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VSD IN SPAIN. COOPERATION BETWEEN POLAND AND SPAIN IN TERRESTRIAL PHOTOGRAMMETRY

Abstract

During the last four years, a close cooperation between the Department of Photogrammetry and Remote Sensing Informatics of AGH and the School of Arabic Studies of the Spanish Council for Scientific Research, CSIC, has been carried out for the diffusion of photogrammetric systems in the field of recording monuments and other cultural properties. VSD of AGH has proved to be a suitable instrument, easy to be implemented and learned without any strong knowledge on photogrammetry, and so, easy to be used by architects and archaeologist by themselves. In the framework of this collaboration, the VSD software has been improved for its use in the field of terrestrial applications, and has been fully translated to Spanish. More than 20 licenses are actually working in Spain, most in Universities used for educational purposes, and some others in archaeological research projects. Some have been also bought for commercial use by small companies working in the field of cultural heritage.

Some implementations have also been made to offer a simple and cheep photogrammetric system combining simple stereoscopes, digital cameras and portable computers. Up to seven digital cameras have been calibrated for this purpose till now. Images from calibrated digital cameras have proved better results than scanned images. A portable and easy-to-use system based in the VSD is actually offered for professionals working in the field of conservation.

In the last years a close cooperation between the School of Arabic Studies belonging to the Spanish Council for Scientific Research and the Department of Photogrammetry and Remote Sensing Informatics of the AGH has been carried up. The first of these centres has been developing wide works of documentation and valuation of the Architectural Heritage from the Islamic period in Spain and other arab countries, using photogrammetric technics. This kind of experience has been used so that other centres and research teams in Spain have been able to use similar technics and methods.

From its beginning, photogrammetry constituted an extremely useful assistant to obtain representations of buildings with metric information. It made it easier to solve precisely the most difficult problems the direct measuring systems presented. However, it is also true that due, firstly, to its complexity and, secondly, to the need for the use of sophisticated and

costly instruments, photogrammetry has been limited in its applications to large buildings and monuments, in which there are usually great difficulties, but for which it is also possible to obtain the resources needed for its application. Costly and, therefore, scarce instruments also limited the number of people who were able to learn the technique which has only enjoyed real commercial development in the field of cartography.

Meanwhile, the needs regarding Cultural Heritage have augmented. An increased social awareness regarding heritage preservation in developed countries and the growing threat in this regards in underdeveloped countries, have increased the demands for greater knowledge and preservation of this heritage. It is not only the rising number of buildings included in the Cultural Heritage which have been traditionally protected on a local, national or international level, but also the attention given to Heritage sites once forgotten, such as is the case of vernacular or industrial architecture, which increase the demands for their study and restoration. The evaluation and study of endangered heritage sites are becoming more and more urgent problems. The processes of cultural and technological change and growing urbanism is altering ways of life and the necessities of societies, which in turn are threatening the preservation of historical sites. These factors pose more of a danger for the smaller heritage sites than the large monuments. In these cases, it is not so much the difficulties inherent in the large monuments which require costly systems of study and analysis, but the rather large number of smaller buildings that pertain to a wider-range heritage which requires a solution based on its needs. In this case, it is not the problems of the big monuments requiring a high level of accuracy, or the representation of complicated structures or diverse decorative forms that needs to be solved, but rather the need to be able to document, often before the disappearance or transformation of the sites, elements which are undoubtedly also of value to our historic past.

The problem we are faced with today is not the high cost of equipment, but rather finding people who are able and willing to take advantage of the latest improvements. Years ago it was usually not hard to convince architects and technicians of the enormous advantages of photogrammetry even when its final application was very difficult, due to the elevated cost involved in the use of precision cameras and stereo-plotters. Photogrammetry was, for many processionals, out of the question, due to the lack of economic resources needed for its application. In our opinion, today it is necessary to convince these professionals of two new concepts, in addition to the already known advantages. Firstly, they need to be convinced of the fact that costs are not necessarily so high. If the high precision which has always been associated with photogrammetry is renounced, to a reasonable degree, its costs may become notably lower than those of traditional systems, reducing as well the problems generally associated with the latter systems. In addition, it is necessary to convince them of the fact that this technique is not exclusively geared toward highly-specialized technicians ***[Almagro, 1999]***.

As a way of illustrating these ideas, I would like to recall a diagram which was made more than 30 years ago by Hans Foramitti, an enthusiastic promoter of the photogrammetric applications within the field of architecture ***[CIPA, 1983]***. That diagram clearly illustrated the advantages offered by photogrammetry in the 1960's. It shows in a very graphic way how photogrammetry offers, above all, a notable reduction in the time needed to carry out a survey, as well as how errors are greatly reduced and how the investments needed to implement this technique, were reasonable, yet significant.

Evidently, the majority of the instruments represented in that graph, although possibly still in use in some places, have been substituted by others of a superior technology. After the development of analytical photogrammetry, digital photogrammetry has open up a new panorama featuring reduced costs, as well as simple and easy-to-learn techniques. The use of standard hardware, whose costs are being reduced almost daily, while improving its storage capacity and data manipulation speed has meant a decrease in the use of specially-manufactured instruments which are necessarily more expensive.

At the same time the problem of producing quality digital images at a reasonable price is getting, day by day, better solutions. Digital cameras are improving the resolution of its images and creating an opportunity for future developments in the field of photogrammetry, as the low-priced scanners are not able at present, to guarantee the digitalization of traditional photographs with sufficient metric qualities.

With these new options and advances, it is possible to design a new graph that would update the one that Foramitti made in 1964 and which we are presenting here (Fig 1). As in the previous graph, the optimum price/service range relation for these systems is shown, which corresponds to what we call simple photogrammetric systems, that we have define as those which require reduced investments (<$5,000) and have easy-to-learn operational procedures. These systems, whether they are stereoscopic, monoscopic measuring, or photographic rectification, provide solutions to the previously-mentioned problems, without having to rule out the use of more sophisticated systems and the participation of specialists in certain cases.

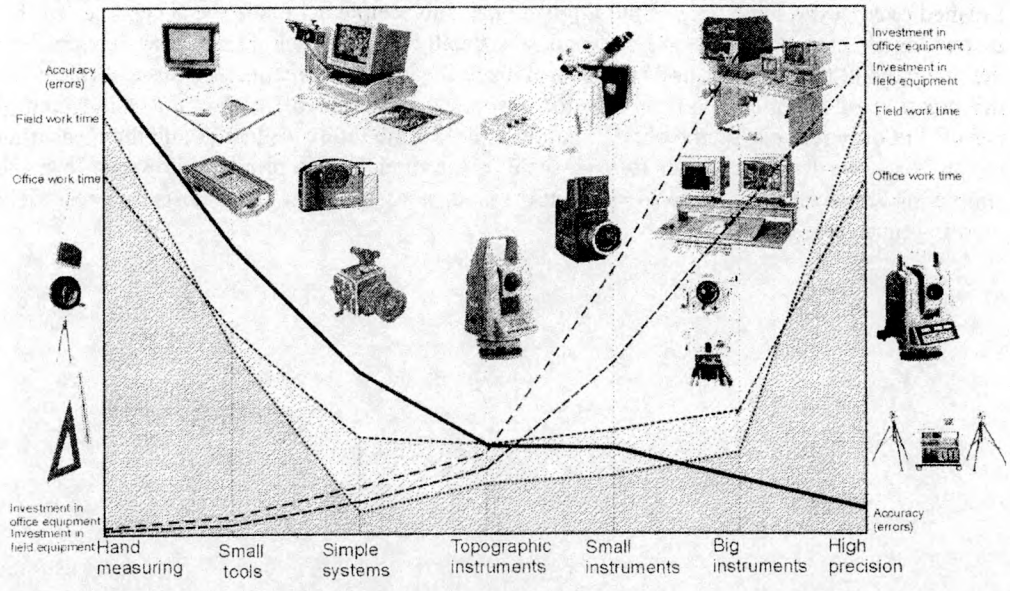

Fig. 1: Optimization of methods for architectural surveys

Among all these systems, VSD, produced by de Department of Photogrammetry and Remote Sensing Informatics of the AGH represents a clever answer to the need of low-cost but high quality systems of recording cultural heritage *[Jachimski, 1995]*. Undoubtedly the greatest opportunity offered today in the field of architectural documentation is the availability of reasonably-priced systems and the prospect of even lower costs in the future, given that there will be sufficient demand. The potentiality of this demand is large to the fact that the field of architectural heritage is in need of adequate documentation capable of solving problems in areas where more traditional means are unable to produce the same results. VSD is giving a real answer to these possibilities and offers real solutions to the problems of recording our architectural and archaeological heritage.

We believe so and we have bet for it. Our experience has made us trust this system and since we had knowledge about its existence, we have been working in order to improve its applications and broadcast its use. CIPA has been until now a meeting point between Prof. Jachimski and me, where from the beginning we have been participating experiences and have talked about needs and how to attend them. Great part of our suggestions has been understood and accepted by Prof. Jachimski being carried out by improvements in the software. The concession of a license to test VSD allowed us to verify in a practical way the great advantages of this system and its application possibilities in our working fields. That allowed us to promote its use between colleagues who came to ask for our opinion or our help in order to start working with photogrammetry. This kind of demand made us go further in our cooperation with the Department of Photogrammetry and Remote Sensing Informatics of the AGH, in order to adapt the software to the existing necessities. One of the first works undertaken was the complete translation of all the program messages to Spanish, which was finished even at the same time as the English one. This simple act made the acceptance of this system much easier for Spanish colleagues, specially in the teaching field, as having both the manual and the software itself in Spanish made it easier to be learnt. It is also of relevance the creation of an orientation process for absolute orientation of models not using control points, but only remarks on the object in order to define the reference planes and the measuring of, at least, one length in order to give scale to the model. This process allows us to make simple surveys with very simplified resources and, consequently, lower costs and less field working time (Fig.2).

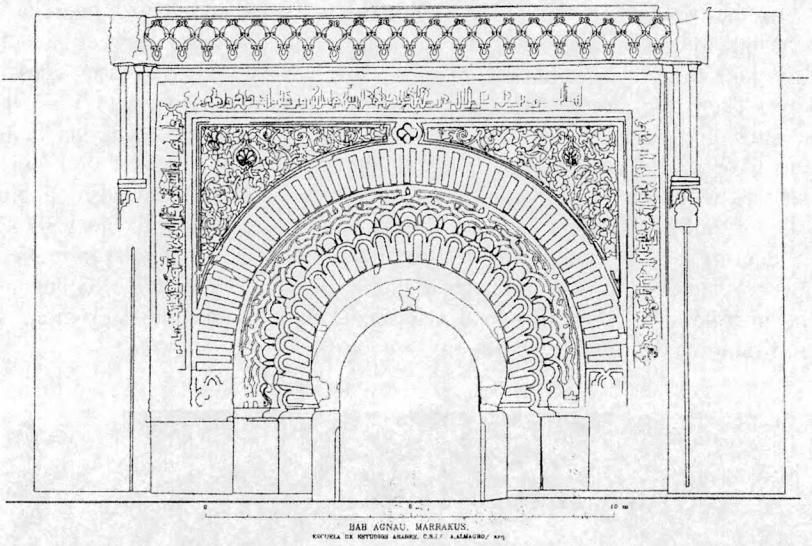

Fig. 2: Bab Agnau in Marraketch (Morocco), plotted with VSD from pictures obtained with Nikon Coolpix 700 digital camera and without control points.

The software has been specially welcomed in the teaching field. More than half of the actual licenses actually used in Spain are being used to teach photogrammetry to students of architecture, topography and photogrammetry. Its characteristics make this software specially suitable for teaching, because it is not only simple to be used and to understand photogrammetry principles, but it also allows the teacher to control the students work and the correct prosecution of the tridimensional model.

The real problem today for the developing of the use of photogrammetry lies in training the people able to operate those systems: architects, archeologists, art historians, curators, draftsmen and technicians in general. Photogrammetry should be promoted and taught to these professionals, not as a sophisticated and complex systems requiring costly instruments and specialized technicians, but as a methodology that is accessible to everybody and which is no more costly than other commonly-used computer software. Photogrammetry should be not only a synonym for precision, but also one for speed and efficiency as regards documentation, an ideal system for producing 3D models in CAD software, for creating data bases, and offering efficient solutions in emergency cases, etc.

Another field where the VSD system has had a good welcome is in archaeology. This science has always had a big needing for documentation, due to its destructive method, which obliges to make the best possible record of the original situation and the successive steps of the process. There are already three archaeological teams working with VSD in Spain, on different sites and different circumstances. In other cases, the system is being used by professionals or institutions dedicated to studying or restoring Architectural Heritage. In all this occasions neither is the software being used or the restitutions made by photogrammetry specialists, and all of the users have started using these technics with the VSD system. This makes evident its easy learning, which is also proved by the results on the formation courses in building surveying dedicated to architects at the School of Architecture of Granada University, in which, in spite of the short time available according with the studies program, students are able to fulfill quite complicated restitutions.

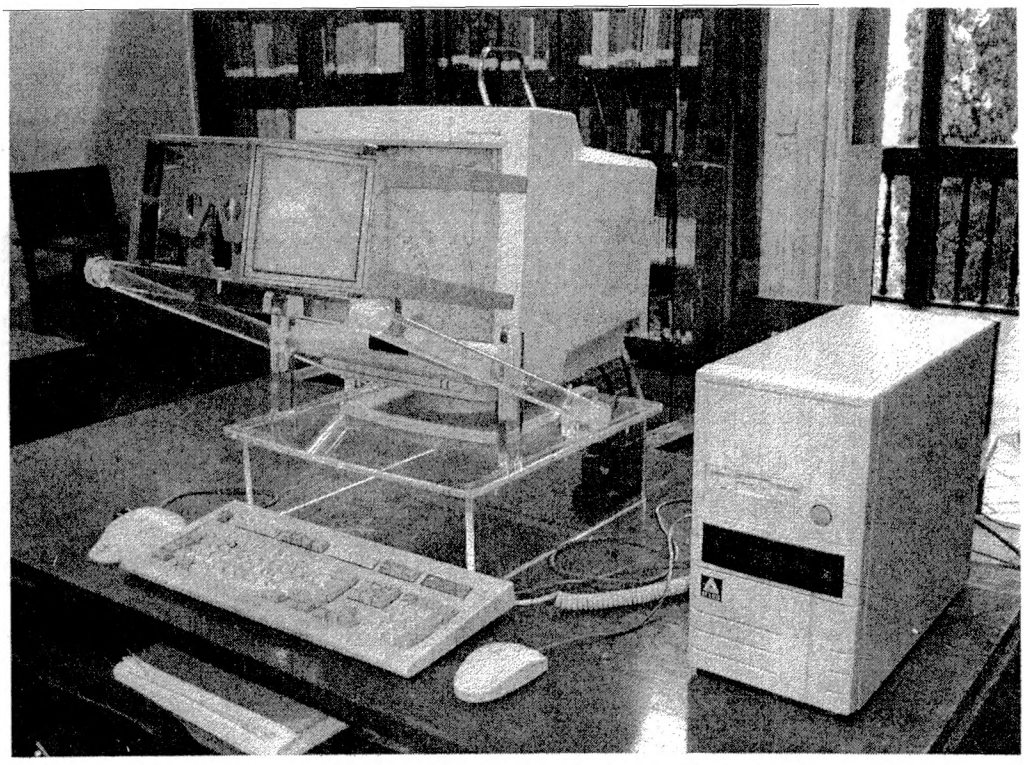

Fig. 3: Support with standard stereoscope

The increasing demand for VSD licenses brought the obligation for us to provide stereoscopes for tridimensional viewing of the model on the screen. First, we used stereoscopes available on the market, making suitable supports for its use in front of the screen. We chose the Australian trademark stereoscope because of its cheapness and little weight. With some small adaptations in order to fix the looking lenses and the manufacture of a suitable support, the first licenses could be worked out. However, the support, made in

methacrylate, turned out to be very expensive, and it had to be produced in a specialized workshop (Fig 3). Ours were made in the mechanical workshop at the Institute of Astrophysics of Andalucia belonging to the CSIC.

Afterwards, we decided to search for a more simple and cheap solution, designing stereoscopes specially adapted to our particular needs and, specially, the use of VSD in portable computers. The design is based on simplicity and strength on the different parts and on the easiness to find and manipulate the materials. Optic elements (lenses and aluminized mirrors on the external face) are bought at an optical material factory. The structure of the stereoscope is a simple aluminium rectangular tube cut and modified with the tools of an aluminium carpenter workshop. Different supports for each kind of screen are built with ironmonger shop pieces and metallic shelves which are easy to buy and cheap. In this moment, and in spite of the handmade way of making, a certain kind of standardised production has been achieved in order to offer these pieces to future costumers of the VSD system (Fig 4).

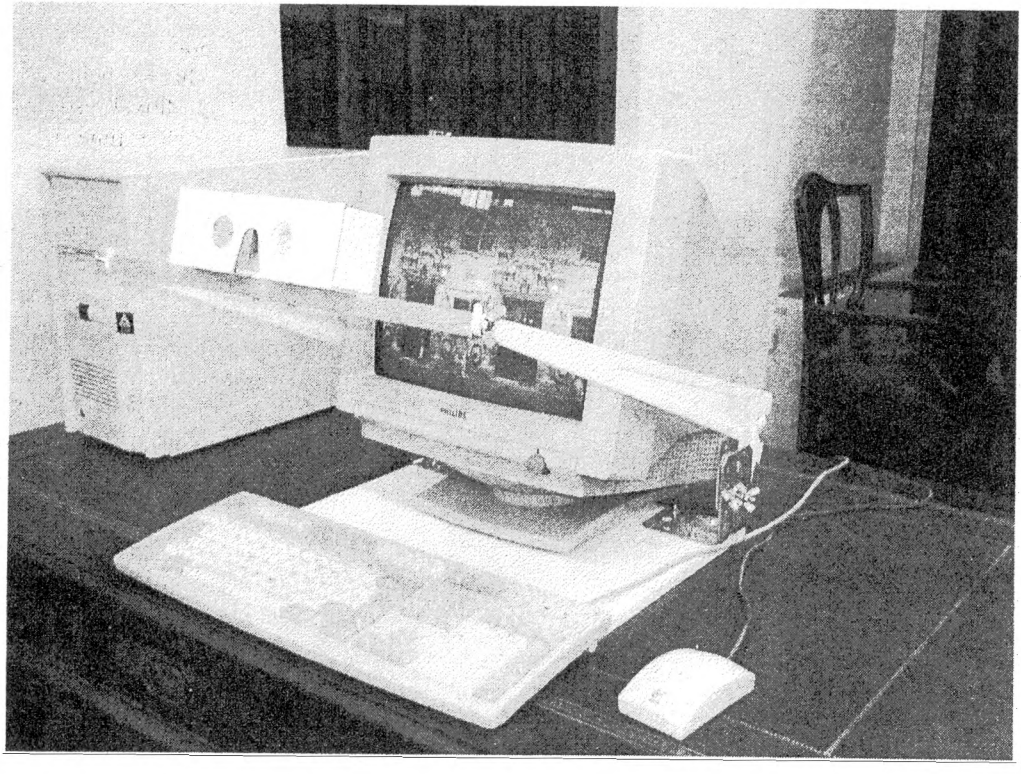

Fig. 4: New stereoscope mounting

Another problem that has had to be solved is how to obtain digital images with enough quality and reasonable price. We started working with photographs taken with a semimetric camera and digitalized by different kinds of scanners. Normal desktop scanners did not work satisfactorily, as they caused uncontrolled y-parallax caused by the nonhomogeneous movement of the CCD. The Department of Photogrammetry and Remote

Sensing Informatics of the AGH digitalized some images for us with very good results, but with the inconvenient of not having them immediately available. A special scanner for large format slides has just been bought and has allowed us to get acceptable results, although it has also needed a high inversion for its buying (5400US$).

We have achieved better results using digital cameras of standard production. Although the resolution of its images is still low, their metrical qualities are far higher than the ones obtained using desktop scanners. First tests were made with a Kodak DC200 camera of 1152x1864 pixels (1Mpixel), which has the advantage of having a completely fixed lens. In spite of the reduced resolution, we could verify its excellent results in the relative orientation of these images. We worked, afterwards, with a Nikon Coolpix 700 camera, which, although is an auto-focus camera, allows the blockade of focussing on fixed positions. This camera has a resolution of 1600x1200 pixels (2 Mpixel).The final results are similar, but with a sensible improvement in image details. The cameras were calibrated with the Orient bundle adjustment software from the Institute of Photogrammetry and Remote Sensing at the Technical University of Vienna. The VSD software has been used to measure the coordinates of the image points. Using this experience, we have calibrated a number of cameras for different VSD users, most of them Nikon Coolpix 700 or 750, that are being used to obtain stereo pairs for stereo-plotting. The appearance in the market of 3 Mpixel resolution cameras offers new possibilities and, most of all, the perspective of having in short time similar resolution to the one of a traditional photograph.

Finally, we have worked in order to combine all these elements in the development of a portable photogrammetric system, able to be carried and used anywhere, and with a wide range of possibilities specially in the field of archaeology. With this aim, we used a portable computer with one of the already described stereoscopes correctly fixed to the screen and combined with a digital camera. This system enables to acquire images in the site, to transfer to the computer and to convert it for its use with the VSD and to plot without depending on any photographic laboratory or any other resource not mentioned before (Fig 5). This system has been tested widely enough and is, in our opinion, a revolution in photogrammetry applications, with assumable costs in an archaeological project and offers a very important reduction of costs specially in field survey time.

In a near future we expect to intensify our collaboration with the Department of Photogrammetry and Remote Sensing Informatics of the AGH due to improve and update the VSD software, with the strong desire, in the beginning of the next century, of making photogrammetry a usual tool in surveying and protecting our cultural heritage.

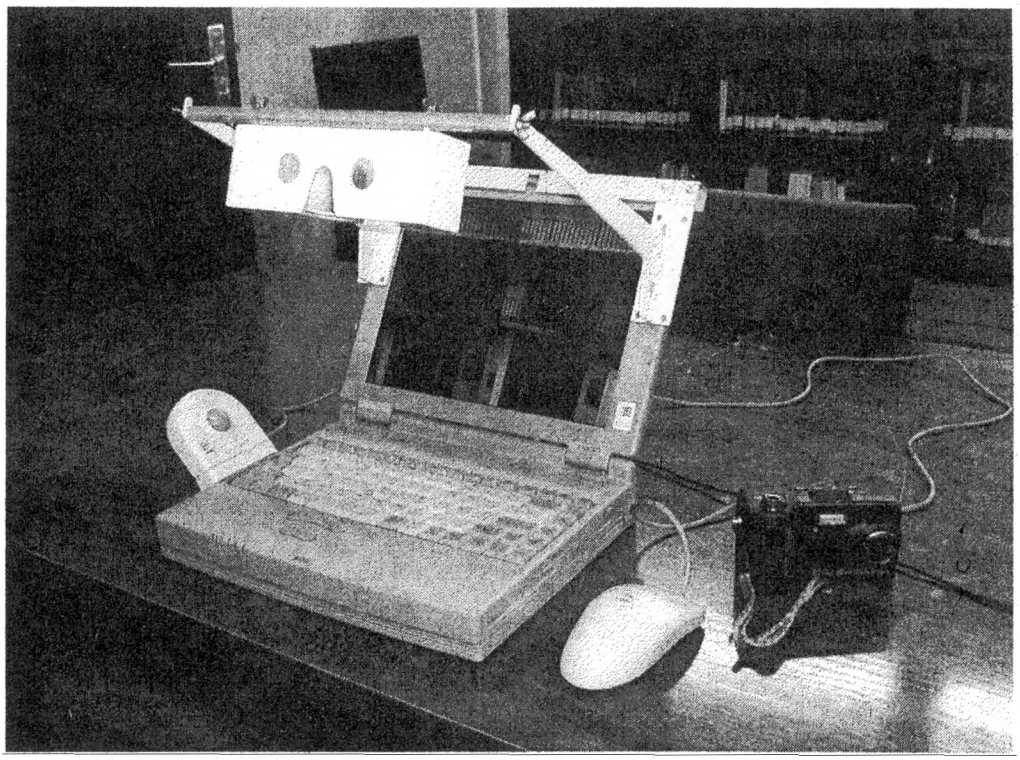

Fig. 5: Portable photogrammetric system based in VSD

References

1. Almagro A., 1999, *Photogrammetry for everybody,* XVII CIPA Symposium, October 3-6 1999, Recife/Olinda- PE-Brazil. Publication in CDRom.
2. CIPA 1983, *Hans Foramitti et le développement de la photogrammetrie architecturale.*
3. Jachimski J., 1995, *Video Stereo Digitizer. A small digital stereophotogrammetric working station for the needs of lis and other application,* Geodesy, Photogrammetry and Monitoring of Environment (Chosen Problems), Geodezja, 38, p.71-93.