

## The Photogrammetric Week Series – A Centennial Success Story

DIETER FRITSCH, Stuttgart

### ABSTRACT

When Dr. Carl Pulfrich 1909 introduced the “Vacation Course in Stereophotogrammetry”, terrestrial photogrammetry has driven most applications. He, the founder of stereo-photogrammetry, was convinced, that after the introduction of the stereo comparator (1901) a new milestone was needed to improve the accuracy of photogrammetric object reconstruction. Obviously, there is nothing better than initiating an open discourse between scientists, developers and practitioners. This great idea has driven all Photogrammetric Weeks and been maintained until today. We, the past and present organizers, speakers and participants gratefully acknowledge the idea of technology transfer in this manner.

The paper first remembers to Dr. Carl Pulfrich, the physicist and photogrammetrist, and refers to his contributions to stereo photogrammetry. Speaking about 100 years of Photogrammetric Weeks should also remember the big milestones in photogrammetric history, complemented by general historical remarks. Nowadays, the Photogrammetric Week Series are well documented by a digital archive which is improved step by step in the future. Some photographs complement the historical journey in time just to show the spirit of the events. The structure of having invited speakers in the mornings and vendor demonstrations in the afternoons is optimized - the social program provides ample time for intercultural relations and simply to maintain friendships. The paper concludes with an outlook to the next years of photogrammetric research and development.

### 1. REMEMBERING DR. CARL PULFRICH

Carl Pulfrich was born on September 24, 1858 as first son of a school teacher in *Burscheid* near Dusseldorf. After primary and secondary school he studied Physics, Mathematics and Mineralogy at Bonn University. At that time, the German Empire or “German Reich” - just launched in 1871 - provided stable political basic conditions to the well-being of science, economics and culture. Prince Otto von Bismarck, the first “Reichs”chancellor, delivered and implemented the pillars of the German social security system which are still in progress until today, but – most probably – have to be adjusted to the “missing children society” of 2005.



*C. Pulfrich.*

Fig. 1: Dr. Carl Pulfrich

Right after graduation Carl Pulfrich started research in optics and finished a PhD thesis in 1881. He accepted a position as assistant and lecturer at the Institute of Physics at his Alma mater (1885-1890) and started a collaboration with chemists to design and build a new refractometer. This kind of instruments delivers measurements for the determination of the refraction index of optical media using the refraction or total reflection of light. During this work he excited the attention of Dr. Ernst Abbe, who, as Partner of Carl Zeiss, built a refractometer as well. In 1890, Dr. Abbe invited Dr. Pulfrich to become an associate of the Carl Zeiss Jena enterprise, mainly to design optical measurement instruments. He accepted and stayed there until he died 1927.

By the way, Carl Zeiss, an university mechanic, founded his company 1846. He started to build microscopes for biological, chemical and medical applications. He realized very soon, that further improvements of his microscope products could only be made by scientific computations. Thus,

he started in 1866 the collaboration with Dr. Ernst Abbe, at that time a professor of physics at Jena University. In 1875 Dr. Abbe became partner and shareholder of the Carl Zeiss enterprise and started the development of optical-mechanical instruments. Carl Zeiss passed away in 1888, leaving 327 associates in his company.

Photogrammetry at those times was not yet developed at all. A first hint on using photogrammetric techniques was already given by the French physicist Françoise Arago (1786-1853), when he in 1839 explained the invention of photography in front of scientists at the French Academy in Paris. He pointed out, that his new invention could serve “to measure the highest and inaccessible buildings and to replace the fieldwork of a topographer”. Most probably, Arago knew about the work of J.H. Lambert, a great German mathematician (1728 – 1777), who published in 1760 investigations to reconstruct spatial objects using perspective drawings.

As soon as photography had reached some level of quality (around 1850), efforts began to use photographs for the measurement of photographed objects, through what the discipline of photogrammetry actually has been invented. Obviously, the efforts were indeed focused to the surveying of terrain in order to derive topographic maps, and on the other hand, to reproduce exact ground plans and drawings of buildings. The photogrammetric techniques concentrated for about 50 years (1850 – 1900) on photographs of objects, which were taken from several locations showing different views. The task at that time was to find homologous points, corners and edges in the photographs and to reconstruct a ground plan simply by intersections. Very soon it became clear, that the search for corresponding (matching) image features could only be successful in architectural photographs and photographs of salient or mountainous terrain, that means, images having sharp object features.. Unfortunately, it failed in images representing smooth object features. At those days, Italians and Austrians described photogrammetry as successful method to deliver topographic maps of mountainous terrain. The German architect, A. Meydenbauer made in 1858 the first photogrammetric reconstruction of a building. It is said, that he carried out his experiments without knowing about the similar approaches and proposals reported some years before. He was very successful in the way, that the Prussian Secretary of Cultural Affairs provided him resources to found the “State Photograph Institute Maintaining Architectural Monuments (Staatliche Messbildanstalt für Baudenkmäler)”.

Most probably, Abbe and Pulfrich discussed also the methods of photogrammetry, when Pulfrich entered Carl Zeiss. In 1896 Pulfrich had the job to advance the stereoscopic distance meter, which was invented by H. de Gousilliers and continued by Abbe. Simultaneously with this development Pulfrich followed the idea, to decompose the measurement principle of the stereoscopic distance meter into two temporally independent views, which were photographed through spatially separated lenses and could be measured afterwards stereoscopically. **Herewith, Pulfrich became father of stereo photogrammetry!**

In restless activity Pulfrich developed the theory and instruments of stereo photogrammetry. In 1901 he presented the stereo comparator, which was followed by the stereo autograph plotter of E. von Orel in 1908 (and not 1911 as reported by many books). The ideas of Pulfrich and the expertise of the “Zeissians” helped to make this big instrumental progress with a mechanical space resection. With this instrument the first-ever automatic mapping was made possible, using two photographs of arbitrary terrain, a real breakthrough. One can definitely say, that starting with 1900 the company Carl Zeiss has pioneered and actively promoted photogrammetry for about one century. Having strong expertise in optics combined with the craft of instrument making the company was predestined to meet the challenges. Thus, it seems sheer coincidence, that about the same time when Pulfrich invented the stereo comparator, the South African H. G. Fourcade presented his Measuring Stereoscope and Survey Camera (in 1904). He compiled the first-ever terrestrial topographic map covering the slopes of Devils Peak (near Cape Town). As to who was the first, or whether the credit is due to Germany or South Africa will remain an unsolved question (H. Krahnemann, 2001).

The abundance of Pulfrich's work and contributions to the field of stereo photogrammetry is even more astonishing, as he got blind with one eye in 1906 and therefore was not more capable to see stereoscopically. But his lively spirit overcame the lack of exact spatial perception. He died on August 12, 1927 when his rowing boat turned down in the Baltic Sea.

## 2. SOME MILESTONES IN PHOTOGRAMMETRY AND THE PHOTOGRAMMETRIC WEEKS

**2.1.** If one considers the invention of the stereo comparator in 1901 by Dr. Carl Pulfrich (see fig. 2), the chief measurement instrument designer of Carl Zeiss Jena, as the starting point of stereo photogrammetry, we probably can better understand his intention to start a "vacation course in stereo photogrammetry". The real achievement was to add the third dimension by measuring the parallax in baseline direction in a pair of stereo photographs, but obviously not many took notice of this revolutionary breakthrough. Therefore, there was a real need for technology transfer, what means, simply to make the technology known at all. In June 1909 Pulfrich sent out a call in the German 'Zeitschrift fuer Vermessungswesen (ZfV)' for such a vacation course, which then took place in Jena from October 4<sup>th</sup> to 9<sup>th</sup>. It is known that 46 participants came together - apart from Germany they came from Austria (4), former Yugoslavia (2) and one representative each from Russia, former Czechoslovakia and Hungary. The course contained lectures and instruments training with instruments made available by Carl Zeiss Jena. From a management point of view the course was run and managed on a more or less private basis by Pulfrich himself. The fee was 20 Marks.

The first-ever course is also a milestone in the history of the German Society for Photogrammetry, Remote Sensing and Geoinformation (DGPF), because in a restaurant outside of Jena, these gentlemen were sitting together and founded the society. It is needless to say, that most probably, they have had a good dinner and some beers, as it was and still is the standard of the social program of all Photogrammetric Weeks.

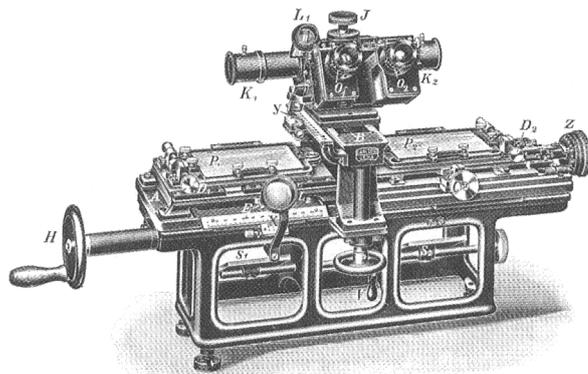


Fig. 2: Stereo comparator of Dr. Carl Pulfrich (Zeiss Jena, 1901) – most probably the training instrument of the first-ever vacation course

The vacation courses were maintained in the following years, that means, they took place also in 1910 until 1913, having more or less the same structure and same number of participants. Their location was the 'Volkshaus' of the Carl Zeiss Foundation, a building with several halls, in which one hall was rented for the lectures and another one for the instrument measurements. Terrestrial photographs were taken by the participants in the near vicinity of Jena, who had to measure them as well. These first series of five courses were interrupted by the first World War (1914 – 1918).

**2.2.** Carl Zeiss Jena, as a leading supplier of optical instruments had by then already been in existence for some sixty years. Terrestrial photogrammetry was the absolutely application, but most probably, as later, a small segment within the portfolio of the Zeiss company. The first range of Photo Theodolites was followed in 1915 by the first camera for exposing a controlled series of aerial photographs. Camera design and optical perfection have ever since been an ongoing challenge. By 1937 Carl Zeiss Jena had already manufactured about 5,000 cameras. By 1921 the potential of photogrammetry reached a volume that made it necessary to establish Zeiss Aerotopograph, a subsidiary to take charge of worldwide marketing. On the processing side, the Universal Stereoplanigraph with optical restitution followed in the same year. This was a truly ‘first order’ plotter with base-in/base-out facility to accomplish strip triangulation. Then there was the Multiplex Projector System where a battery of up to 21 Anaglyph Projectors served 1:25,000 topographic mapping and triangulation. For photo-mapping the self-focusing SEG rectifier was offered in 1921 as well, and the slotted template method as a mechanical form of triangulation served the composition and mosaiking of large blocks of photographs.

Around 1920 Pulfrich himself turned towards photometry, leaving the development of photogrammetric instruments to a new generation of scientists and developers, such as W. Sander, Walther Bauersfeld and Otto von Gruber (see fig. 3). Von Gruber, a professor of Universitaet Stuttgart, became head of department of Carl Zeiss Jena in 1930. Before he left the university, he organized the “6<sup>th</sup> Vacation Course in Photogrammetry” from April 8<sup>th</sup> to 20<sup>th</sup>, 1929. Again 41 participants



Fig. 3: Prof. Otto von Gruber

came from 14 countries, in the meantime two from overseas, from China and Dutch India. The settings of the course did only slightly change, but the main emphasis was now aerial photogrammetry. Also here, the course was managed by von Gruber himself, the fee was 100 Marks, which had to be paid into a personal account. Von Gruber was a very dominating scientist, probably the discussions were driven by him and the atmosphere was by far not that relaxed as it was with the inventor of the course. All lectures were well documented in a book edited by von Gruber and published by the publishing house Konrad Wittwer, Stuttgart. The book itself is well-written and contains many actual formulas and content still valid until today.

From 1929 until 1940 some more 15 vacation courses were held in Jena in a quick succession. It should be mentioned here, that from 1932 the Zeiss Aerotopograph company organized the meeting. The name changed for the first time in 1933 when the course was called “Introductory Courses” or alternatively “Jena

Introductory Courses in Photogrammetry”. Obviously, the term “Photogrammetric Weeks” appeared 1937 for the first time, the courses lasted as a rule for two weeks. In 1932 Prof. Reinhard Hegershoff from Technical University Dresden (TUD), professor of surveying and photogrammetry, joined the organization team around Prof. von Gruber and shared the organization until 1940.

**2.3.** The postwar era meant a restart virtually from scratch, not only for the Photogrammetric Week series, but for photogrammetry itself. With the division of Germany Carl Zeiss Jena was split into an eastern (Jena) and western camp (Oberkochen) and with the fading hopes for an early reunification, new developments began in both quarters. By now strong competition was on the move with Wild Heerbrugg dominating the photogrammetric plotter market. The Oberkochen division made significant achievements particularly on the camera side. The distortion-free RMK A series was introduced 1967 followed in the early nineties by the current RMK Top which will still

stands for many years to come. In the east the LMK was presented 1982 followed by the first stabilized camera mount and FMC performance as trend-setting innovations.

The Zeiss GZ 1 Orthoprojector presented at the ISPRS Lisbon congress found an overwhelming reception and opened up a new market for orthophoto products, which have ever since on offer with a wide choice of superimposed cartographic details. Incidentally, the first experimental Orthophoto produced in South Africa again covered the slopes of the Devils Peak mountain with the rig Survey Department and the University of Cape Town. It was run by Dr. Walter Brucklacher from Carl Zeiss Oberkochen, an enthusiastic promoter of orthophoto technology.



Fig. 4: The 22<sup>nd</sup> Photogrammetric Week at the Technical University of Munich (1954), a) from left: Prof Richard Finsterwalder (TUM), Prof. Kurt Schwidefsky (Carl Zeiss Oberkochen), and Dr. E.O. Messter, Zeiss Aerotopograph Munich



b) Excursion to the Wallberg and demonstration of the TAF (Terrestrial facility Finsterwalder); at the instrument; Eng. H. Baumert, right hand Dipl.-Ing. Hans-Karsten Meier, TU Munich.

The Photogrammetric Week organizers Hegershoff and von Gruber passed away 1941 and 1942, respectively. Prof. Kurt Schwidefsky, associate of the Carl Zeiss Oberkochen, and who had taken part in the pre-war events as a lecturer, took the lead to the next milestones. The company Zeiss Aerotopograph, organizer of the Photogrammetric Week series since 1932, moved from Jena to Munich. Its director, E.O. Messter, was also an enthusiast of photogrammetry, its instruments and applications. The tradition continued in 1951 with the name “Photogrammetric Week” in Munich, the 21 meeting of this series. At that time, a new aspect came into effect in the way, that a collaboration with an university was searched for. Prof. Schwidefsky found in Prof. Richard Finsterwalder an excellent partner (see fig. 4a), and hence the events took place at the Technical



Fig. 5: Snap shots at the Photogrammetric Weeks Munich, a) 1955 at the Demos, and b) 1958 Prof. Schwidefsky as session chairman.

University of Munich (TUM). The postwar beginning was hard to realize. In 1951 only 28 participants were present, from no less than 13 countries, amongst them the USA. Between 1951 and 1963 the event was jointly organized by the Zeiss Aerotopograph company in association with TUM and held nine times with increasing participation from countries from all over the world.

**2.4.** The sudden death of Prof. Finsterwalder in 1963 brought up another milestone in the history of the Photogrammetric Week series. In the meantime Prof. Schwidofsky had left the Carl Zeiss Oberkochen company to take over a chair of the Technical University Karlsruhe. Additionally, the Zeiss Aerotopograph company was taken over by Carl Zeiss Oberkochen, when Messter left the former company. Fortunately, Prof. Schwidofsky still felt responsibility for the courses and shifted them to Karlsruhe, where it was held four times (1965 until 1971). He shared first the organization with Dr. Ahrend from Carl Zeiss Oberkochen, later with Dr. H. K. Meier (Carl Zeiss Oberkochen) and Prof Fritz Ackermann, Universitaet Stuttgart. The number of participants increased up to 160 in average.

These were the times when the Analytical Plotters were introduced. The ISPRS congress in Helsinki saw a presentation of a variety of solutions. Here, the Zeiss Planicomp concept was presented, first the C Series and later in the P Series – this family stood its ground for about 30 years. The analytical approach has also led to the Zeiss Z 2 Analytical Orthoprojector which was presented at the 1980 ISPRS congress in Hamburg and followed later by the Wild OR 1.



Fig. 6: a) Prof. Meier at the Demo 1975 (35<sup>th</sup> Photogrammetric Week) and b) the 36<sup>th</sup> Photogrammetric Week in Stuttgart.

**2.5.** After the retirement of Prof. Schwidofsky it was decided to continue the Photogrammetric Weeks in Stuttgart. The two year turnus, still maintained until today, has held good and become established, also the time window between the ISPRS congresses. Since 1971 the two weeks course was reduced to one week. Thus Prof. Ackermann (Univ. Stuttgart) and Prof. H.K. Meier (Carl Zeiss Oberkochen) shared the course management from 1973 until 1987 having regular participants of about 240 in average. After the retirement of Dr. Meier his successor, Prof. Dierk Hobbie came into business, who was on board until 1997. Prof. Ackermann retired in 1992, thus the management shifted to Dr. Hobbie and Dieter Fritsch. I have decided in 1992 to complement the Photogrammetric Week topics with selected paragraphs of Geographic Information Systems (GIS), which indeed increased the number of participants to more than 300.



Fig. 7: a) The organizers of the 40<sup>th</sup> Photogrammetric Week, Prof. H.K. Meier and Prof. F. Ackermann, together with the Keynote Speaker Prof. Jörg Schlaich, Universitaet Stuttgart



b) Awarding the Pulfrich Prize to Dr. Wolfgang Förstner and Heinrich Schewe for their contributions in Photogrammetric Image Matching during the 41<sup>st</sup> Photogrammetric Week by Prof. H.K. Meier

**2.6.** Carl Zeiss Oberkochen tried to unify the production of surveying and photogrammetric instruments in jena and Oberkochen right after the reunification of Germany (1990). Obviously, the worldwide competition made it even harder to balance the budgets and to start always new innovations in a shorter life cycle. A further stepping stone towards softcopy photogrammetry was presented by Carl Zeiss Oberkochen at the 42<sup>nd</sup> Photogrammetric Week in Stuttgart (1989) when the very successful Zeiss PS 1 Precision Scanner was introduced. This has opened the way for computerized solutions of photogrammetric workflows, image analysis and GIS modules. The emphasis thus turned to workstation systems and the integration with other processing packages. This is, where it became imperative to join forces with an established supplier of hardware and software complementary to the own product portfolio. The choice fell on Intergraph, who had for some time already been appreciative of the exceptional standard of Carl Zeiss products. As OEM customer they had in fact been supplied with with a very substantial number of basic P1 Analytical Plotters for their InterMap Photogrammetric Workstation and had standardized on the PS 1 Precision Scanner within their product range. Obviously, it was a logical step to launch a joint venture in August 1999 of Carl Zeiss Oberkochen and Intergraph Huntsville, which was called Z/I Imaging. Rudi Spiller as the Z/I Chief Operation Officer took over the industrial part in the Phowo organization until he left 2002. At that time Carl Zeiss sold its 40 % shares of Z/I to Intergraph, leaving in total the terrain of photogrammetry, as it quit some years before the surveying instruments business. As we have seen by the historical remarks, the Photogrammetric Week series were strongly associated with the company Carl Zeiss, first Jena, afterwards Oberkochen. I had then to decide what to do.

The Photogrammetric Week series has overcome all management difficulties, as shortly demonstrated by the excerpt in this paper. Stimulated by the OpenSource movement in software development, I thought, why not to open the courses for other industrial partners as well. In this way, the OpenPhowo idea was born. Thus, we started two years ago to bring in more industrial partners than only one (which was for a long time the company Carl Zeiss). The future will show, whether we will have another 100 years of Photogrammetric Week series. I am very optimistic. A synopsis of the Photogrammetric Week series is given in the Appendix of this book – hopefully this table will be continued for many years to come.

### 3. THE PHOTOGRAMMETRIC WEEK SERIES ARCHIVE

With the progress in publication the Photogrammetric Week series are regular published since the early 1970s. As mentioned before von Gruber edited the famous book in 1930 as an outcome of the 6<sup>th</sup> Photogrammetric Week (see fig. 8a). My predecessor and friend Prof. Fritz Ackermann started a publication series of the Institute for Photogrammetry in 1972, and therefore was able to archive all Photogrammetric Week series which took place in Stuttgart (since 1973, see fig. 8b). Since 1993 we deliver the Proceedings in advance as a textbook right after registration. Additionally, the textbook is printed softcopy on a CD-ROM, available as a free gift in the participant's bag.

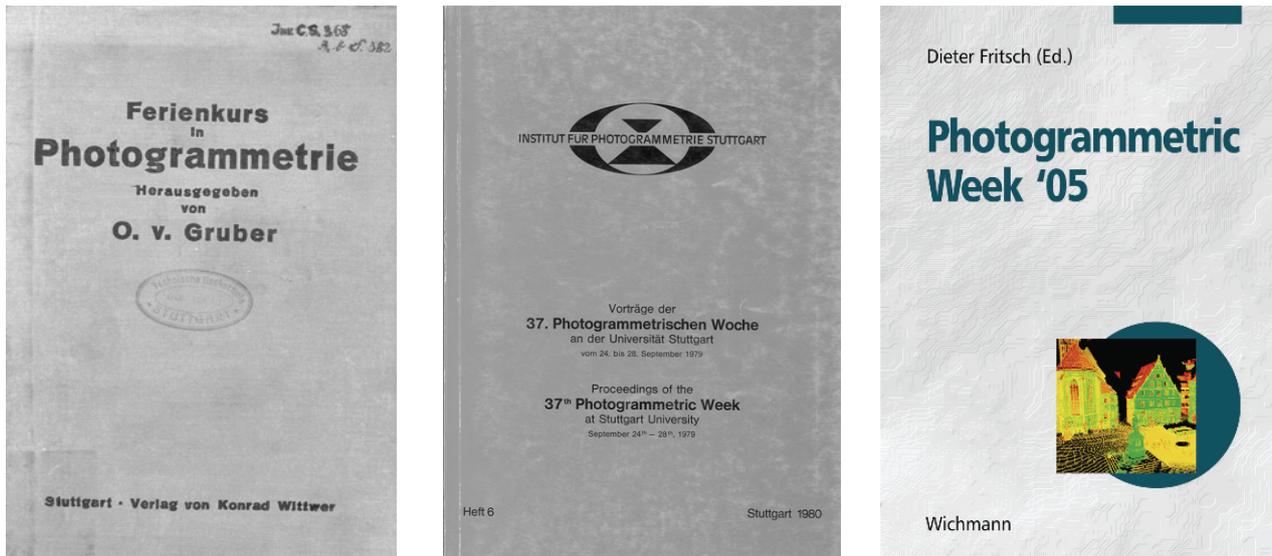


Fig 8: The Photogrammetric Week series archive.

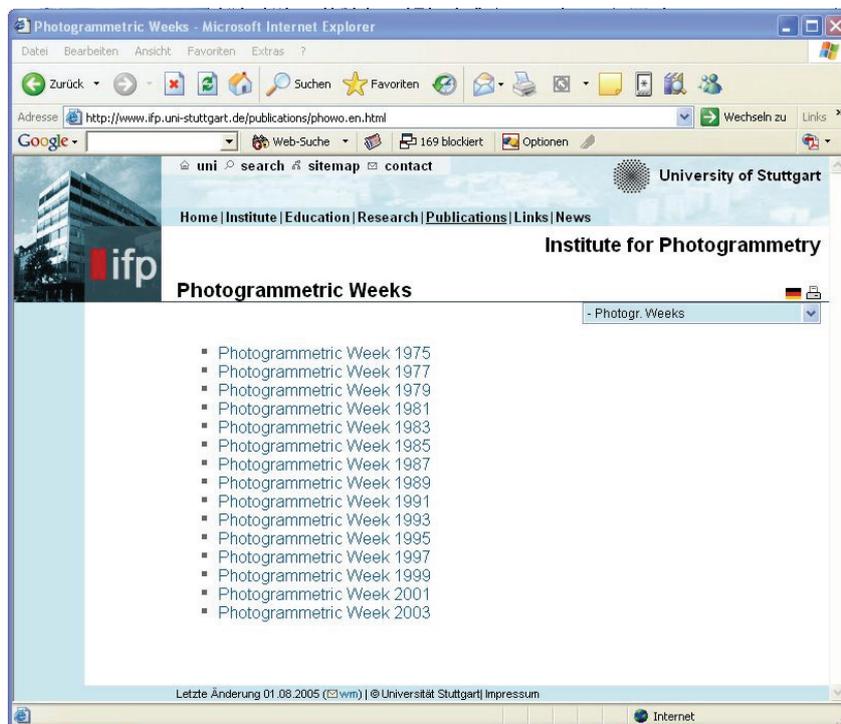


Fig. 9: Web portal to get access to the proceedings of the Photogrammetric Week series.

Today, we have started to put all proceedings of the Photogrammetric Week series to the Web, as far as the material is available. Therefore the interested reader can have access through the portal of the Institute for Photogrammetry which is as follows: <http://ifp.uni-stuttgart.de>. A short look into the portal is given by fig. 9. The portal is available in German and English, further languages will be offered very soon, as it is in line with the University's policy. It will be interested to follow the further generation of search engines which will index much better the Web content than it is offered today. Semantic internet will offer all of us excellent opportunities for accessing any documents we are searching for.

#### **4. CONCLUSIONS AND OUTLOOK**

The short excursion back to the roots of the Photogrammetric Week series shows, that it needs always some individuals, who take responsibility and risks to start something new. It is a very interesting story this series can tell. It is strongly associated with the ups and downs of our discipline itself, today a high tech hardware and software environment to be used for manifold applications, in the range from classical topographic mapping to 3D Virtual Reality GIS and Computer Facility Management Systems as well as highly precise industrial measurements to cultural heritage projects.

Photogrammetry was and still is a fascinating discipline. It is on us, not only to further develop photogrammetry itself, but to offer always events for open discussions and interdisciplinary and intercultural relations. The Photogrammetric Week series are well-known world-wide and well-accepted – let the series be a successful example for other events which just started some years ago and are looking forward also for a centennial story of success.

#### **5. ACKNOWLEDGEMENTS**

First of all, let me give my thanks to all those who were active in the promotion of the Photogrammetric Week series. Sincere thanks go to the past organizers, Prof. Fritz Ackermann, Prof. Hans Karsten Meier and Prof. Dierk Hobbie. All three are Honorary Participants of the Photogrammetric Week series and I still hope to welcome them at the forthcoming opening sessions always with a good bottle of wine.

Let me also thank the associates of the Institute for Photogrammetry (ifp), Universitaet Stuttgart, with whom I always have the pleasure to prepare and share the organization. It is a strong team who is managing the event since more than 30 years. But let me also gratefully acknowledge the participants who come to about 50 % from German speaking countries and to 50 % from more than 50 countries worldwide. This is a great achievement having maintained the spirit of the open discourse in science, development and practice from the beginning.

Let me also express my sincere thanks to the company Carl Zeiss, which for a long time was a very reliable partner of the Photogrammetric Week series.

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