# Digital Photogrammetric Imaging – Past, Present and Future

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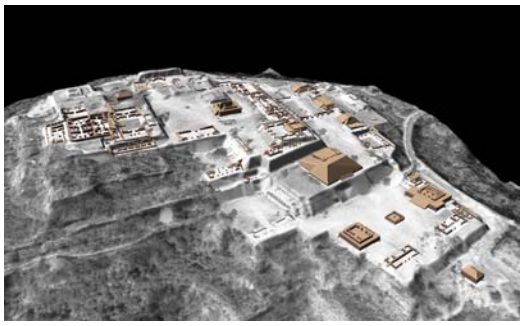
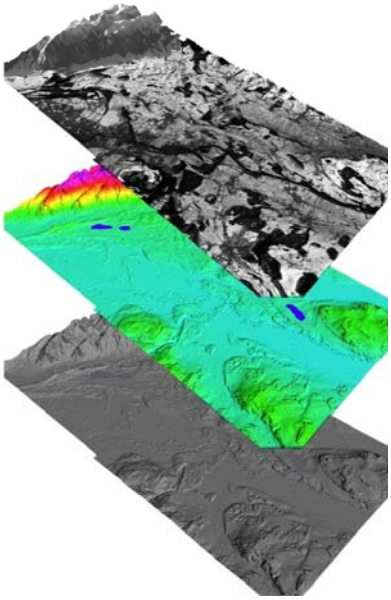








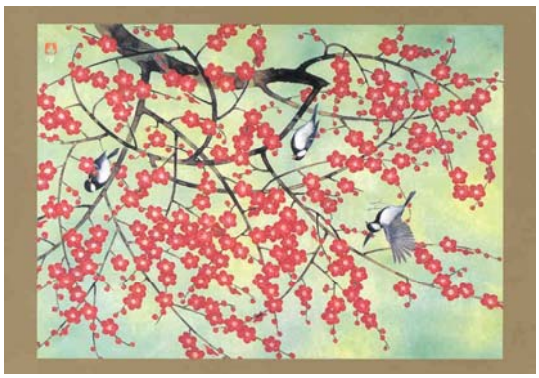

## 40th Phot. Week, Stuttgart 1985

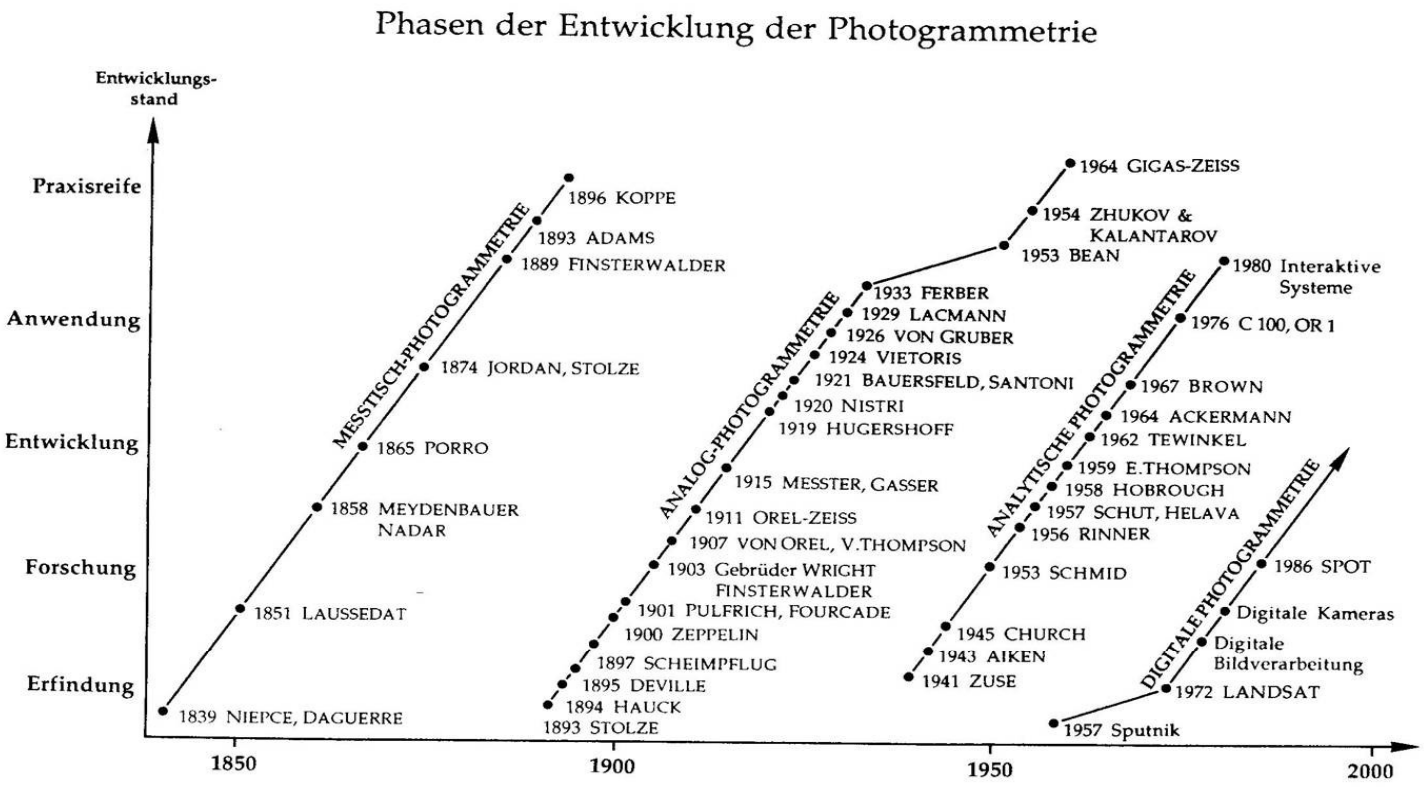
**Ackermann, F.: Technology transfer – a glance back at 39 Photogrammetric Weeks**

„... It can be stated ... that the primary concern of mediating between science and practice embodies the general aim .... One can say and hope that future meetings in the field of photogrammetry and its related disciplines continue to devote themselves to this task with engagement and success.“

*Participants:* 1909 -1913: 32
1973 -1985: 240

**Congratulations !**






Courtesy Gottfried Konecny





# Development of digital photogrammetry

**Early 80s: Paradigm change "From Analytical to Digital"**

Requires "fore-runner technology":

+ Sensors ☺
+ Computing platforms ☺
+ Software (lacking)

## Contents

-The early years (1970-1984)

- First systems and experiences (1984-1988)
- Acceptance and refinement (1988-1994)
- Time of consolidation (1994-2000)
- Fully digital era (2000-now)

## The Future ?

"I never think of the future. It comes soon enough."

*Albert Einstein*


**Safe prediction:**
Sensors: Smaller, Processing: Faster,
Results: Better(?)





## The Foundations

1964 - 1980: Image processing algorithms

1972 - 1980: Network aspects (syst. errors, blunders; reliability)

1980 - 1984: On-line triangulation by sequential estimation (Kalman,TFU, Givens)

1980 - 1984: Charge Coupled Devices (CCD) and applications

Butted Linear Array CCDs with 10 000 elements in a row

Framegrabbers, Workstations (Tektronix, Sun)

Image processing systems with data acquisition devices

1984: L.S. image and template matching (algorithmic basis)

# The early years (1970 – 1984)

*1972 Landsat 1,* NASA, Satellite remote sensing

*1976 13th Congress of ISP, Helsinki*
7 Analytical Plotters, Analogue → Analytical

*1979 Mapsat* (Colvocoresses, epipolar principle, along track)

*1980 14th Congress of ISP, Hamburg,* ISP → ISPRS

*1981 Stereosat* (Welch&Marko, along track image triplet)

*1982 DPS* (Hofmann, image triplet)

*1984 15th Congress of ISPRS, Rio de Janeiro*
***> Introduction of digital close-range photogrammetry (CCD cameras)***

*1986 Launch of SPOT-1 (22 Feb)*





# Early developments in close-range photogrammetry

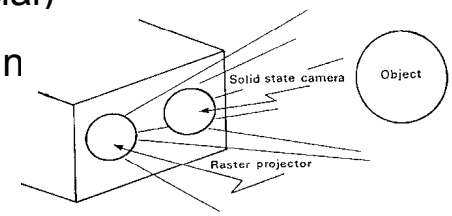
*1974 Woltring:* Human motion studies with PSD → Vicon system

*1976 ISP Congress Helsinki:* RTP awareness

*1978 Pinkney/Kratky:* On-line 30Hz vidicon, resection
(Space Shuttle manipulator arm)

*1981 Reece:* SELSPOT based research (DLT, commercial)

*1983 Real:* Matrix camera with digital image processing in photogrammetric applications

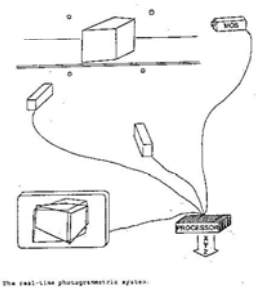



*1983 El-Hakim:* Photogrammetric robot vision

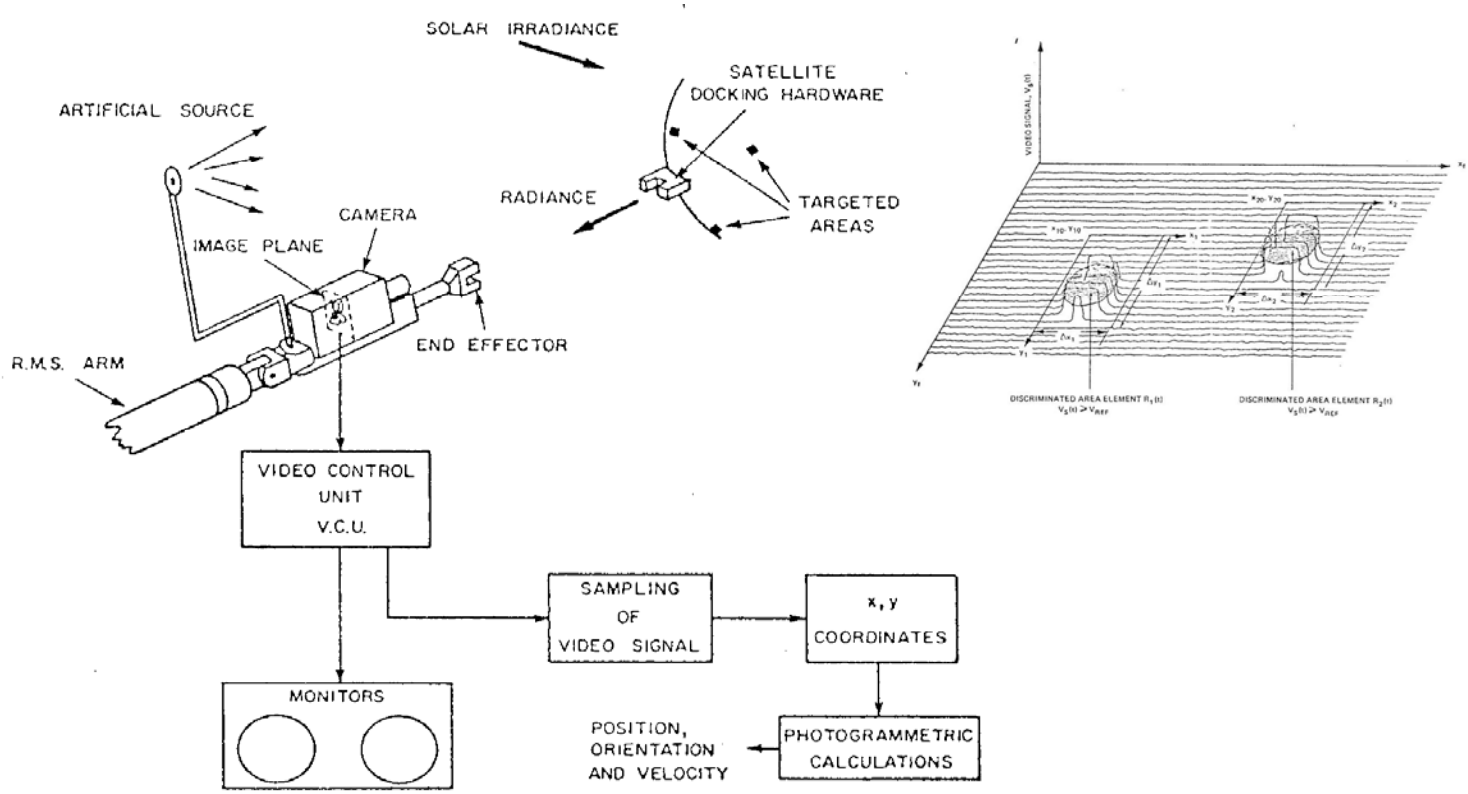
*1984 Haggren, ISPRS Congress Rio de Janeiro:*

New vistas for industrial photogrammetry

Fig.1.: ROBOT VISION




The real-time photogrammetric system.




Pinkney, Kratky, NRC, 1978: Docking maneuver for Space Shuttle Manipulator arm





# Fully digital systems

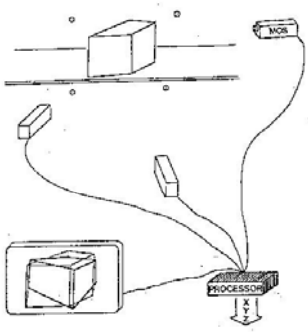
**H. Haggren, Rio de Janeiro 1984:** *"The present low pixel resolution has to be cracked in some way."*

**HUT prototyp system:**

2 video cameras, special processing modules

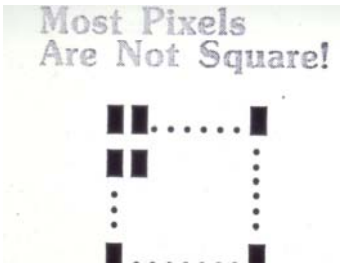
128x128 pi, 4 bits

Accuracy: 1 : 500 – 1 : 1000




The real-time photogrammetric system.

Mapvision

# "Digital Plotters"

- Sarjakoski,1981, Case,1982, Albertz, Koenig,1982, Dowman,1982, Jaksic,1984, Kunji,1984, Gruen,1986

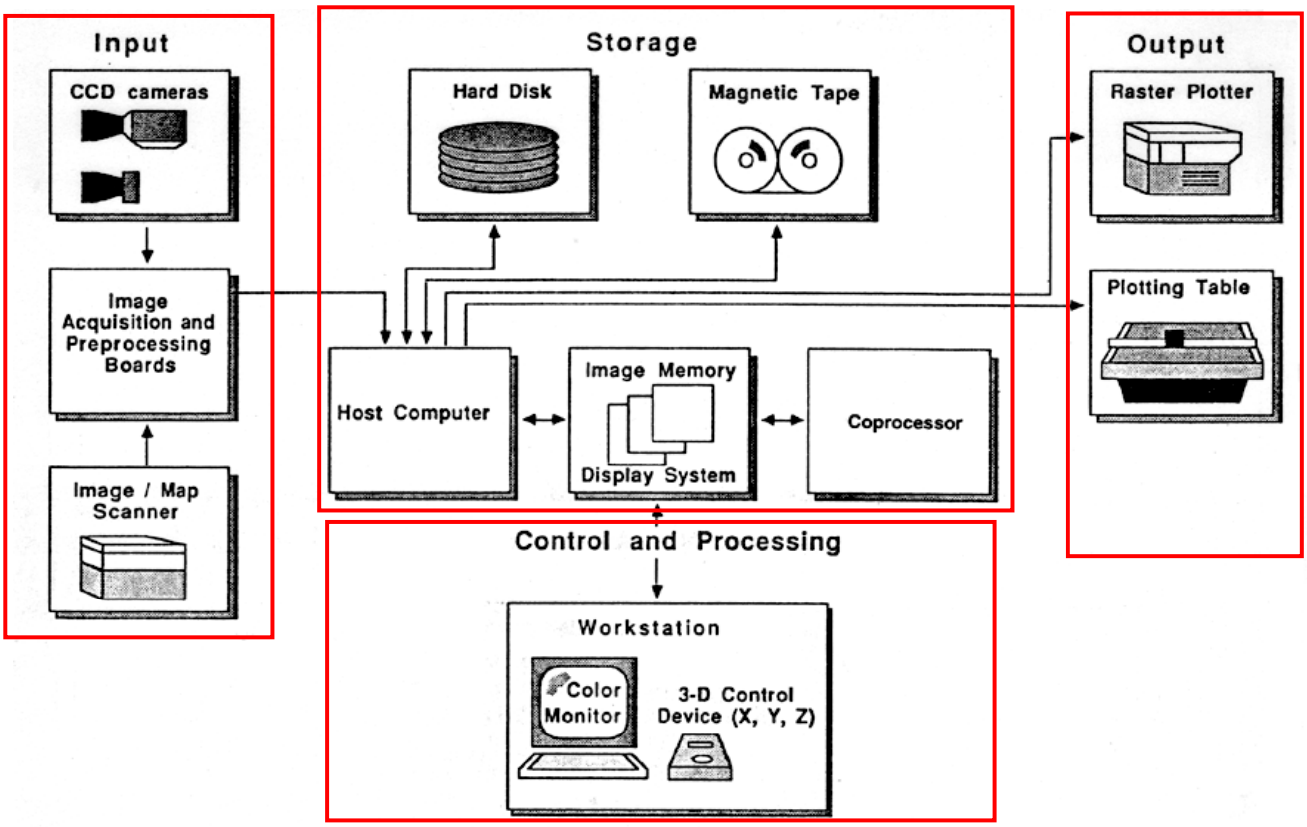
- 1985 "DIPS" Digital Station at IGP, ETH Zurich
  KONTRON IPS 68K
  2 CCD frame transfer cameras AQUA TV (384x576, 604x576 pixels)

-1986 ISPRS Commission II Symposium, Baltimore, Maryland
  Phot. and Remote Sensing Systems for Data Processing and Analysis





# Hardware architecture of a Digital Station



## DMA specifications for DSCC

- Processing of stereopair; automatically, operateur-controlled
- Photometric processing
- Per photo: 20'000 x 20'000 pi
- Radiometric resolution: 8 bits
- Roam Rate: 2.5 mm/Sek (200 pi/sec)
- Fast model traversing:
  Establishment of stereomodel $\leq$ 2 sec
- DHM data generation: 200 pts/sec
- DHM matching accuracy: 1 pi/image
- Superposition („Video Map“)
  **p**lanimetric elements, elevation data; flicker mode
- Generation of local image patches (feature points)
  (objects, control points, tie points)





## First systems and experiences (1984 -1988)

*1985 Burner et al. :* Calibration of vidicon tubes
*Real, Fujimoto:* CCD-based stereo system
*Hobrough, Hobrough :* STEREOPSIS system (“videogrammetry“)

*2.- 6.12. 1985, Cannes:* SPIE Conf. “Computer Vision for Robots“

*1986 El -Hakim :* CCD-Stereo system based on IRI-D 256
*Wong, Ho :* 2 GE TN250 CID cameras (toy moose)
*Murai et al. :* 2 linear array CCDs (2048 pi), structured light
*Haggren :* MAPVISION, 4 CCD cameras, synchronization, targetted object points, 1 sec per point

*1986 Gruen, Beyer :* 4 CCD cameras, Kontron IPS 68K, non-simultaneous, 2D testfield

*1987 Gruen, Beyer, Dähler:* DIPS II, Sun, Datacube boards, 3D testfield, systematic errors

Accuracy (El-Hakim):

Cameras: 2 Hitachi KP - 120 (static stereo)
320 x 244 pi ; 6.6 x 8.8 mm
pi size 27 x 27 µm

Object: 30 x 30 cm ; marked targets

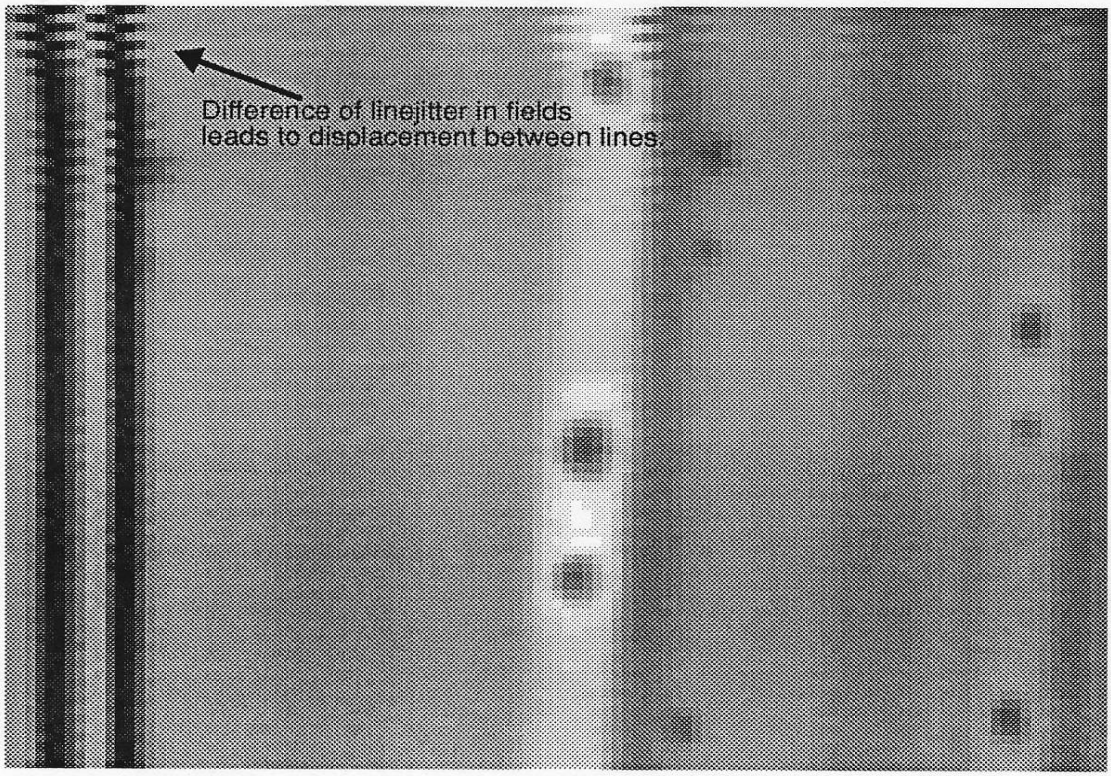
$M_B = 1 : 48$

$\mu_x = 0.12$ $\sigma_x = 0.08$
$\mu_y = 0.11$ $\sigma_y = 0.09$ [mm]
$\mu_z = 0.15$ $\sigma_z = 0.20$

$\mu_{x,y} = 3\ \mu m \ \hat{=}\ 0.1$ pi

Relative Acc. 1:2500

## Problems with video signal




Linejitter shown for an image grabbed from a video recorder.





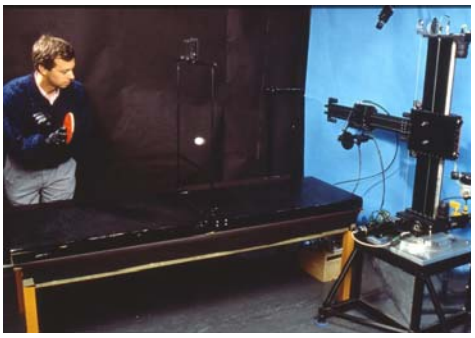
# Precision and Accuracy

| Application | Precision / Accuracy |
|---|---|
| Internal Stability | 0.005 Pixel (30 - 40 nm!) |
| 3-D laboratory conditions | 0.02 Pixel<br>1 : 40 000 accuracy<br>1 : 70 000 precision |
| 3-D industrial conditions | 0.1 Pixel and better<br>1 : 10 000 and better |

Speed : 20 msec up to several minutes

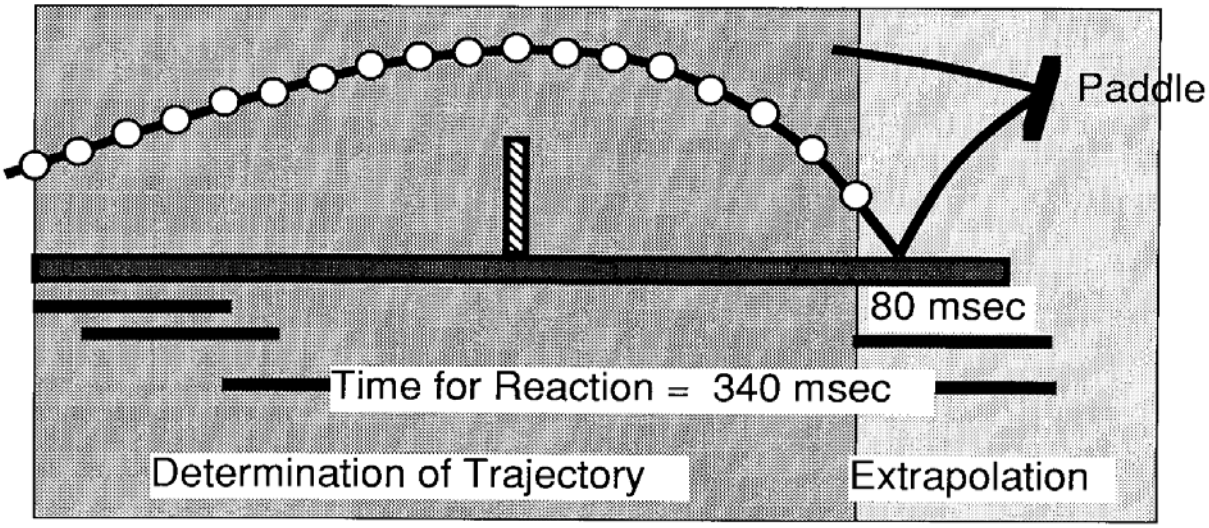
# Table Tennis Robot 1988

DAGM Zurich Winner, World Champion Singapore



## Trajectory: Timing

Speed of ball: 5 m / sec
Positions: 18








# Development of sensors

***Terrestrial Photogrammetry***

1986 Canon CI 10 + JVC Monitor 0.4 Mpi SFr 5 500

1986 Canon RC 701 SLR + player/rec. 0.2 Mpi SFr 11 200

**PhoWo 14-19 Sept. 1987:** Towards Real-Time Photogrammetry

1989 Kontron ProgRes 3000 7.5 Mpi, 8 sec/image, SFr 50 000 + 22 000

1993 Kodak DCS 200 1.5 Mpi SFr 16 000

**Today:** Hasselblad & Phase One back 39 Mpi, 2 sec/image
ca. SFr 40 000

# Development of digital photogrammetry

**ISPRS Commission II Symposium Rovaniemi, July 1986:**
**"From Analytical to Digital"**

**ISPRS Intercommission Conference on**
**"Fast processing of photogrammetric data", Interlaken, 2-4 June 1987:**
First conference fully devoted to digital techniques
- HW for Machine Vision systems (Kontron Bildanalyse GmbH)
- Transputer Arrays for real-time feature matching
- Image acquisition, image quality, calibration of video cameras
- Digital processing of SPOT imagery
- On-line triangulation
- Image matching: Multi-image, Facets stereo (FAST) vision
- Automatic DTM generation on Kern DRS-11
- Förstner Operator
- Mapvision system, DCCS (Helava)
- Digital ortho-images, array algebra

**Panel Discussion: "Digital Photogrammetry – Quo Vadis?"**
**PhoWo 2009: "Future of Photogrammetry"**





# K. Atkinson, ISPRS Kyoto 1988:

"The Kyoto Congress saw Commission V, once the ugly sister of ISP, emerge as one of the stars of the show."

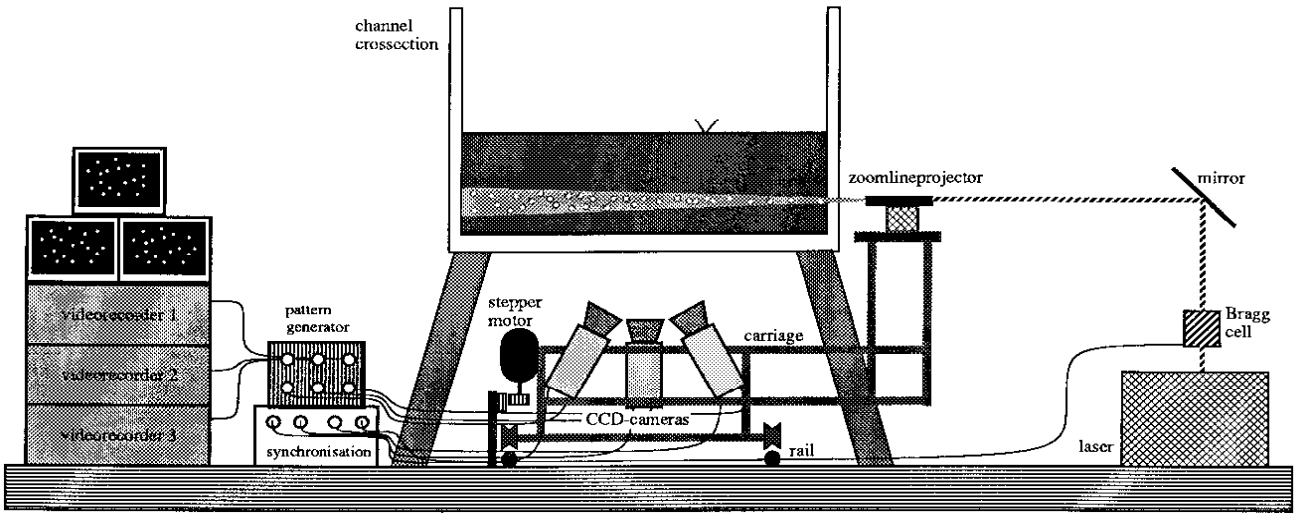
## Acceptance and refinement (1988-1994)

- Calibration operational
- Digital aerial cameras (medium format)
- High accuracy measurement algorithms/systems
- Fully digital automated systems
- Digital ortho-images
- CAD interface/integration, visualization
- Diversity of applications
- Industrial photogrammetry established
- Few robotic and medical applications





## PTV measurements




Software: Free web download, 45 lic. per year
27/28 August 2009: COST Conference, ETH Zurich

## Development of digital systems

Without scientific basis

**ISPRS Conference on "Digital Photogrammetric Systems", 4-6 September 1991, TU Munich:**
Session "Design Research" – user interface, data transfer, image handling, measurement techniques
(design no scientific basis, on-the-job experimentation)
What automatic – what semi-automatic?





## 3 stages of an innovative product

1. Technical solution
2. Acceptance by customer
3. Strategic instrument in the market

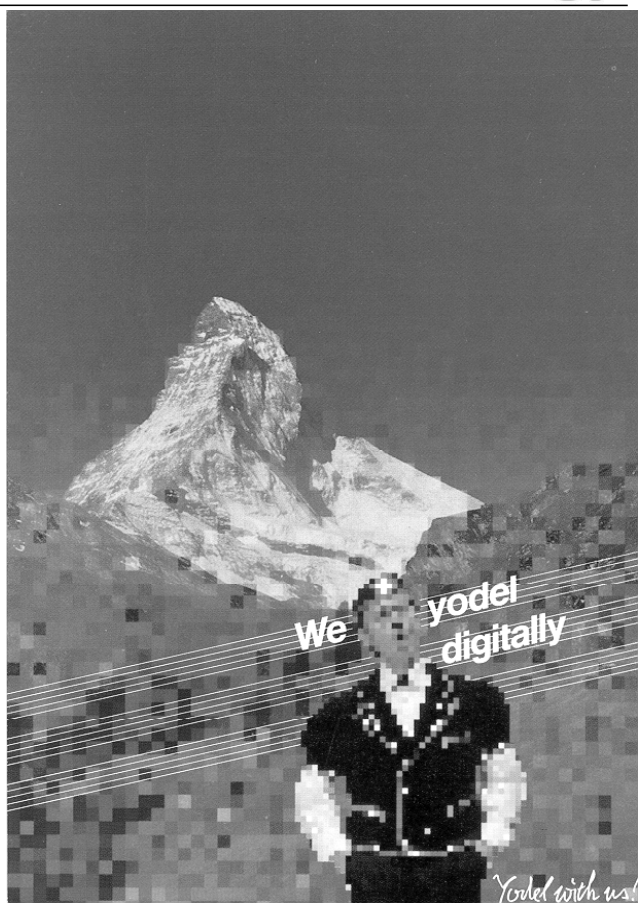
## Technology – too early / too late?

„The citizen's problem, at bottom, is how to assess the things that so often come forth in the beguiling guise of blessings."

*Wirz: Marginalien zur Werbung. Werd Verlag, Zürich,1989*

## Digital Workstations

On the ISPRS agenda: Since 1986
(Symposium Comm. II, Baltimore)




**Kern & Co., ISPRS Congress Kyoto 1988:**

**„We yodel digitally“**





**ISPRS Symposium Zürich, Sept. 1990:**
**“Close-Range Photogrammetry Meets Machine Vision”**

WG V/6: Biostereometrics and Medical Imaging

- **Applications:** Face, eye, dentistry, heart, lung, knee, hip-joint, respiration, body surface, motion (human, animal), sports

- **Sensors:** CT, SEM, MRI, X-ray stereo, REM stereo, laser scanning microscopy, tomography, radiography, ultrasound, CCDs

1989: Comm.V

WG chairmen in Lagna

# Time of Consolidation (1994-2000)

- Large format digital aerial cameras, LiDAR
- Feature and object extraction (city models, road extraction)
- 1998: 15 commercial digital stations with 3D capabilities
- Image matching for DSM generation

- Highres satellite sensors: IKONOS, etc.

- Terrestrial photogrammetry:
  + High accuracy (1:10 000 to 1:100 000), industrial/eng. applications
  + Fast processing, image sequences (robotics, motion analysis, PTV)
  + Surface measurements, large structures ;
    laser-scanners, structured light systems
    1998: 27 commercial systems for surface reconstruction
    16 body scanners and 7 face trackers
  + Mobile Mapping, multi-sensor concepts
    1999: 10 road-based MM systems



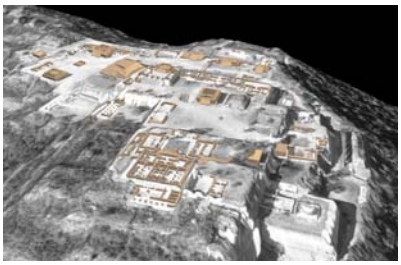


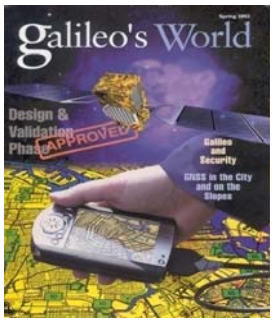
# ISPRS Congress Vienna 1996 – Comm.V topics

| | |
|---|---|
| • **Architectural Photogrammetry** | |
| **photographic/hybrid** | 21 |
| **digital (CCDs)** | 11 |
| • **Industrial applications** | |
| **photographic/hybrid** | 3 |
| **digital (CCDs)** | 20 |
| • Moving objects | 7 |
| • Moving sensors | 1 |
| • Calibration | 3 |
| • Depth-from-focus | 1 |
| • Network design | 1 |
| • On-line triangulation | 1 |
| • Size of targets | 1 |
| • Matching | 2 |
| • Meas. algorithms/accuracy | 1 |
| • Orientation without CPs | 1 |
| • Spatial resection, closed form | 1 |
| • Mikroscopy | 3 |

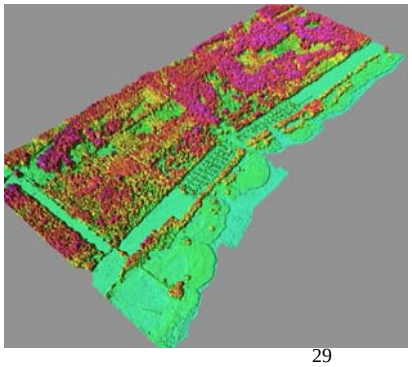
## Al Gore, Vicepresident USA, January 1998:
## The Digital Earth: Understanding our planet in the 21 century

„I believe we need a 'Digital Earth': a multi-resolution, three-dimensional representation of the planet, into which we can embed vast quantities of geo-referenced data."






- Digital Earth Society (Beijing)
- Google Earth
- Microsoft Virtual World, etc.







## Fully digital era (2000 – 2009)

**19th ISPRS Congress, Amsterdam 2000:** ADS40

**Highres satellite imaging** (within 10 years: footprint improved by factor 10)

**PhoWo 2003:**
Ubiquitous computing
Analogue vs. digital image data collection (cameras : DMC, UltraCam)
IKONOS, Quickbird
LiDAR DEM
Distributed photogrammetric data analysis: Automated AT, integration of sensors (GPS/INS), Pixel Factory
3D visualization and animation (city models, buildings outside and inside)

# Space activities

ESA-ESTEC: Planck, Herschel, Gaia, 1:1 Mill.


NASA‘s Rover SPIRIT


Moon Explorer SELENE; JAXA


ESA’s Mars Express

China‘s Chang‘e-1





# Development of satellite sensors

1972 Landsat MSS 80 m GSD

1986 SPOT stereo 10 m

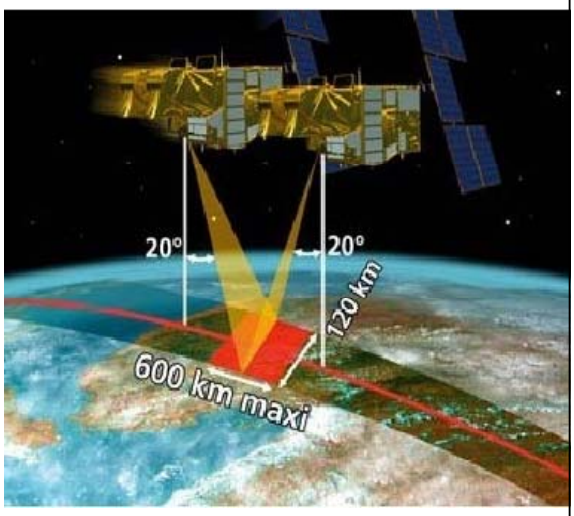
2001 Quickbird stereo 0.6 m

*Within 35 years: > Factor 150 in resolution*

10.2007: WorldView-1 0.5 m

1.7 days revisit

10.2008: GeoEye -1 0.5 m




# HRSI Processing: Summary

**Georeferencing**

- For IKONOS, Quickbird and SPOT-5 bias-corrected RPCs & rigorous models with same results: planimetry: 0.3 pi height: 0.5 pi
- For ALOS/PRISM and Cartosat-1: planimetry: 0.5 - 0.8 pi height: 0.3 - 0.8 pi
  → Sufficient for conventional mapping 1: 10 000

**DSM generation**

- Accuracy (along track): 1-5 pi depending on terrain slope and land cover
- ALOS/PRISM: 2 – 3 pi
- Cartosat: 1 - 3 pi
- But still many large bunders → Not ready for mapping 1: 50 000 !
- DSM > DTM reduction not solved yet





# Radiometric Quality

Zurich aerial

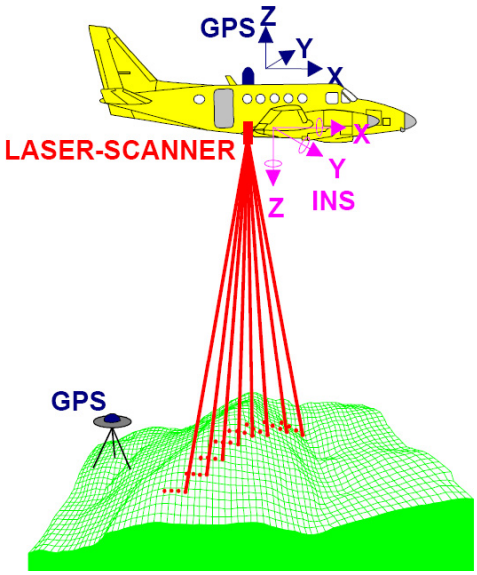
PRISM Zurich

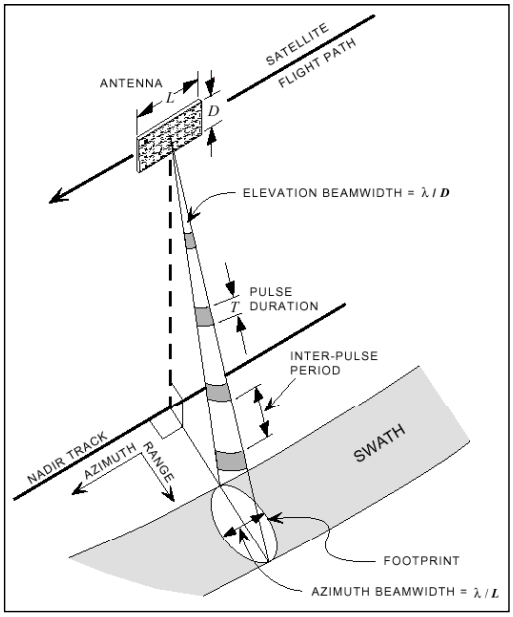
# Aerial Sensing

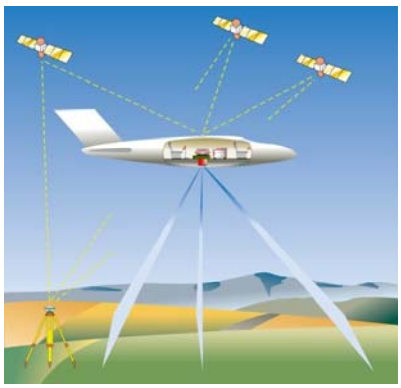
## Optical digital cameras (large/medium, oblique)

## Laserscanners (LiDAR), GPS/INS

## Radar, InSAR



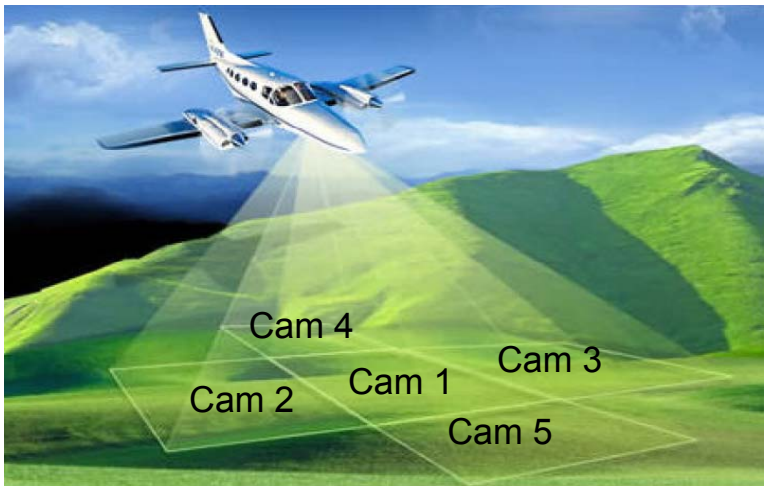
Das Produktion Model
mit einer Optik und einer Focalebene





# Multiple camera heads

New trend: Oblique imaging







Courtesy: Dr. A. Hellmeier www.rolleimetric.com

# Photogrammetry and Remote Sensing:

Turning images into n-dim models (+ semantic info)

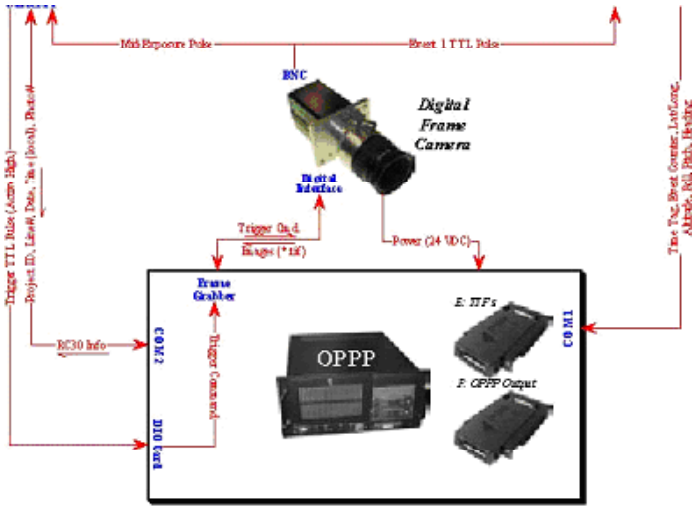
*Example: Firenze*






## A REAL-TIME PHOTOGRAMMETRIC MAPPING SYSTEM, Sherman Wu et al.

***One-Path Photogrammetric Program (OPPP):*** Processes automatically DEM, ortho-images, and contour lines on-board and in real-time



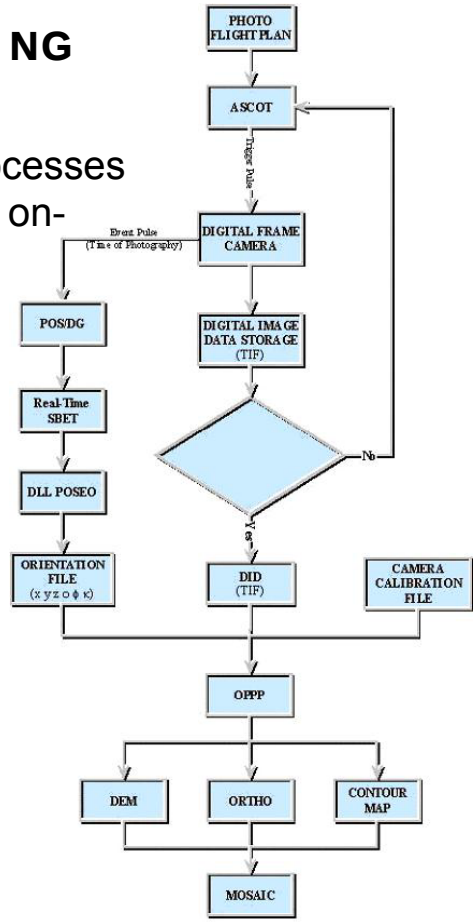




Figure 3. RTPMS general processing flow.

# Development of close-range sensors

Low cost cameras

Panoramic cameras

Laserscanners, structured light

3D CCD/CMOS chips

Hybrid systems

**Large format cameras:**
**Hasselblad&Phase One:**
**39 Mpi, 2 sec/image, ca. SFr 40 000**

**Mobile (Ubiquitous) Photogrammetry**

**Example: Sony Ericsson K750, 2Mpi camera, bluetooth, UBS, etc.**


**Ladybug2**

**6 CCDs**

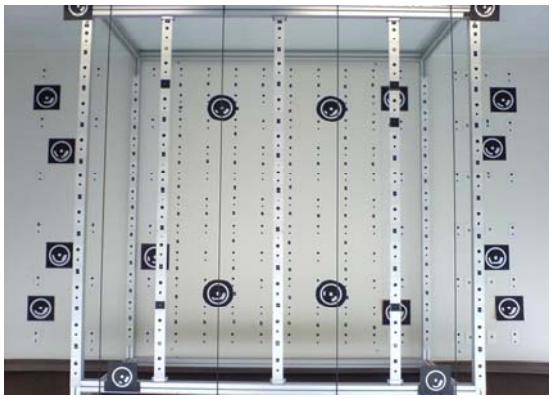
**30 FPS**

**4.7 Mpi/frame**





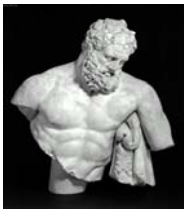


5 M pi Kamera
video 30 f/sec
GPS
8 Gbyte Speicher

# Cultural Heritage

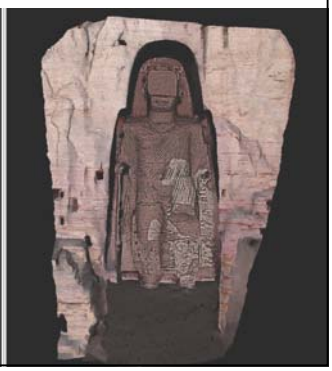
Alfred Escher



Weary Herakles


Petroglyphs in Chichictara

St. Gallen Globus

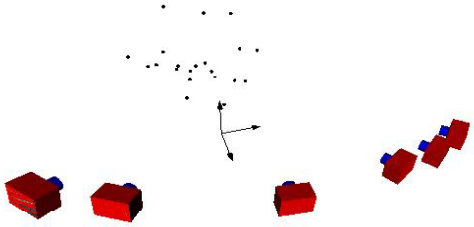


Bamiyan Buddha

ETH Eidgenössische Technische Hochschule Zürich
Institute of Geodesy and Photogrammetry igp

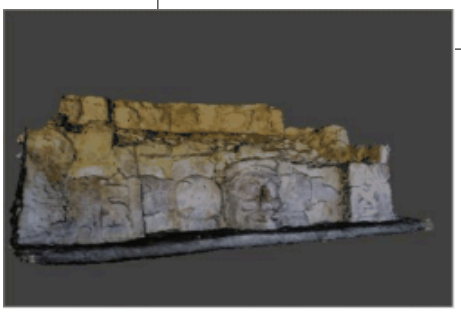
# Fast 3D modeling – *Templo los Macarones, Campeche, Mexico*

Some of the original frames (total 6 images, 1856x1392)
Object dimensions: 3 x 1.5 m

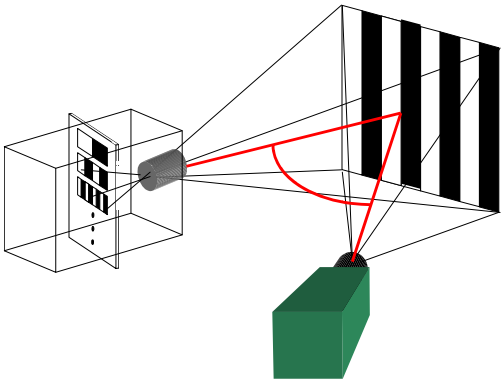


Recovered camera poses

Shaded 3D model
(2M points and 20 000 edges)



Textured 3D model

## Breuckmann optoTOP-HE system

- Accuracy ca. 50 microns
- 1.5 days with 67 scans
- Each scan 1.3M points

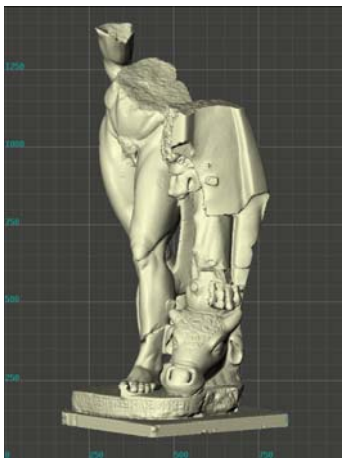
ETH Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

breuckmann

info(+)TRON "Birlikte Geleceği Yaratıyoruz"



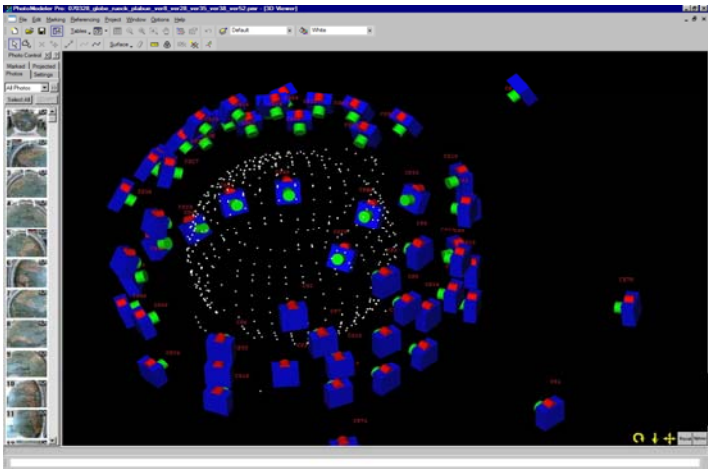




# Multi-sensor approaches
# Project St. Gallen Globe Replika

**Data acquisition:**
ca. 460 Scans with stripe projector and
ca. 250 + 2000 images with digital cameras

**Data processing:**
Object-accuracy ~0.8 mm







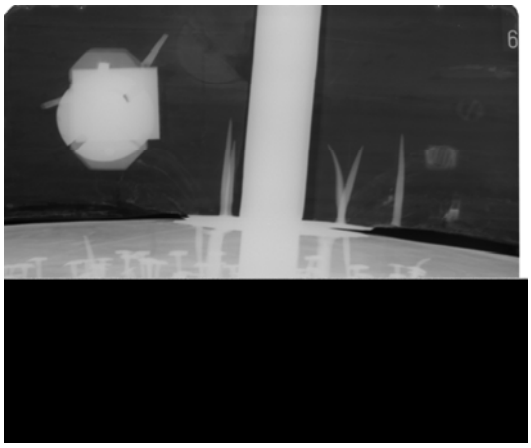
# St. Gallen Globe Replika, 3D model

Hybrid (textured) model

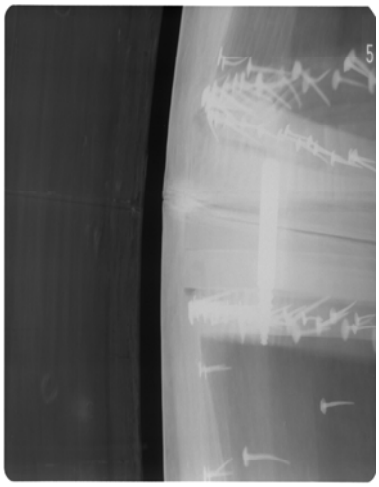
Wireframe model

# Analysis of Interior by X-Rays

- X-rays to analyse the interior of the Globe (construction of axis, materials)
- Performed by EMPA (Annex Institute of ETH Zurich for Material Science)



Axis and metal parts



Material behind the globe surface

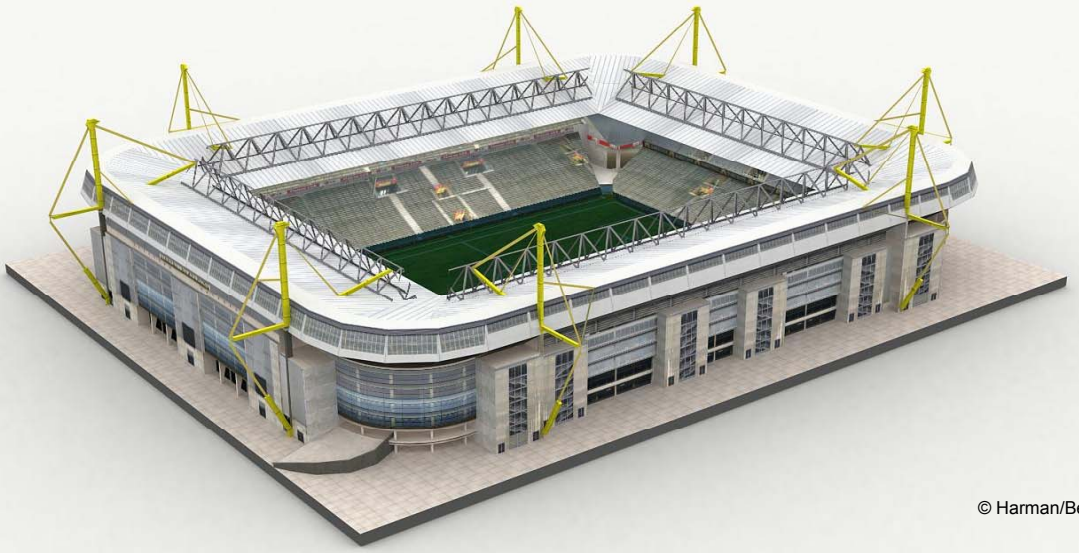




# Use of hybrid systems: Laserscans and images

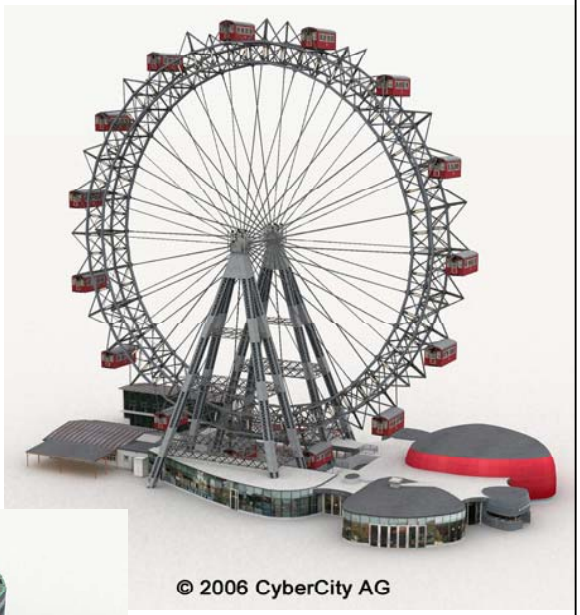
## 3D city modeling: 3D LANDMARKS for car navigation

Courtesy CyberCity AG



# 3D city modeling: 3D LANDMARKS for car navigation

Courtesy CyberCity AG




© Harman/Becker, CyberCity



# Forum Pompeji – 3D Modeling of complex site using multi-sensor, multi-resolution approaches

+ Dept. INDACO, Politecnico of Milano, Italy
+ Institute of Geodesy and Photogrammetry - ETH Zurich, Switzerland
+ Centre for Scientific and Technol. Research – B. Kessler Foundation, Trento, Italy
+ Dept. of Applied Sciences, Parthenope University, Naples, Italy

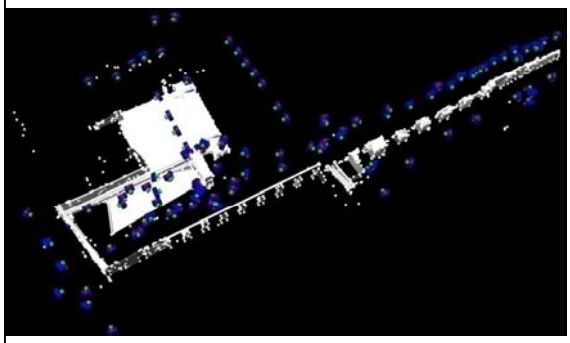
## Used technologies and multi-resolution data

| | Sensors | Use | Quantity | Geometric resolution | Texture resolution |
|---|---|---|---|---|---|
| Aerial images | Zeiss RMK A 30/23 | DSM of the site at low resolution | 3 (scale 1:3500) | 25 cm | 5 cm |
| | Pictometry | Texturing | 4 | - | 15 cm |
| Range sensors | Leica HDS3000 | Modeling of entire Forum at middle resolution | 21 scans (400 Mil pts) | 5-20 mm | - |
| | Leica HDS6000 | | 45 scans (800 Mil pts) | 5-10 mm | - |
| Terrestrial images | Canon 10D (24 mm lens, 6 Mpixel) Canon 20D (20 mm lens, 8Mpixel) Kodak DCS Pro (50 mm lens, 12 Mpixel) Nikon D300 (20 mm lens, 12 MPixel) | Modeling of small finds, mural architectural structures, ornaments | > 3000 | 0.5-10 mm | 0.2-5 mm |





## High resolution: Photogrammetry with interactive modeling



*Photogrammetric block for a large structure (temple of Jupiter)*

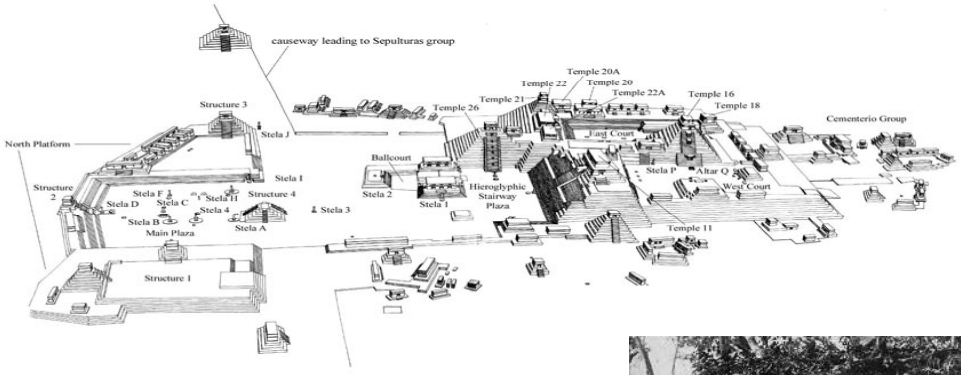
- Over 3000 images acquired
- Bundle block-adjustment
- Interactive modeling to define the main geometric entities
- Geometric resolution (footprint): 0.5-10 mm

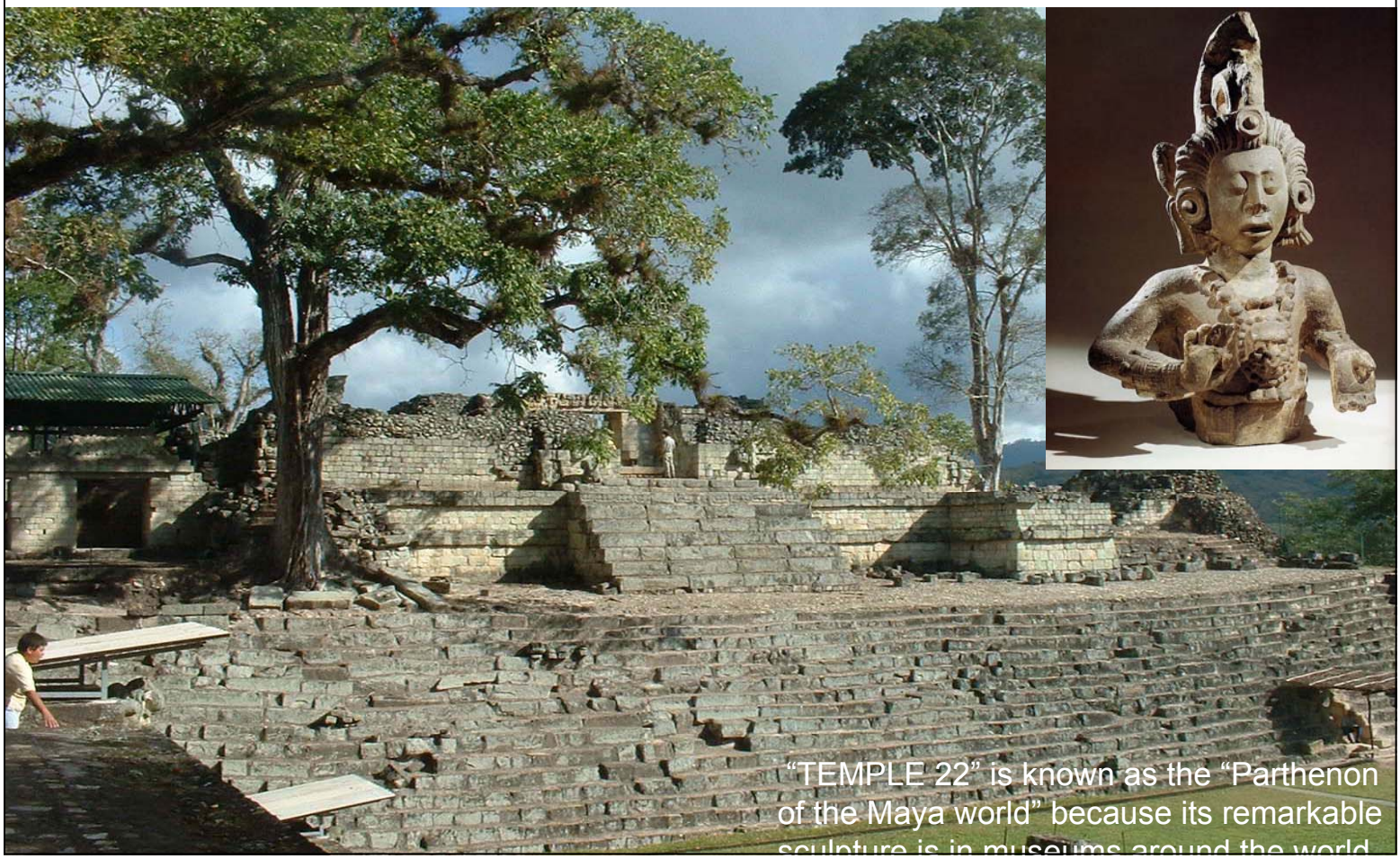
# Forum Pompeji - 3D model





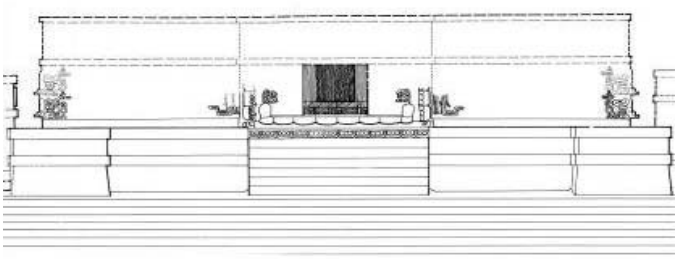
# The Sacred Mountain in Social Context: Symbolism and History in Maya Architecture— Temple 22, Copan Honduras



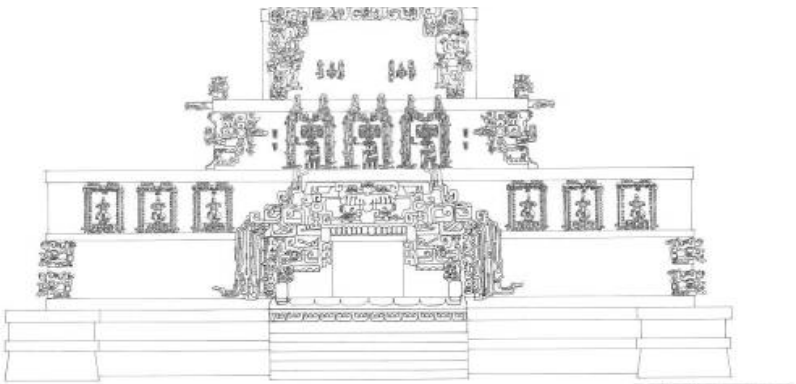






## A NEW VISION OF TEMPLE 22 EXISTS, BUT HOW TO EXPLAIN THIS COMPLEXITY OTHER THAN IN 2D DRAWINGS?



BEFORE: Hohmann and Vogrin 1982



AFTER: von Schwerin and Allen 2009

**THE ANSWER:**

reality-based 3D model and reconstruction of Temple 22, East Court and Principal Group, at varying levels of detail.

**METHODS:**

1. Photogrammetry and laserscanning of architecture and sculpture on site, and in warehouses and museums via photogrammetry and structured light for reality-based reconstruction.

2. CAD integration and VR simulations for the reconstructed portions.

3. Develop 3D GIS website for online download and viewing of the model (among other things).

# UAV photogrammetry (Palpa/Nasca, Peru)






ETH Eidgenössische Technische Hochschule Zürich
Institute of Geodesy and Photogrammetry igp

# Student project: Castle Landenberg

Symbol of Obwalden in the Swiss passport

# Landenberg: Flight planning

- Circle with a radius of 25 meters
- 24 images; every 15°
- Images oblique
- Simulation





# Student project: Castle Landenberg

# Aeroscout Scout B1-110 with aerial laser scanner



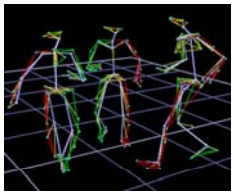


# New Motion Capture standards

**Vicon:** MX 20+ Motion Capture Camera, Markers

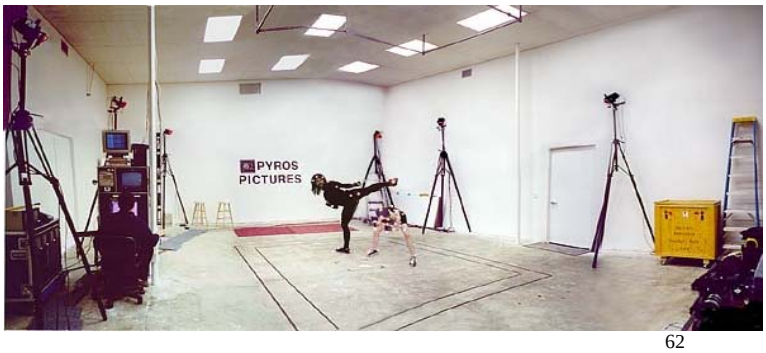
2 Mill. pi, 166 frames/sec, 10 bit

MX Ultranet: 245 cameras simultaneously



**Movie Troy** (Prad Pitt):

555 shots, up to 5 performers simult.
3 hrs MOCAP data



## Motion Analysis

**The Return of the King**: 18 000 virtual effects shots

3 500 Linux-based processors

420 people (Weta Digital, Wellington)

**Gollum:** MoCap, roto-motion, keyframe animation

16 cameras à 1.3 Mpi, 60/120 fr/sec

10 people MoCap, 15 people MoEdit

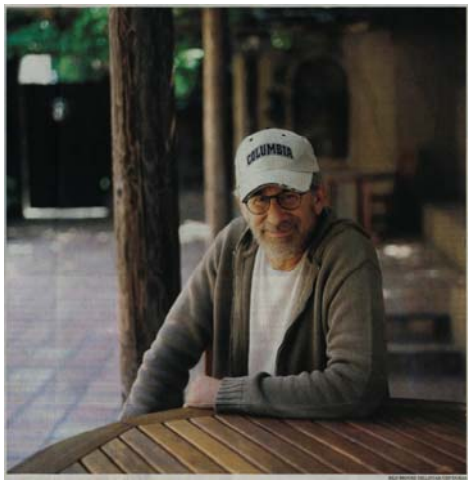





## 3D movies (+ TV channel BSkyB, 2010)

**Steven Spielberg (TA 4.7.09) on the revolution of the 3D film:**

“ I find it fascinating how 3D images resemble real life; we also see reality three-dimensionally”



Producer of
„Transformers: The Revenge of the Fallen“
and
„The Adventures of Tintin“

# Geogames

- DTM and satellite/aerial images


Microsoft Flight Simulator X

- DTM and train-track data

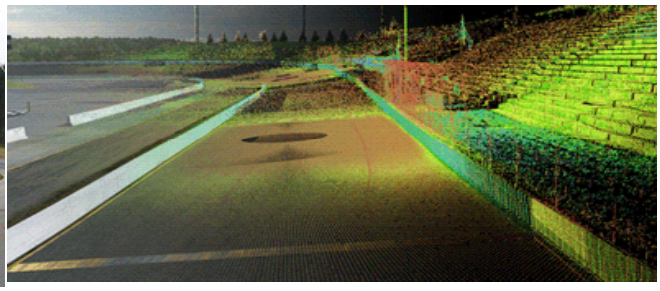
Microsoft Train Simulator 2





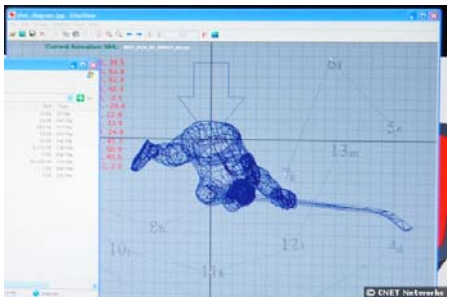
# Geogames

- Laserscan to obtain race track geometry



iracing.com – motorsport simluations

- Motion capture to animate (laser scanned) model



NHL 2k9 – images by cnet.com

## Photogrammetry – a secret technology?

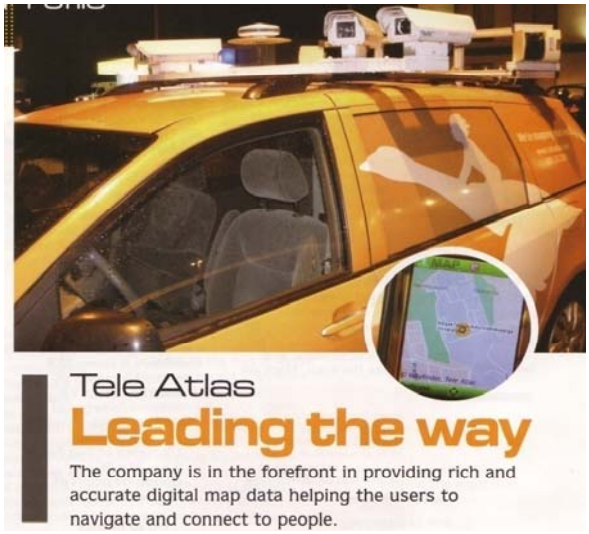
„As a scientist I had a unique opportunity. During my time astronomy reached the market places.“

*Galileo Galilei to Andrea Sarti in „The Life of Galilei“, by Bertold Brecht*





## The Market Place





ISRO set to launch country's first indigenous geomatics software

Developed by ISRO's Ahmedabad centre, new software to be more compatible with Indian satellites and will cut costs

2.2009: Teleatlas maps Thailand
3.2009: GeoEye-1 for Google Earth
8.2009: WorldView-2 arrives at Vandenberg Air Force Base, Launch 6.10.09

**28/05/2009: RapidEye Constellation's 100 Days**
RapidEye have collected more than 69 Million square kilometres of at least 80% cloud-free images during their first 100 days of operation.
The imaging campaigns were concentrated in Europe, the U.S., Brazil and China.
More than 36 Million square kilometres of the Earth's surface, or about one quarter of the total landmass were imaged, often several times.

## 28/05/2009: 3D Models of European Cities

Blom has completed the production of the first 40 high quality 3D models, Blom3D, of European cities. The Blom3D models have been delivered to Tele Atlas for integration into navigation, LBS and mapping solutions.

Tele Atlas has already announced that they have launched the photorealistic buildings and blocks created by Blom, as part of their navigation solutions. Their solution, named Advanced City Models, will enhance the user-experience of any navigator integrating the solution.





## 01/06/2009: Large-Scale Mapping for UK

The GeoInformation Group has launched a new mapping programme. UKMap is the UK's first commercially funded, large-scale topographic mapping and address database created completely independently of the Ordnance Survey.

Employing more than 100 people across three continents, UKMap is a five-year programme to map over 500 towns and cities covering all urban areas with a population greater than 10,000 - some 24,000 square kilometres throughout the UK.

London is the first complete UKMap city with over 1,700 sqkm and will be available on 1 Sept. 2009.

UKMap Copyright The GeoInformation Group 2009

## Geo-enabling Mobile Phones (navigation, maps, 3D models, …)

O.-P. Kallasvuois, President&CEO Nokia, 4.2009: ”We have focused our investments on five primary categories: maps, music, messaging, media and games.”

## Changes in society & economy

→ New environments for R&D, Education and Professional Practice

+ New interest in geosciences

*Natural and man-made hazards*

+ Communication

*Technology & knowledge transfer, data accessibility*

+ Globalization of science

+ Diversification, interdisciplinarity

*Technology and applications*





## Impact on profession

### (a) Inflation of data

*„An image is worth a thousand words“ – What will 100 Mill. images tell us?*

***Ubiquitous imaging, Cloud-based Computing***

Processing capabilities trailing behind data acquisition rate

→ ETHZ: Center for Imaging Sciences & Technologies

Google, Microsoft street images: *Transparent human*, personality issues

### (b) Increased system complexity

→ More blackboxes or better/more education?

### (c) Competition from neighbouring disciplines

→ Development of own capabilities and attitudes

(openness, flexibility, self-assurance)

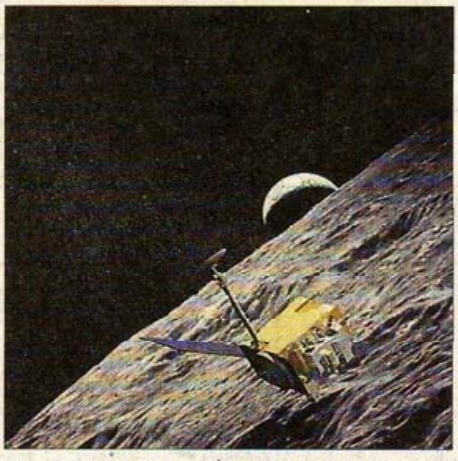
→ Maintain depth in research

# Mission mit Sollbruchstelle

## Die Nasa will eine Sonde auf den Mond abstürzen lassen

Die Nasa nimmt den Mond wieder ins Visier. In der Nacht zu Freitag mitteleuropäischer Zeit will die US-Raumfahrtbehörde zwei unbemannte Sonden auf den Weg zum Erdtrabanten schicken. Die Mission gilt als Vorbereitung künftiger bemannter Mondflüge. Die beiden Raumfahrzeuge, der *Lunar Reconnaissance Orbiter* (*LRO*) und der *Lunar Crater Observation and Sensing Satellite* (*LCROSS*), sollen in Cape Canaveral an Bord einer *Atlas-V*-Rakete ins All geschossen werden. Der Startzeitpunkt soll zwischen 23.12 Uhr und 23.32 Uhr deutscher Zeit liegen.

Der *LRO* wird den Himmelskörper in 50 Kilometer Höhe umkreisen. „Wir müssen uns besser mit den Landschaften des Mondes vertraut machen, mit seinen Bergen und Tälern, um künftige Landeorte gezielt auswählen zu können", sagt Scott



*Die LRO-Sonde wird einen Landeplatz für künftige Astronauten suchen.* Nasa

# Weg frei für Google

## Datenschützer gestatten Street View

Mit Googles Online-Kartendienst Maps wird man sich nun bald auch Rundumansichten deutscher Städte anschauen können. Wie der Internetkonzern meldet, habe man sich mit den Datenschutzbeauftragten der Länder auf Verfahren geeinigt, wie den Bedenken der Datenschützer und vieler besorgter Bürger gegenüber dem Dienst Street View Rechnung getragen werden soll. Google hat demnach zugesagt, Gesichter und Nummernschilder unkenntlich zu machen, die von den Kameras erfasst werden. Menschen, die nicht wollen, dass Bilder ihres Hauses veröffentlicht werden, können dies über eine Webseite melden, die rechtzeitig vor der Veröffentlichung zur Verfügung stehen soll. Die Rohdaten – die Bilder ohne Verfremdungen also – sollen spätestens nach zwei Monaten gelöscht werden. Für den Leiter des Unabhängigen Landeszentrums für Daten-

## Photogrammetry today:

+ From **point positioning** and **2.5D mapping** to an **integrated, unified n-D technology,** encompassing **satellite, aerial** and **terrestrial sensor platforms**
+ From **single sensor/multiple processing instruments** to **multiple sensors/single processing platform** technique

***(1) Technologies are converging (satellite, aerial, terrestrial)***
Processing (almost) platform-independent
***(2) Image understanding is a hard problem***
Full automation only possible for highly structured images or unstructured products
Remedy: Multi (hybrid)-data approach (?)

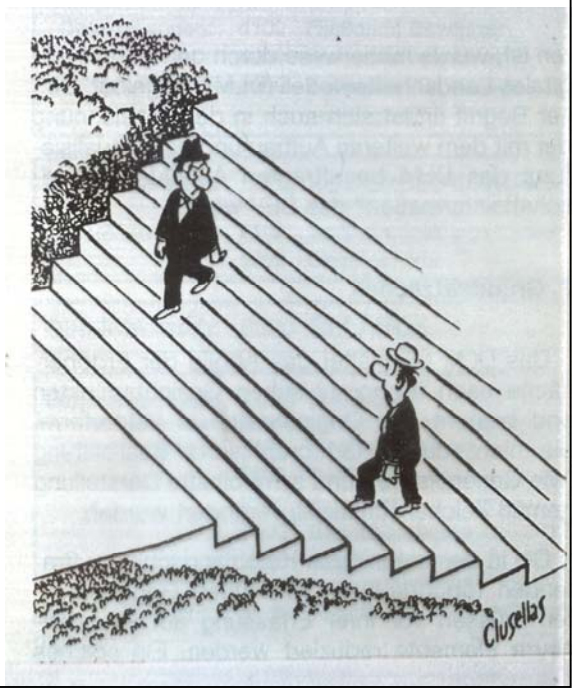




## Image-, scene understanding

***Rodney Brooks, MIT (The Road to 2030 - A Wild Ride), 2005:***

" (For navigation) The robots of tomorrow will need to have the object recognition capabilities of a 2-year old child,…"




**Measurement or modeling errors ??**

## Do not forget:

### Photogrammetric principles/priorities

* Sophisticated sensor models, network competence
* Refined measurement algorithms (⇢ precision)
* Redundant data (⇢ reliability)
* Self-diagnosis, quality control
* System design for general applicability
* Engineering approach: Testing, validation, robustification

**Service to profession !**





## The Future

### Al Gore, Vicepresident USA, January 1998:

„Working together, we can help solve many of the most pressing problems facing our society, inspiring our children to learn more about the world around them, and accelerate the growth of a multi-billion dollar industry.“