

**KERN INTEGRATED SYSTEMS  
HARDWARE AND SOFTWARE ARCHITECTURE**

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**Abstract**

The need for fast, safe and centralized handling of digital geometric data led to the development of extensive data bases. Then, increased claims on information called for links between such data and additional information.

In Land Information Systems (LIS), for instance, the relations between geometric and thematic, descriptive information are defined in relational data bases.

In order to be integrated into such LIS, data collected photogrammetrically must first be adequately structured. Since it should be possible to update such data economically, a data base is required. This, however, is easily done in modular structured systems.

Since 1980, the introduction of analytical stereoplotters has considerably changed the methods of photogrammetric data capture. In the 90s, the advent of pattern recognition techniques used in conjunction with powerful correlation algorithm will enhance automation in photogrammetry by eliminating certain monotonous routine work.

The Kern Integrated Photogrammetric System pioneers solutions will become standard practice within the next few years.

**1. Introduction**

Before it can be transferred into LIS, data collected by photogrammetry must be adequately structured. This is done most economically off-line, thus implying that data capturing and data structuring are two separated processes.

One of the cheapest ways of updating digital data by photogrammetric methods is the superimposition of the collected data onto the optical stereomodel. In order to achieve this task, direct access to a data base is required.

Large organisations operating several systems can gather the data collected from photogrammetric capture stations by integrating these systems into a network.

## **2. Past and Future of Photogrammetric Data Capturing**

As in the past, the main application of photogrammetry will continue to be the production and updating of maps and plans.

The dynamic restitution procedures applied in conventional analogue stereoplotters not only demanded a high degree of interpretative capability from the operator, but also a good deal of patience and perseverance. The plotted original plan constituted the basis for all subsequent processes, such as quality drawings.

The static restitution methods developed for computer-assisted analogue stereoplotters considerably facilitated the task of the operator. The automatic control of the plate-carriers in the modern, computer-assisted analytical stereoplotters brought further relief and today, the operator can increasingly concentrate upon the more creative tasks of interpretation. However, certain functions, like observing large numbers of individual points, e.g. for digital terrain models, still remain tedious routine work.

CCD cameras installed in analytical stereoplotters can take over some of those routines, whereby automated feature-recognition will play an important part. The operator, apart from his interpretative tasks, will have to supervise the system. Thus, in spite of more automation, his function will be even more demanding and important.

The spreading of analytical stereoplotters has been accompanied by an increasing incorporation of digital data into data bases, whereby geometrical, as well as descriptive data has to be stored. This, however, implies a given structure for all data, including the photogrammetrically compiled data, which, unfortunately, does not lend itself easily to such structuring. It is a topical question, whether data should be structured at the photogrammetric workstation. However, tests have proved that on-line structuring is expensive in terms of capital costs, and requires specialised knowledge about data base systems, which cannot reasonably be expected from a photogrammetric operator. Therefore, data capturing and structuring should be clearly separated.

## **3. Demands on Photogrammetric Systems**

Modern photogrammetric systems represent large capital investments, which have to be amortized within a relatively short amount of time. For this reason, demands on such systems are invariably high. They concern, amongst others, the following points:

### **3.1 Price-Performance Optimization**

At the time of purchase, a photogrammetric workstation, may fulfill a well defined demand, but today the market is evolving so fast that other functionalities may be requested. Therefore, it is essential that further hardware and software components can be added, and kept operational as long as possible. Thus, continuity and modular design are preferable to frequently changing instruments, since they offer the best possible ratio between price and performance.

### **3.2 Reliability and Serviceability**

Frequently, photogrammetric systems are operated in shifts for up to 24 hours a day. Therefore breakdowns requiring repair by a technician, who may only be available after hours or even days, are not acceptable. The statistical rate of failure of the well-proven and extremely reliable Kern DSR analytical plotters is as low as 0.3 breakdowns per annum. And owing to their modular design, any servicing which might be required will not cause major interruptions of production.

### **3.3 User Friendly Software and Efficient Operation**

The efficiency of a computer-assisted photogrammetric system is dependant on such factors as fast operator training, self-explanatory, menu-guided software and simple, logical sequences. The user-friendly software by Kern is standardized to serve even different types of photogrammetric systems.

### **3.4 Universality**

The hardware of the Kern DSR is designed for the utmost universality: all photogrammetric applications can be handled with just this one instrument: aerotriangulation, data-capturing and editing, revision, digital terrain modelling, data superimposition, correlator applications, networking, integration within geoinformation systems and other data bases, etc.

## **4. The Kern Integrated Photogrammetric System**

### **4.1 The Kern DSR Analytical Plotter**

The central unit of the Kern data capturing system is the DSR analytical stereoplotter. Its architecture, with distributed processing, independent plate processor and fixed optical system, was presented in 1980 and has become the de-facto standard in the design of analytical plotters. The advantages of this architecture, retained in the new DSR series, are assumed to be known. Recent supplementary modules, such as

image superimposition, correlators, interactive graphics etc. can be added to all models, allowing versatility and optimum price/performance ratios.

With the same basic features, the DSR can be equipped with different computers to reach the standard of performance required by the user; subsequent hardware changes are easily possible:

DEC PDP 11 series	--> DSR 12
Personal Computers	--> DSR 14
DEC MicroVAX/VAX station	--> DSR 15

#### **4.2 The Image Superimposition System KRISS**

The hardware of the new KRISS superimposition system reflects the technological state of the art. High resolution screens, as well as huge memory capacity, allow for practically unlimited information to be superimposed.

Four versions of KRISS are available, to suit different purposes and applications:

KRISS M-50 : Monocular superimposition, resolution 50 microns.  
KRISS M-25 : Monocular superimposition, resolution 25 microns.  
KRISS S-50 : Stereoscopic superimposition, resolution 50 microns.  
KRISS S-25 : Stereoscopic superimposition, resolution 25 microns.

#### **4.3 The Kern Correlator-System (2nd generation)**

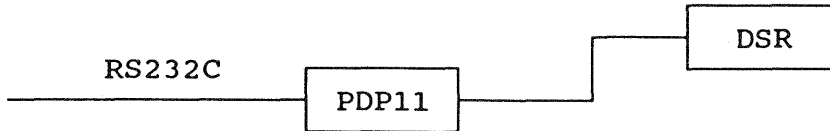
Five years of experience with correlators and the availability of new CCD cameras and image processing boards, have led to a major development of the well-known Kern correlator system.

By using parallel processing, based on Transputers, the computing time required for the correlation process can be drastically reduced. Thus, even demanding algorithms, such as the automatic recognition of obstacles (buildings, trees etc.) can now be applied economically.

#### 4.4 Network and Data Transfer

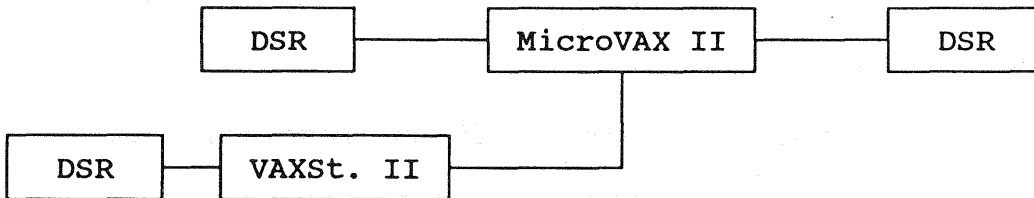
##### Data-Transfer Through Serial Line

This is the cheapest way of transferring data from one system to another one:



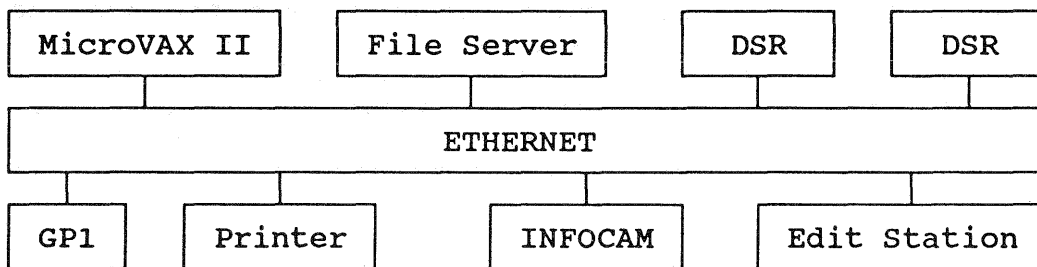
##### Data-transfer and networking with DEC Thin Wire Ethernet

DEC Thin Wire Ethernet permits any combinations of networks:



##### Network Systems with DEC Ethernet

Larger organisations can build up comprehensive networks, which can be extended to include photogrammetric workstations, geoinformation systems, editors, plotters etc.



#### 4.5 INFOCAM: The Integration of Photogrammetric Data in a Central Data Base

Photogrammetrically collected data is rarely sufficiently complete or correctly structured to allow direct downloading into a central data base. In addition, during data base revision using photogrammetry, for example while using a superimposition system, geometric data and its associated attributes have to be extracted from the central data base and

made available rapidly and with complete fidelity to the photogrammetric operator.

In order to create an interface between data collection or revision and the central data base, an intermediate data base is required. This intermediate data base should be optimised to handle geometry information, and contain good graphic manipulation capabilities. The Kern INFOCAM System offers a solution for the integration of photogrammetric data with a central data base, and provides the required properties for data structure and data manipulation as well as the ability to both generate and read meta files.

## **5. The Philosophy Behind Kern Software**

The performance of a system depends mainly on the efficiency of its software. User-friendliness, modularity and continuity are deciding factors in determining the investment's long term value.

### **5.1 User Friendliness**

Software by Kern is characterized by simple interactive dialogue sessions. Help-pages explain all functions, eliminating time-consuming reference to manuals, especially for rarely used functions.

### **5.2 Standardization**

The input/output-menu are identically structured throughout all programs of the system. The dialogue between operator and software only has to be learned once and is valid for all Kern systems. Operators working in larger organisations with various systems can be employed in a variety of tasks, and even lesser used routines may be learned quickly. This renders any organisation more flexible.

### **5.3 Modularity**

The modular concept of Kern software includes guidance by a main menu permitting fast and direct access to all the programs available. Even routines added later on or developed by the user himself can be integrated into the system at any time.

### **5.4 Self Developed Application**

The comprehensive range of software offered by Kern covers most applications. But occasionally, individual solutions to certain problems may require special software. You may ask Kern to develop this software for you, or you may decide to do it yourself. In this case, Kern will put at your disposal useful program libraries containing commonly used routines, which can

be fitted into your own programs. This considerably reduces the work involved in programming.

## 6. Conclusion

We are moving towards an environment based on workstations, used alone, or integrated into larger systems. Photogrammetric workstations consisting of a Kern DSR with image superimposition, integrated with the Kern INFOCAM System, will serve as one of the tools for the revision of data bases.

The integration of the DSR, CCD cameras and Transputers will provide an increase in processing power which can be utilized in many areas, such as the automation of DTM collection.

Digital image processing techniques, such as pattern recognition, will be implemented further into photogrammetric processes and the use of entirely digital image photogrammetric systems will become more widespread.

Digital systems in photogrammetry will require more facilities for dealing with raster data, for example raster data bases and full compatibility between raster and vector information.