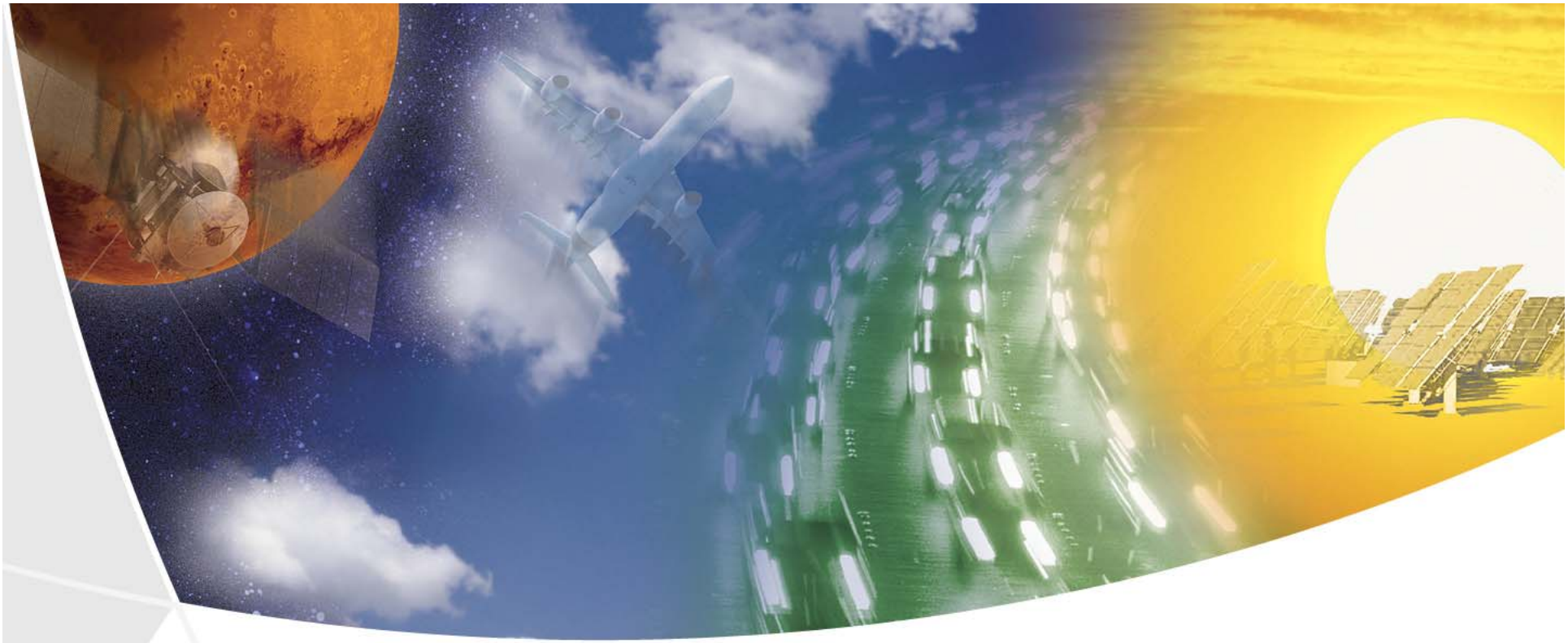

Generating of 3D-Worlds using High-Resolution Sensors

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DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

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- Introduction of the Department of Optical Information Systems
- Generating of 3D-Worlds
  - Background
  - Development of high-resolution camera systems
  - Geometrical calibration
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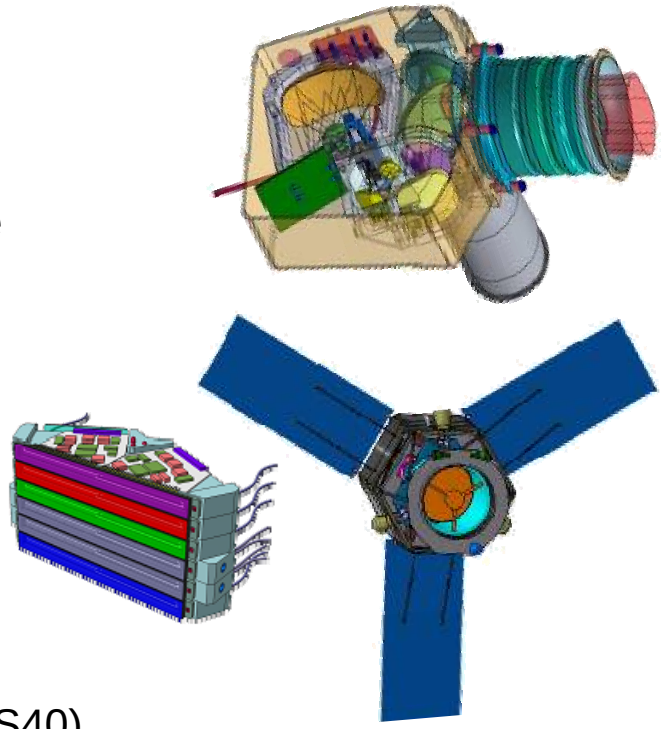
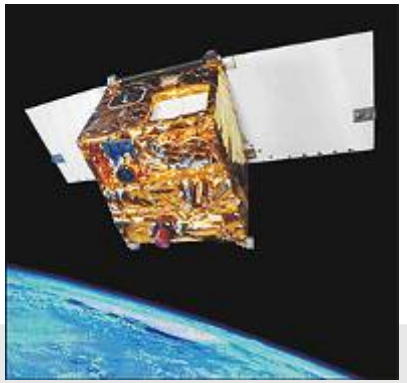
  - Visualization
- Outlook

Department of Optical Information Systems

Introduction

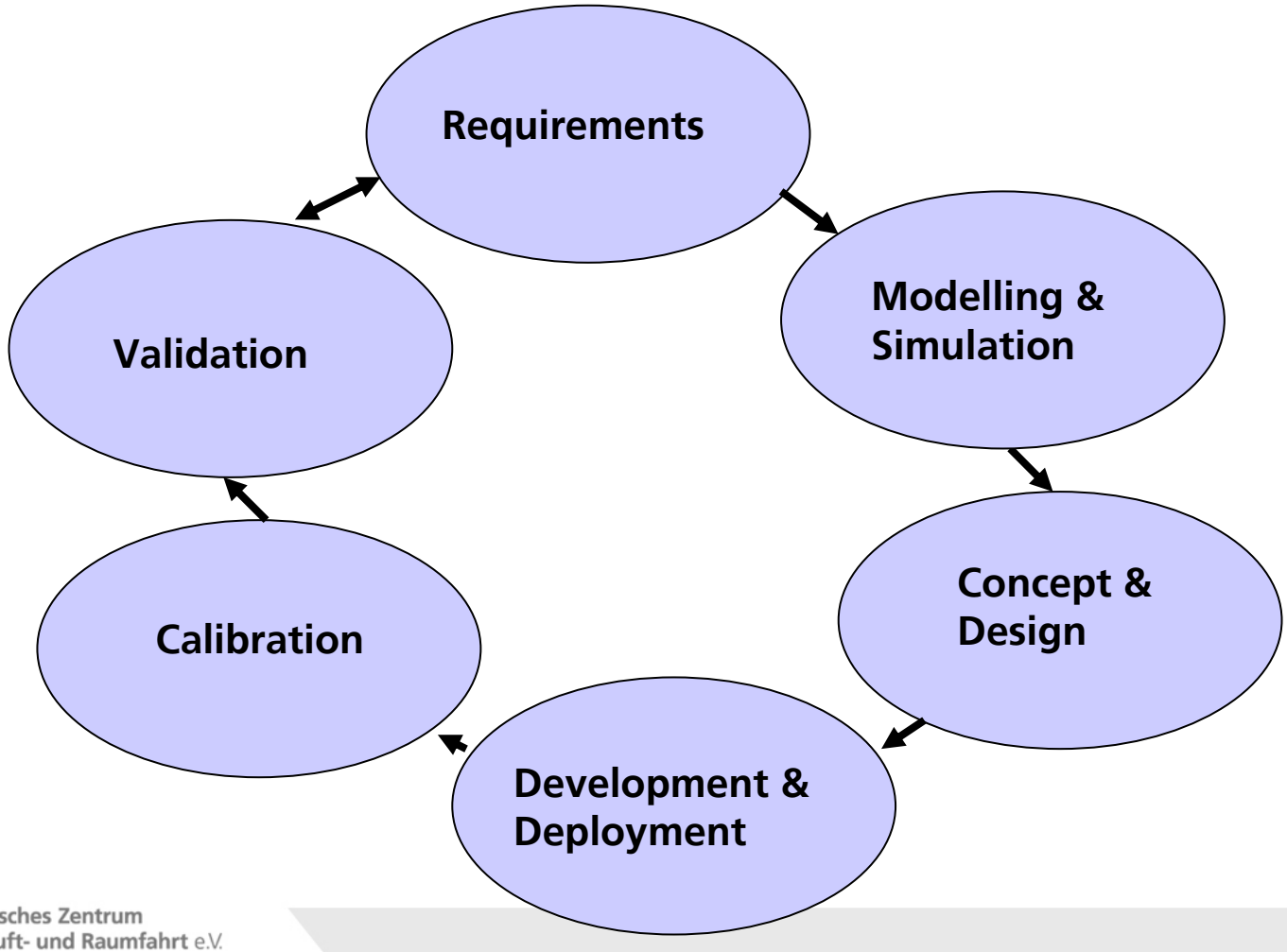
- History
  - 1981 Institute of Cosmos Research at the Academy of Science of East Germany
  - 1992 Integration into DLR
  - Affiliation to different DLR institutes
- Structure
  - 3 units
  - 47 employees (42 scientists)
- Business fields
  - High resolution camera systems (e.g. ADS40)
  - Small satellite technologies (e.g. BIRD)
  - System Engineering
- Current main projects
  - Kompsat-3, MERTIS, TET/OOV





Department of Optical Information Systems

System-oriented development approach



3D-Worlds

Background

- What for?
  - Analysis
    - Topographic maps & surface models for cartography, geology, mining, etc.
  - Robotics (navigation and interaction)
    - Medical technology, exploration, security
  - Visualization & Archiving
    - Facility management, museums
- How?
  - Direct retrieval
    - 3D measurements (e.g. laser) or modelling (CAD tool)
  - Indirect retrieval
    - 3D scenes out of 2D images
    - Two views from different known positions
    - Human seeing, cameras

3D-Worlds

Development of high resolution camera systems

- Experience
  - First commercial digital airborne camera for photogrammetry and remote sensing (ADS40, cooperation with Leica Heerbrugg)
  - Panorama camera (EyeScan, cooperation with KST Dresden)
  - Focal plane for spaceborne system (Kompsat-3, Korean project)
    - Line scanner, 24.000 pixels per lines, panchromatric, R, G, B, NIR, 0.5 GByte/s
- Challenges
  - Data volume, real time processing, visualization, archiving, …

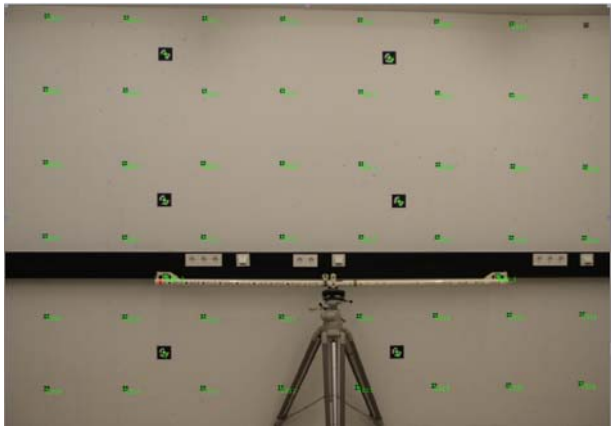
3D-Worlds

Geometrical Calibration

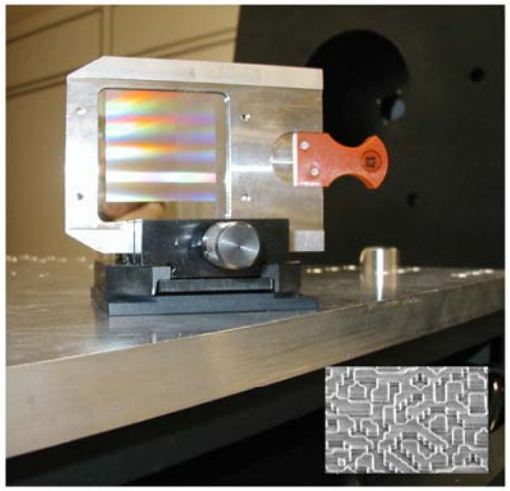
- Why?
  - Measuring tasks for metric cameras
  - Deviations from ideal pinhole model caused by optical components ⇒ Distortions
  - Determination of pixels viewing direction

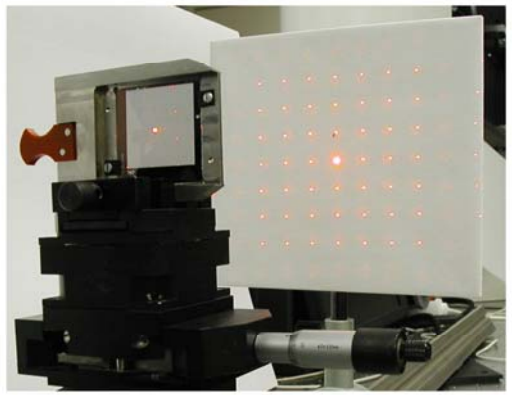
3D-Worlds

Geometrical Calibration (cont.)



- How?
  - Field of well known control points
  - Goniometer
  - Diffractive optical elements





3D-Worlds

Data capture

- Ground based
- Stereo by shifting the position

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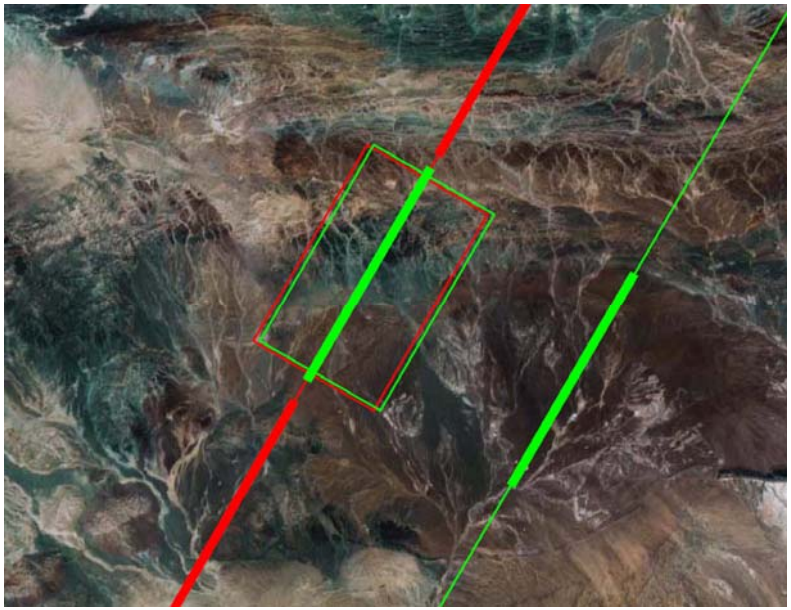
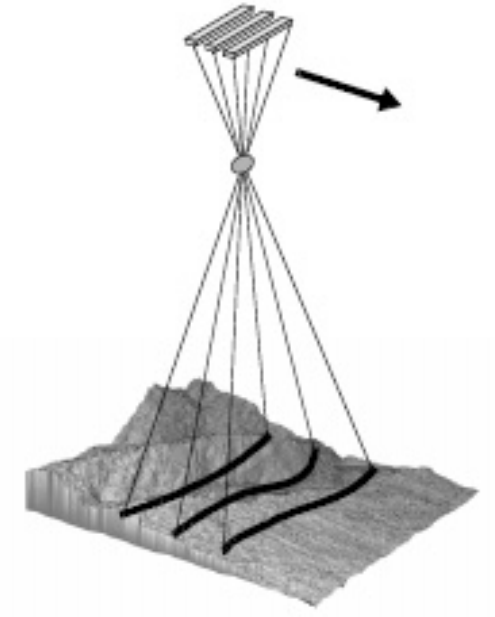
3D-Worlds

Data capture (cont.)

- Airborne/ Spaceborne
- Stereo capability by across/ along track imaging





3D-Worlds

Stereo processing

- Needs for stereo processing
  - at least two images with known orientation and calibration data
  - reliable point matching (Biggest challenge)
- Years of trial and error, from difference and correlation to complex approaches, e.g. Semi-Global Matching and Mutual Information, H. Hirschmüller (DLR-RM)
- Derivation of textured 3D models

3D-Worlds

Data fusion

- Laserscanner
  - Single point measurements by “time of flight” or phase analysis
  - Scanning by rotation
  - 3D point clouds
  - Meshing
  - Texturing with imagery

3D-Worlds

Visualization

- Passiv
  - Stereo glasses … movies … caves
- Interactiv
  - Rendering & Raytracing
  - Real time

3D-Worlds

Outlook

- Future goals
  - Intelligent cameras
  - SensorWebs
- Organic Computing?