic surface that allows a part of the displayed image to be magnified. The area around the magnified area is automatically shrunk to allow the extra space to be allocated to the area being magnified. While, at the same time, this surrounding area can still be viewed at a reduced scale, so that the context can still be maintained. The reverse transformation can also be executed so that any point within the magnified area can still be mapped accurately back to its position on the original image. Thus the spatial transformation is completely reversible. Consequently any measurements or editing operations can be carried out on both the magnified and the overview images without any discernible loss of accuracy. If the magnified area is removed or switched off, the original image still retains the measured or edited features in their correct locations.

PDT "Lenses"

The magnified area on the display screen of the work station can be thought of as having had a "magnifying lens" placed over it. The "lens" can be of any suitable shape - e.g. round, square or rectangular. Indeed the shape library can be extended by IDELIX to provide any polygonal shape. The shape function for the "lens" shoulders can also be supplied by IDELIX so that the shape can be adjusted by the user. It is also possible to deploy two or more "lenses" simultaneously to magnify specific areas on the image [Fig. 3]. Such an arrangement would, for example, allow very accurate pointing to be carried out on each image to measure the distance between two points on a map or orthoimage.

All "lenses" also support "folding". This particular feature allows the magnified area to be moved within the area of the overall image, with the base of the "lens" staying attached to the overview image in the correct position [Fig. 4]. For certain applications, this "folding" feature could be useful - e.g. for the comparison of two magnified areas located in different parts of the image. However the use of "folding" will,

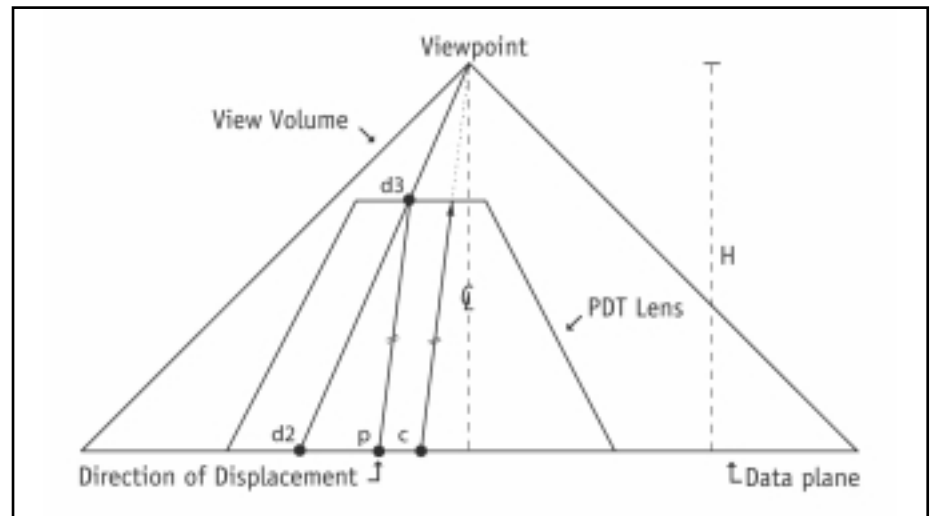


Figure 2: Diagram showing the basis of the geometric transformation used in the PDT solution.

of course, cause an occlusion of part of the surrounding overview image

Anatomy of a PDT "Lens"

A PDT "lens" comprises two areas - (i) the actual magnified area (called the "focal region" by IDELIX); and (ii) the surrounding shoulder area, where the scale changes smoothly and continuously from the magnified partial area to that of the unmagnified overview image. A Software Development Kit (SDK) is supplied by IDELIX to those software houses wishing to incorporate the PDT viewing technology into their products. Apart from the core PDT "lensing" technology, the SDK also includes optional controls (a) to allow the size of the magnified area and that of the shoulder area to be changed; and (b) the magnification of the locally magnified area (or "focal region") to be varied [Fig. 5]. The extent and the shape of the shoulder area determine how quickly the magnified partial area merges with and extends into the main overview image. Thus these

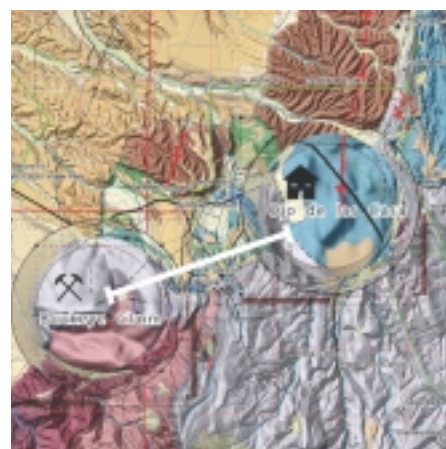


Figure 3: The use of two PDT "lenses" to allow the accurate measurement of the distance between two points during a GIS analysis.

parameters determine how the linking data contained in the shoulder area is compressed. The SDK toolkit is already available for a number of computer platforms. These include various versions of Windows (including Windows CE) and different flavours of Unix (including SGI IRIX, Linux and Linux ARM), plus the Mac OS. A version of the toolkit is being prepared for the Sun Solaris OS. Future plans include a toolkit for use with Java-based applications.

Company Background

IDELIX Software Inc. is based in Vancouver in British Columbia, Canada. It was founded in 1996 by Dr. David Baar. The original title of the company was Advanced Numerical Methods. However, early in 2001, after the company received \$2.25 million in venture capital funding, the name was changed to IDELIX Software - a more market-oriented title! Since then, in April 2002, it has raised a further \$1.5 million in a second round of funding. IDELIX is aiming to have its PDT viewing technology introduced into the products of a number of companies that are prominent suppliers of software to the photogrammetric, mapping, remote sensing and GIS markets.

PDT for GIS

In 2001, IDELIX launched PliableGIS as a data presentation tool for use with ESRI's ArcView software. Essentially it provided an extension to the basic ArcView package allowing magnified partial images to be displayed and interpreted, as described above. Earlier this year (2002), IDELIX discontinued

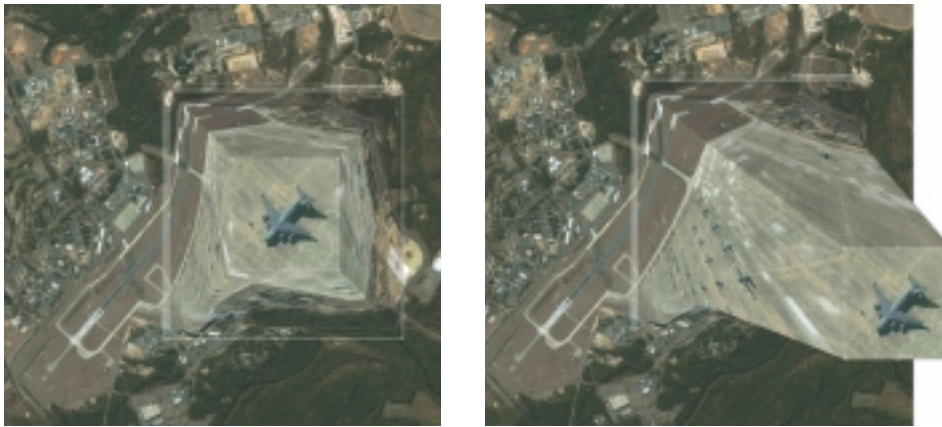


Figure 4: An IKONOS space image of Pope Air Force base showing the magnified image of an aircraft before and after "folding". (Image courtesy of Space Imaging)

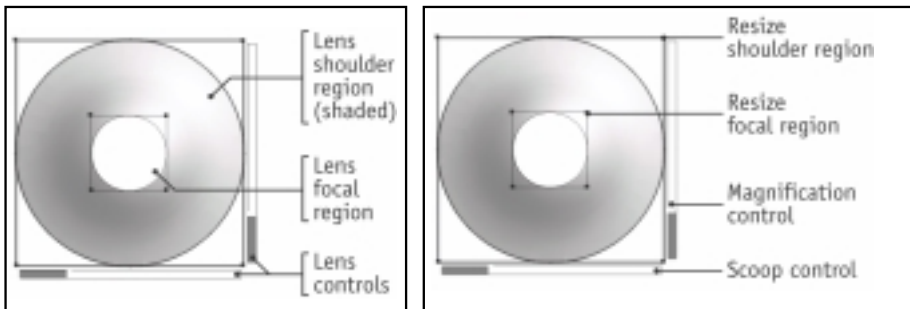


Figure 5: (a) The magnified area (or focal region) and the surrounding shoulder area of a basic PDT "lens". (b) The controls for setting the magnification and the sizes of the magnified area (or focal region) and the shoulder area of the "lens".

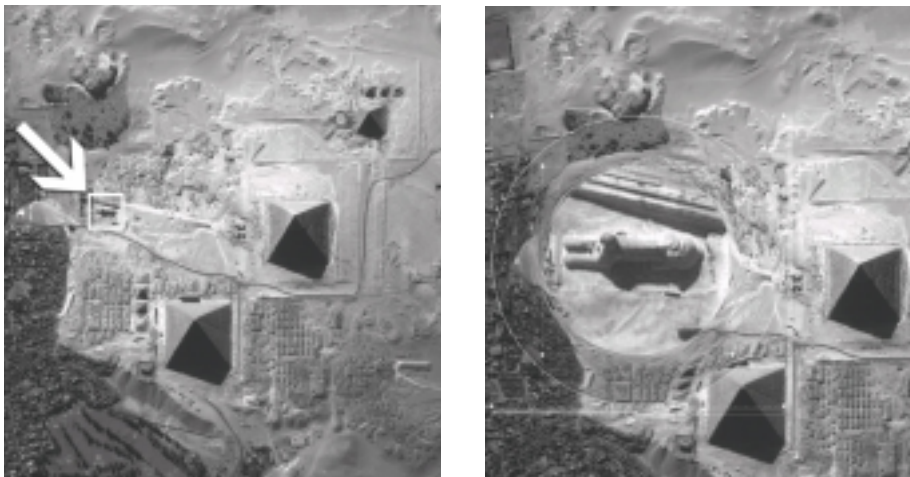


Figure 6: The PDT viewing technology as applied to a high-resolution IKONOS space image showing the area of the Sphinx (a) before, and (b) after magnification using the PDT "virtual" lens. (Image courtesy of Space Imaging)

its plans for the development of this particular extension. The main reason for this decision was that the company realized that the full efficiency gains of PDT for GIS editing required the integration of the technology to be carried out by ESRI. Whereas PliableGIS as an extension could only be used for display, inspection and interpretation tasks. Thus it could not be used for editing or for measurement tasks such as head-up digitizing. These additional operations would only be possible if ESRI integrated the PDT viewing technology directly into the ArcView code. Since then, IDELIX has focused its business development efforts into trying to achieve such an integration.

PDT for 3D

The PDT viewing technology can also be applied to 3D data, e.g. in those situations where the analyst's line of sight to the inner layers within a 3D model may be obstructed by the opaque outer layers of the model. PDT 3d is IDELIX's new (patents-pending) technology for the reduction of the occlusions and the provision of detail-in-context viewing of 3D information with a minimal adjustment of the original structure. In this way, PDT 3d provides an alternative to cutting planes across the model or carrying out information filtering of the data.

PDT for Digital Imaging

The PDT technology can also be used to aid and simplify the viewing and editing of airborne and spaceborne digital images [Fig. 6]. It offers a complete set of image viewing functions, including the provision of different "lenses"; the capability to view and edit high-resolution images; side-by-side viewing of images allowing comparisons to be made between them; etc. These capabilities can be seen in a demonstration that is offered on the IDELIX Web site - having the following URL - <http://www.idelix.com/pdtdemos.shtml>.

PDT for In-Car Navigation

The PDT imaging technology has also been applied to in-vehicle navigation systems that utilize small-format LCD displays [Fig. 7]. As readers of Geoinformatics know well from the frequent articles on this topic appearing in the magazine, these systems provide moving map displays and diagrammatic representations of road networks with turn-by-turn navigation and route guidance. However the typical in-vehicle LCD displays have a limited size of screen. So, once again, IDELIX is helping to solve this particular problem using its PDT viewing technology. With this, the driver or navigator can view selected areas in detail without losing the overall location or the areal context within which the vehicle journey is being undertaken.

Boeing Autometric DPWs

As readers will know from the profile article published in the July/August 2002 issue of Geoinformatics, Boeing Autometric has integrated the PDT viewing technology into the software of its Digital Photogrammetric Workstations (DPWs) [Fig. 8]. The software containing Autometric's implementation of the PDT technology was released for both its SoftPlotter (version 4.0) and KDSP (version 1.2) DPWs this summer (2002). Of course, the use of stereo-viewing is an essential feature of a DPW for the photogrammetric mensuration of control points; for feature extraction for map compilation; for DTM elevation point measurements; etc. and in the associated editing and quality control operations. Thus some additional development had to be undertaken by IDELIX to allow its PDT viewing technology to be used with the overlapping stereo-images acquired from airborne and space-



Figure 7: The PDT viewing technology as applied to a map image in an In-Vehicle Navigation System.



Figure 8: Boeing Autometric has incorporated the PDT viewing technology in the latest version (1.2) of its KDSP Digital Photogrammetric Workstation (DPW). (Image courtesy of Boeing Autometric)

borne platforms. This was delivered in the form of a toolkit to Boeing Autometric, whose programmers then used it to embed the PDT capability into the DPW software. Autometric has secured an exclusive licence to use the PDT technology in its DPWs for a period of three years. This excludes other DPW suppliers from adopting the technology for stereo-viewing applications during this period.

Experience with Autometric's DPWs

One of the first users of the PDT technology on the SoftPlotter and KDSP DPWs has been Atlantic Air Survey based in Dartmouth in Nova Scotia, Canada. The company has reported a 20% increase in productivity in the feature extraction process using its DPWs. It also found the PDT technology to be very useful when editing contours and DEM data and in performing quality control tasks. It will be interesting to hear, in due course, the experience of other users of Autometric DPWs when using the PDT technology.

GeoConnections

IDELIX has recently entered into a partnership to integrate its PDT technology within an Internet client. This partnership forms part of the GeoInnovations programme of GeoConnections - which is a Web-based initiative led by Natural Resources Canada to develop the Canadian Geospatial Data Infrastructure (CGDI). This CGDI structure will be available to users world-wide.

Conclusion

It will be most interesting to see whether the ingenious solution provided by Dr. Baar and his colleagues at IDELIX comes into widespread use within the different sectors of the geoinformatics industry. Obviously it has considerable potential in helping to solve the problems associated with the limited format sizes of computer monitor screens when displaying large sets of geospatial data. However the productivity gains and the commercial and marketing aspects of the PDT technology will be very important if it is to be introduced and adopted widely within the industry.

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