Photogrammetry in the internet - challenge or temporary usage

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ABSTRACT

The development of the internet started in the year 1969 with a research project of the US government. The aim of the project was the development of a network which enables the connection and communication of different computer platforms. Whereas at that time only four computer where connected in a first implementation the estimated number of connected computer today amounts to more than 47 millions (source: ct report 2, Geld online 97). Further investigations came to the result that the number of world wide users of the internet would be more than 1 billion after the year 2000 (Grunau, 1996). The data highway has become the embodiment of the step of mankind towards the age of information technology. In this paper the potential of the internet for applications from the field of photogrammetry is discussed. The first part gives the fundamentals for the understanding of the internet. Existing applications are shown with examples to demonstrate the manifold features of the internet. Afterwards potential applications are discussed which are not yet realized but are already technical possible. An outlook shows possible developments of the future.

1. FUNDAMENTALS

The services of the internet are supported by multiple graphic oriented software tools which could be used without much prior knowledge. The setup of the connection and the communication between the computers are transparent to the users. In the following some terms are explaint which are needed to understand the functionality of the internet.

1.1 Internet

The term internet denotes all computers and communication networks which are using the protocol TCP/IP (Transmission Control Protocol/Internet Protocol) (Comer, 1991). No superior control instance exists in the internet but it is composed of innumerable local and global networks. The internet provides a lot of different services as for example electronic mail (e-mail), working on a remote host (telnet) or the transfer of files between different hosts (ftp). One of the most popular services is the World Wide Web (WWW) which makes not only its own functionality available but also provides all other services of the internet with an uniform user interface.

1.2 Access to the internet

Research institutes and large companies are often connected physically to the communication network of the internet. Users which are not connected directly to the internet (which is the majority today) can use the telephone network for the data transfer. They need a normal PC which is connected to a modem. Today the typical standard transfer speed of modems is 33600 bit/sec (July 1997). The latest generations can work with speeds up to 56000 bit/sec. Users which have access to ISDN can get a bandwidth of 64000 bit/sec for each ISDN connection. After installing the modem the user can connect to an online service or an internet provider. The difference between online services and internet provider is that online services do not only provide internet access but they provide also access to additional information sources which are only available for subscribers. The arising costs for online services or internet provider are composed from a monthly basic rate, possible hourly charges and the telecommunication rates. Supplier of online services are for example America Online (AOL), CompuServe, Microsoft Network (MSN) and T-Online (only in Germany).

1.3 WWW

The World Wide Web is based on a client/server based architecture. WWW server make information available in the internet which can be retrieved with browsers (clients). A lot of different browsers are available on the market with very similar functionality. The main representatives are Netscape, Microsoft Internet Explorer and NCSA Mosaic (Nolden, 1996). Browsers are used to visualize information like text, pictures, videos and more. Figure 1 shows the browser of the company Netscape visualizing information of the German Umbrella Organisation of Geoinformation (DDGI).
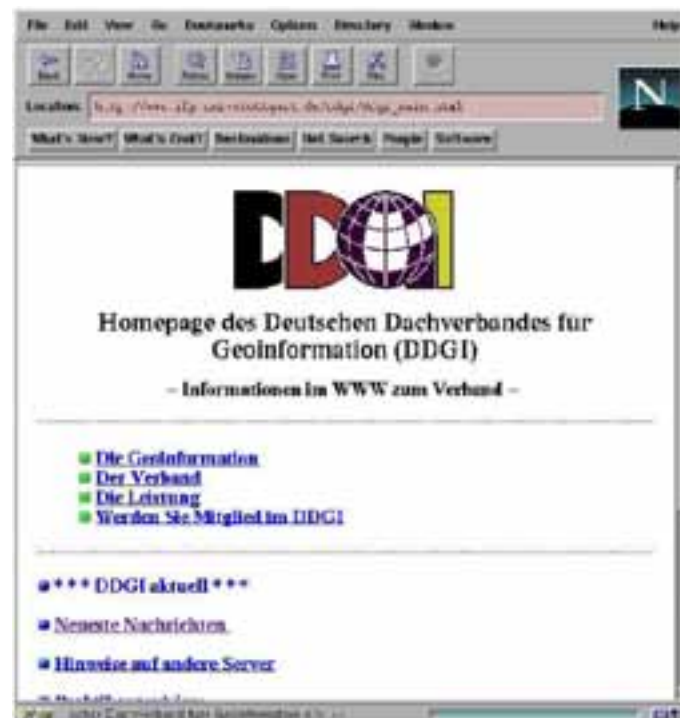

Figure 1: Netscape browser with information of DDGI.

Navigation in the WWW is based on an hypertext system which has been developed at the European Laboratory for Particle Physics (CERN) in the beginning at the nineties. The fundamentals of the WWW are hyperlinks represented with highlighted text or graphics in the document which is visualized in the browser. If the user clicks with the mouse on an hyperlink a connected document is loaded into the browser. This document could be again an hypertext document but also a graphic, an audio, a video or even a program. It is not necessary that the documents have to be stored statically on a server because they can also be created dynamically dependant on the context. Because of the large amount of medias which can be handled in the WWW it has to be classified not only as an hypertext system but as an hypermedia system. The documents can be stored on any WWW servers in the world. The physical place where the document is stored and the way how it is transported to the client is transparent to the user. The user can "jump" between any server and retrieve information from the whole world. Therefore the WWW is not a hierarchical structure but a net structure. There exists no defined starting or ending point and the user can navigate on any way through the network.

A further possibility to load a document without navigating with hyperlinks is the use of the Uniform Resource Locator (URL). The URL is an extension of the filename concept and enables the unique identification of files on any host in the internet. It consists of the name of the internet protocol (which is http [hypertext transfer protocol] when using WWW), the name of the host and the filename. The Uniform Resource Locator of the German Umbrella Organization of Geoinformation (DDGI) is for example **http://www.ifp.uni-stuttgart.de/ddgi/ddgi_main.html**.

1.4 Search engines

The amount of available information in the internet is increasing very fast. The search for specific information can be very time-consuming. One way to retrieve information in the WWW is to follow hyperlinks so long until the desired information is found. In this way a lot of unnecessary information has to be retrieved and the success is not guaranteed. Search engines are provided in the internet in order to get more directly to a desired document. A search engine is a thesaurus which needs one or more keywords as input and produces a list of related WWW documents as output. One of the most comprehensive search engine in the internet is offered by the Californian company Yahoo (**http://www.yahoo.com**). In order to reduce the amount of documents in the result the query can be specified with boolean expressions. A request to the search engine of Yahoo to search for all documents which contain the keyword *photogrammetry* resulted for example in a list with 7250 entries (this query was done on May 15, 1997. Meanwhile it is very likely that further documents are added).

1.5 Virtual Reality Modelling Language

WWW browsers are able to represent text, graphics, audio or videos. Most of the standard formats can be used for the data exchange. An additional exchange format is the Virtual Reality Modelling Language (VRML). VRML enables the exchange of three dimensional scene descriptions which can be explored interactively by the user. Control elements are displayed in the browser to navigate in the virtual three dimensional space. The user can move in any direction and with any speed. It is possible to connect audio sequences to the three dimensional objects to make the virtual world more realistic. The sound sequences are played in an intensity which is dependent from the virtual distance of the user to the object. Figure 2 shows an example for a virtual world which is described in VRML (**http://www.bath.ac.uk/Centres/CASA/london/**). It is a 3D-map of a part of central London. The buildings are captured in detail above and under ground. It is possible to define hyperlinks between 3D-Objects and other WWW documents.

1.6 JAVA

The development of the programming language JAVA is discussed as a revolutionary change in the computer world. JAVA has been developed by the company SUN-Microsystems and enables the development of cross-platform interoperable programs which can be used in different operating systems from desktop to supercomputers. This enables the exchange of complete applications which can be executed on any client as independent programs. JAVA programs are activated by mouse click in the same way as any other document. There are already a lot of professional applications available. More information can be found for example at **http://www.gamelan.com/**.

1.7 Intranet

Intranets are company wide local networks which are using the same technology as the internet. They are subnets of the internet without the necessity to be connected to the internet. The idea of intranets is to use the existing software tools of the internet to improve the communication and the exchange of information within a company. The user can work with the same software to communicate in the internet as well as to communicate within the company. Firewall techniques are used to protect the data against unauthorized access from outside. Especially companies where the users need access to distributed data sources make use of intranets in order to make work flows more efficient and to enable company decisions with high up-to-date data. A good overview on intranets can be found at **http://intrack.com/intranet/**.
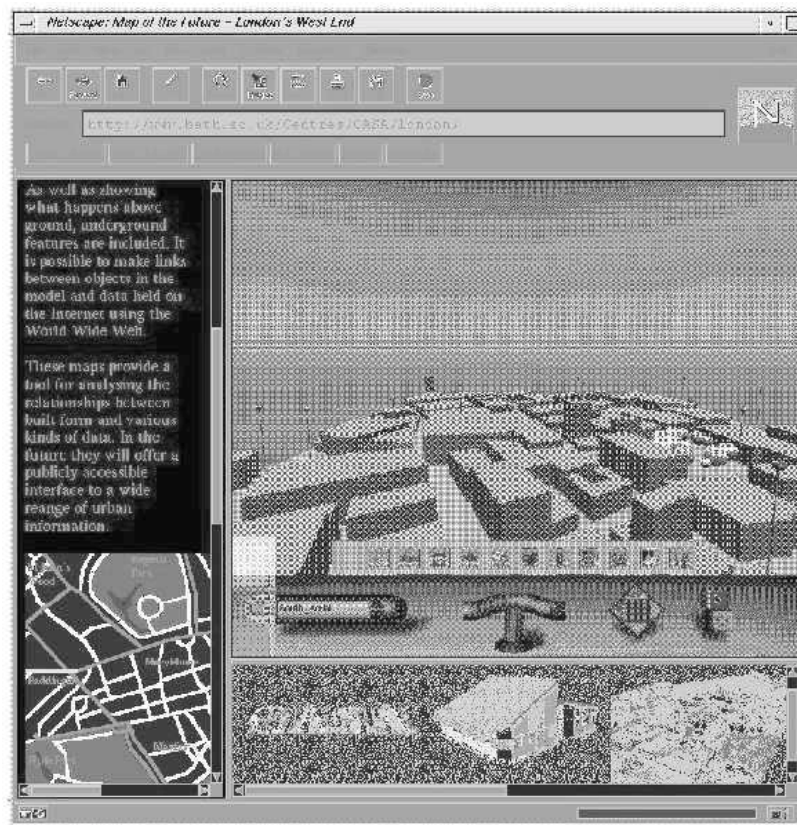
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Figure 2: Virtual 3D-map of London.

2. EXISTING APPLICATIONS

Today a lot of applications relating to the field of photogrammetry are realized in the internet. Especially spatial data provider and meta information systems about spatial data provider can be found in the internet with an increasing trend. However the palette of existing applications has a wider variety than that. From scientific discussion groups over supplier of hardware and software to geodata based services a lot of different applications are available. In the following some of these applications are selected and presented.

2.1 Scientific information

The very first institutions which has been connected to the internet were the universities. Meanwhile the online presence is a standard for scientific institutions. The focus of interest are the presentation of projects, people, publications and conferences. This enables a more effective search for specific information. For example literature recherches can be done in a significantly shorter time than without using the internet. An example is the homepage of the Institute for Photogrammetry, University of Stuttgart (**http://www.ifp.uni-stuttgart.de/**) shown in figure 3.

A further possibility to get information about a specific field is the reading of Newsgroups. These are virtual black boards in the internet where users can leave messages, questions or ideas. If an active user leaves a question he will get an answer very often in short time because many experts are reading Newsgroups. The passive user follows the discussions and can get a lot of knowledge to a specific theme. This makes expert knowledge accessible without paying money.

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Figure 3: Homepage of the Institute for Photogrammetry, University of Stuttgart.

2.2 Product and company information

The internet provides a very cheap way of marketing. People which have to decide about buying a product have the possibility to get product information from different companies in very short time. Products on dynamic markets can be presented with uptodate prices. Further contents can be for example company profiles, jobs or even the providing of software updates. Figure 4 shows information about hardware and software products for photogrammetric tasks of the company ZEISS (**http://www.zeiss.de/**).

2.3 Geodata and meta information systems

One of the main problem of applications which are based on geodata is to get these data. In the field of banks or insurance companies there exist a lot of potential users of geo-information systems. But these users are often not organisational and educational able to digitize the data by themselves. Even though spatial data are acquired in a huge amount they are in practise often not usable because of missing documentation or inavailable producer or impossible access (Voss & Morgenstern, 1997). Solutions for problems of this kind can be found in the internet. There already exist a lot of online supplier for raster data (see for examples (Liebig, 1996) or (Osaki, 1996)) because of the simple handling of these data. Raster data can be transfered standardized and converted between a lot of different formats without any losses of information. The main problem of the data transfer of vector data is the different structure of the geometric and semantic data because of different data models (Moegerle & Schüller, 1993). However first approaches to handle these problems can be found (Walter, 1997). With meta information systems an effective online search for vector and raster data can be done. They provide access to supplier and product descriptions of spatial data. This enables a more effective search as when using conventional search engines because it is possible to search not only for keywords but also for coordinates or descriptive attributes. In the following section four supplier of spatial data and meta information systems are presented.
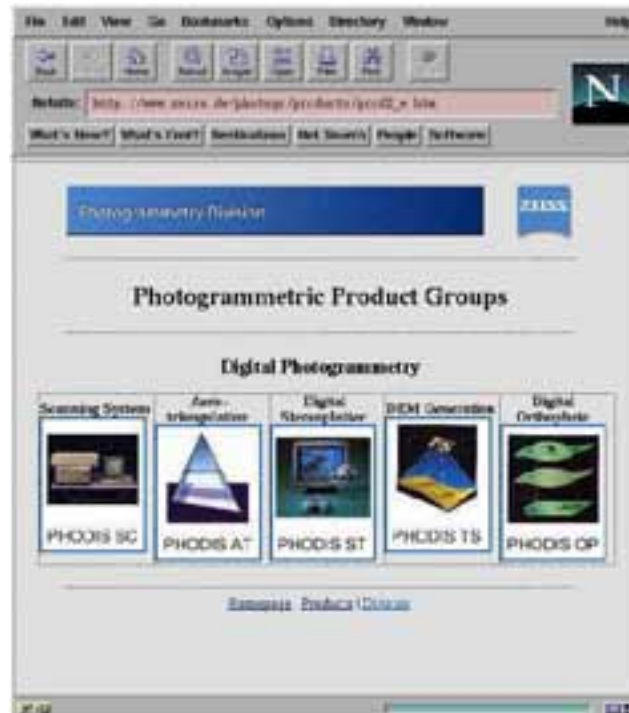
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Figure 4: Product information in the WWW.

2.3.1 Meteorological data supplier

Meteorological satellite data have only limited use for photogrammetric tasks because of the height of the geostationary orbit but they are taken with a high repeating rate and document the high potential for time critical applications in the internet. Beside satellite data a lot of other data sources for meteorological applications are available in the internet. For example some meteorological stations are providing online videos from cameras which are installed on the roof of weather stations. Figure 5 shows data from the satellite Meteosat (**http://www.meteo.fr/**). Every day at 01:30, 07:30, 13:30 and 19:30 MEZ an updated picture is available in the internet.

2.3.2 MEGRIN

The European authorities for cartography are joined together in MEGRIN (Multipurpose European Ground Related Information Network) to realize international projects and to offer their products European wide (Illert, 1996). The meta information system GDDD (Geographical Data Description Directory) has been developed in MEGRIN. The GDDD is based on the standard of meta information which has been proposed from CEN/TC287 (Comité Européen de Normalisation/Technical Committee 287 (CEN, 1996)). It contains data about coordinate systems, quality statements, sources, prices, exchange formats and more. Today GDDD contains 185 data set descriptions of 35 national authorities for cartography (Illert, 1996). Figure 6 shows the World Wide Web interface to GDDD (**http://www.ign.fr/megrin/megrin.html**).

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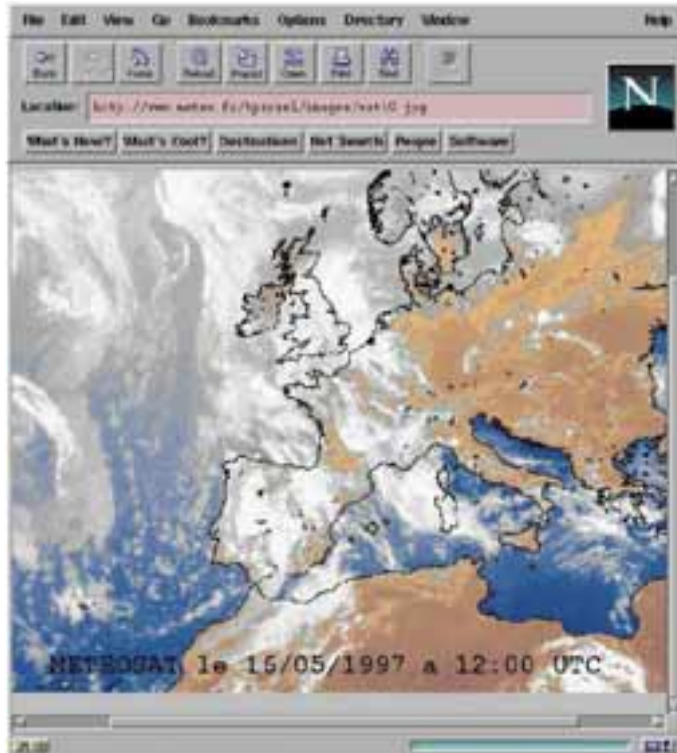Walter   263

Figure 5: Meteosat data from May 16, 1996, 12:00 am.

Figure 6: World Wide Web interface to GDDD.

2.3.3 ISIS

The Intelligent Satellite Data Information System (ISIS) enables the access to the data sets of the German Remote Data Center (DFD) as well as to information about satellites, sensors or other topics which are related to remote sensing. The remote sensing data can be visualized, ordered and transfered online. The database contains more than 150000 data entries, 85000 pictures, 15 sensor types (for example: Landsat, Spot, AVHRR, MOMS-D2 and more) and 40 product types (February, 1997). In addition ISIS facilitates network transfer of digital quicklooks for visual inspection of selected data. Besides a special graphic interface ISIS offers also a WWW interface (**http://isis.dlr.de/**). Figure 7 shows the WWW interface presenting a quicklook from Bulgaria. The data was captured by the multispectral sensor of the Indian satellite IRS-1C.

Figure 7: Quicklook of IRS-1C data in ISIS.

2.3.4 TIGER Mapping Service

The TIGER Mapping Service (TMS) (**http://tiger.census.gov/**) has been developed by the U.S. Census Bureau and provides access to maps in the United States from regional scale to street maps. The user can choose the scale and select a set of visible layers. The maps are cartographically represented and can be transferred as GIF files to the local host. According to statements of the U.S. Census Bureau 25000 to 30000 maps are generated daily. Figure 8 shows an example of an interactively generated map of TMS.

2.4 Services

The offering of geodata-based services is a new trend which can be seen in the internet. A lot of applications already exist in the fields of touristics and marketing. An example is the ATM-Locator of the company VISA (**http://www.visa.com/**), which map the three ATMs (automated teller machines) nearest any location in Australia, Canada, or the USA. In the following two existing geodata-based services will be presented in detail.

Figure 8: Interactive generated map of TIGER Mapping Service.

2.4.1 Route planning

The German company CAS-Software GmbH offers information systems for spatial analyses. Besides product and company information in the internet a free of charge route planning is offered for the area of Germany (**http://www.cas-software.de/**). The user only has to determine start and destination. The result is a complete tour description with time and distance data as well as street names and driving instructions. Additionally a graphical representation of the result on a street map is generated. Figure 9 shows an example for a route planning.

Figure 9: CAS-Software route planning.

2.4.2 Touristic information systems

The Californian company Excite, Inc offers City.Net which is a database with information from over 5000 places in the world. To get information about a specific place the user can enter the name of a city or navigate interactively in maps from world scale to street maps. For every place a lot of information are provided such as hotels, weather information, maps or touristic sights as well as hyperlinks to local servers in that city. The user can make online bookings of hotels, rental cars or airplane tickets. The use of City.Net is free of charge. It is possible to insert individual links to local servers. Figure 10 shows an interactive map from New York which is presented from City.Net (**http://www.city.net/**).

Figure 10: Interactive map from New York in City.Net.

3. VISIONS OF TODAY

Hardware and software in the internet is developing so fast that existing applications rarely use the entire potential. In the following exemplary applications are described which are technically possible but not yet implemented.

3.1 Geodata at your fingertips

Meta information systems offer a fast search for spatial data but the following data exchange is often difficult because of different exchange formats and different hardware and software platforms. The WWW is not necessary in any case to solve these problems but it can be seen that because of the standardized access and the standardized user interface an exchange of data can be simplified. First solutions can be found by the company ESRI with hobie the products *ArcView Internet Map Server* and *MapObjects Internet Map Server* (**http://maps.esri.com/ESRI/esri.htm**). With these applications it is possible to offer spatial data and applications in the internet. A further product is offered from the company Autodesk. The plug-in-module *Autodesk MapGuide* (**http://www.gridnorth.com/**) is a functional extension of WWW browser for visualisation of spatial vector data.

These techniques enable the realization of data warehouses which the user can search in and buy spatial data which have to fulfill specific data quality features. Also the necessary analysis and presentation modules could be loaded from the internet and combined with applications. The accounting of these services is a problem but for example online bank institutes are indicating that already secure solutions for online accounting are available. International internet contracts are still a problem because they are not defined sufficiently in the existing law. In the EU this problem is recognized and currently discussed.

Another possibility is to provide complete geo-information systems in the internet. The users need neither geodata nor software but compute their analyses on the information system of an internet supplier. This is especially interesting for users who are needing spatial analyses only secondary (for example banks or insurances companies). This minimizes the costs for purchase and maintenance of hardware, software and data.

3.2 Real time data

Beside the standardized exchange of data and the disappearance of geographical distances the speed of data transmission is a further advantage of the internet. Data can be made available nearly in real time. This leads to new fields of applications. It is shown for example by (Fritz, 1995) that the supplier of new generations of satellites want to reduce the time from data capture to data delivery to the customer down to 15 minutes. Providers of meteorological data are already proofing that these requirements can be fulfilled by using the internet technology.

Data for traffic navigation systems should be made available for the user immediately after capturing them. Presently available systems organize their data exchange with CDs. The process from capturing the data to producing and selling the CDs takes about three months. The data could be transferred on the demand of the users when using internet. It is only necessary to transfer the changes into the datasets which does not need much time.

4. VISIONS OF TOMORROW

The development of the internet is still in progress. Leading scientists are pointing out that the internet will change the society (eg. (Negroponte, 1995)). This will also lead to changes of the presently existing production world. One possible modification could be the use of network computers (however their realisation will look like) instead of traditional workstations. Java applications and intranets solutions will play an important role in this field.

A common criticison is the missing bandwidth for the transfer of high data volumes which are typical for spatial applications (eg. (Voss & Morgenstern, 1997)). But this is more a political than a technical problem. Recent research is indicating that it is possible to transfer up to 1,000 billions bit per second with the already existing fiber optics technology (Negroponte, 1995). This means that one single fiber optics wire (not a bundle) is able to transfer one million TV channels at the same time (Negroponte, 1995). Increasing requirements of the users will be no problem anymore when using these technology. The high potential of the internet is also recognized by the entertainment industry. This industry invests high volumes of money to develop products like interactive TV or Virtual Reality based on internet technology. In the future this will lead to the fact that the access to the internet will not be provided with traditional slow telephone networks anymore but telephone networks, computer networks and cable TV network will be transferred through one common high speed medium. A connection to the internet will be as naturally as the connection to electricity or water.

Because of these changes spatial applications will get new potential. Systems which have no standardized interfaces will be replaced by open systems. Geodata and applications will be merchandised on virtual data warehouses. The users will pay money for the use of the data and the

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applications but they will not buy them. The know-how will be centralized by the supplier of services and data. The access of end users to geodata will be easier and no special training will be necessary to work with spatial applications.

For example town planning which is already done in a digital manner could be made accessible for the public with the internet. People could get the possibility to follow interactively the planning and visit virtual town scenarios. Another important field is the touristic industry. Multimedia applications and virtual reality based on internet technology will replace traditional catalogues. This is a field with high investments and the underlying data are typically spatial. Therefore applications of this kind has to be watched carefully.

A further interesting aspect shows (Nolte, 1996) with the slogan *kilobyte instead of kilogram*. High mobility is needed because of international joining of companies and markets. But this mobility leads to environmental problems as well as to high costs. With the word wide availability of information on fingertips new answers to this problem can be found. People could work together and exchange informations with internet technology but without moving themselves to remote places. This would lead to big changes of the existing working world.

5. SUMMARY

The internet technology and especially the WWW technology is so important because of the platform independence and the transparent client-server communication for the users (Rickert &Ebbinghaus, 1995). A further important feature is the transmission speed of data. In this paper some applications from the field of photogrammetry are presented. These applications are demonstrating the high potential of the internet. But these application can only show a small part from what is possible today. Further geodata-based applications in the internet can be found for example in (Lessing & Lipeck, 1996). The number of users and the amount of information in the internet is steadily increasing. A lot of applications can be used free of charge. The internet is a challenge for all scientific disciplines and it will lead to big changes in the existing production world. Therefore it is very important to face these challenges and to use the potential of the internet timely.

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