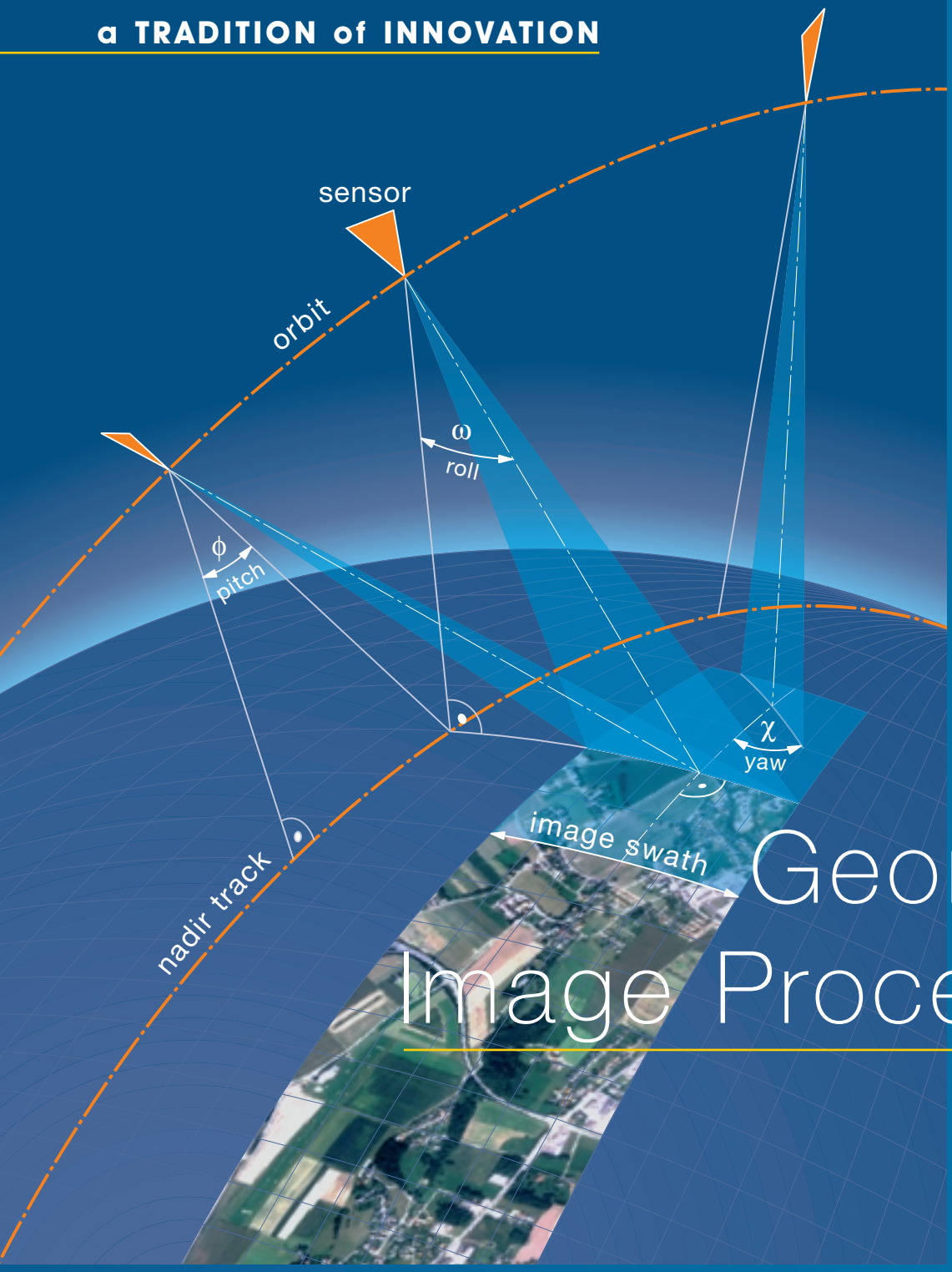
a TRADITION of INNOVATION

JOANNEUM RESEARCH



Geometric Image Processing

Institute of Digital Image Processing

The JOANNEUM RESEARCH Institute of Digital Image Processing has been a pioneer in the geometric processing of a wide variety of remote sensing image data – whether acquired by optical or SAR sensors, from spaceborne or airborne platforms, at low or ultrahigh resolutions. Our experts develop advanced techniques and algorithms to provide custom solutions in geocoding, stereo mapping and SAR interferometry. A special forte of the Institute is the development of fully automatic processing chains, turning raw data into value-added products.

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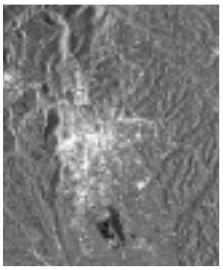
Airborne line scanner image

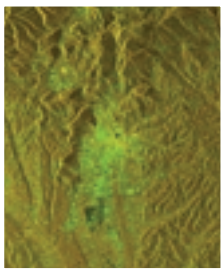
Geometric Modelling

Landsat TM

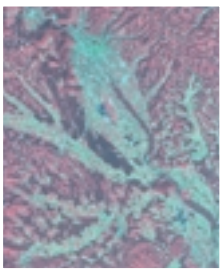
Corona



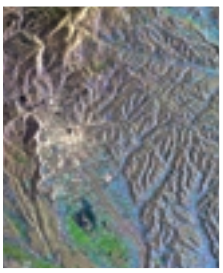
Envisat ASAR



Multi-polarisation Envisat ASAR



Aster



Multi-temporal ERS

Parametric sensor models based on photogrammetric techniques allow for precise transformations between target points on the ground and corresponding image locations.

- Implementation of high precision parametric sensor models for a variety of sensor systems:

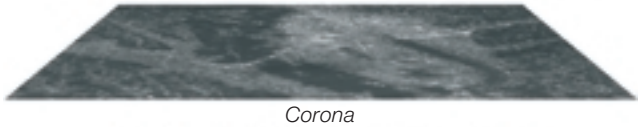
  Landsat (up to TM 7), SPOT 1 to 5, IRS-C/D, MOMS, JERS, Corona, Eros, Ikonos, Quickbird, Daedalus, DAIS, ROSIS, Toposys RGB, ERS-1/2, Envisat ASAR, Radarsat, SIR-C/X-SAR

- Generic models in case of missing/unknown sensor parameters; alternative mapping functions (e. g. rational polynomials)
- Sensor model optimisation using least squares parameter refinement for single and multiple images
- Automated control point acquisition using reference image chips and image matching techniques

Geocoding

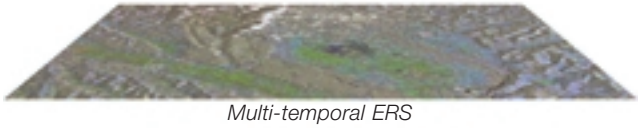
Topographic map

Aster

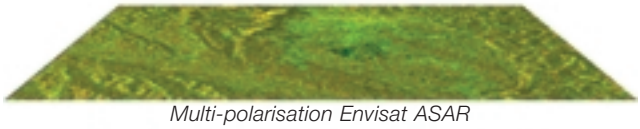


Corona

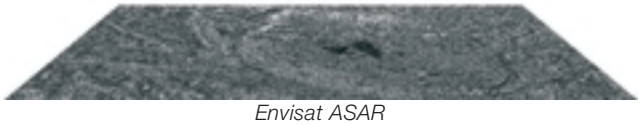
Landsat TM



Multi-temporal ERS



Multi-polarisation Envisat ASAR



Envisat ASAR

The Institute has developed a variety of sophisticated geocoding, registration and georeferencing procedures. These approaches require absolute precision in order to generate registered stacks of perfectly aligned multi-sensor or multi-temporal image data or map products.

- Forward and backward transformations between image and ground based on optimised sensor models and utilisation of digital elevation models for the compensation of terrain induced relief displacements
- Automated geocoding through image chip matching to find control points
- Co-registration using either image matching or sensor model based techniques
- SAR specials:
  processing of polarimetric SAR data,
  layover/shadow mapping or image simulation

Customised solutions for generating

- ortho-images, image stacks
- registered images/image maps
- auxiliary SAR products:
  simulated images, layover/shadow maps

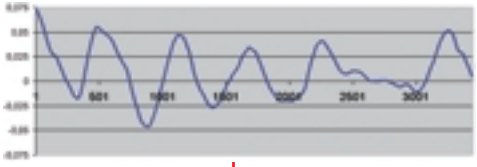
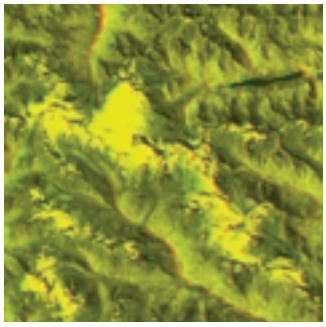
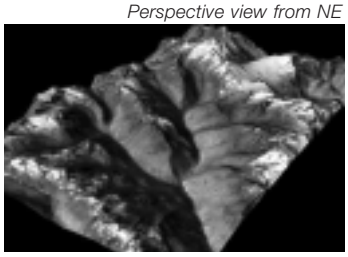


Image Matching and Stereo Mapping



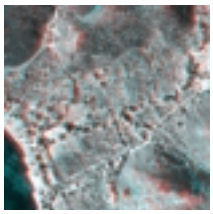
Anaglyph image

Perspective view from NE

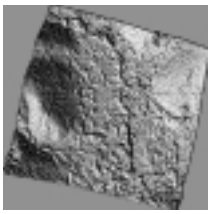


Stereo DEM from JERS

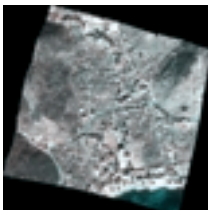
Ikonos stereo images



Digital surface model



Superimposed ortho images



Stereo DEM from Ikonos

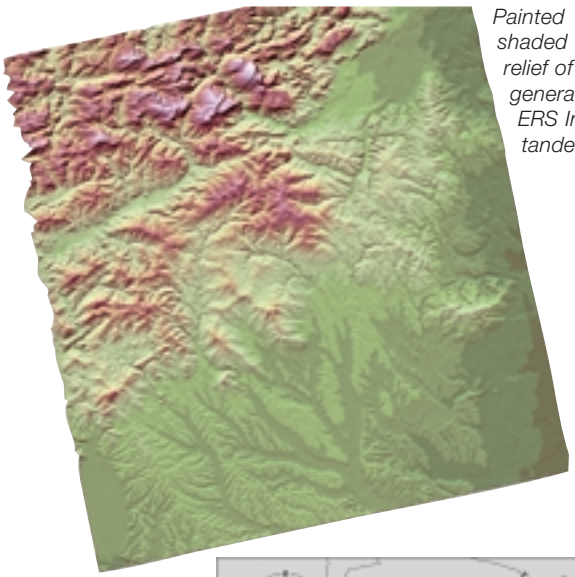
Special expertise exists in the development of generic procedures for extracting 3D information from a wide range of remote sensing stereo images acquired by optical and SAR sensors. Recent developments focus on high-resolution stereo data, which may often be acquired simultaneously in the same overflight. Such image pairs provide the basis for generating digital surface models of high quality.

- Development and upgrade of a variety of automated image matching techniques
- Extraction of 3D information from any kind of stereoscopic remote sensing image data
- Automated tie-point acquisition through matching of points of interest
- Combination of image pairs acquired by different instruments

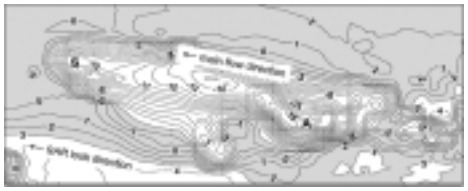
Customised solutions for generating

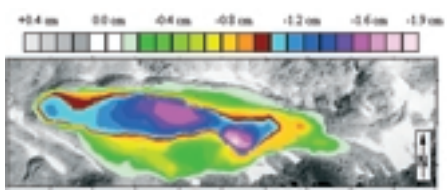
- digital elevation / surface models

SAR Interferometry



Painted shaded relief of DEM generated from ERS InSAR tandem data





Rock glacier surface deformation map generated from ERS InSAR data

The Institute has long-term expertise in SAR image data processing including algorithm development and optimisation for interferometric SAR (INSAR) data. Research in this field covers standard and innovative approaches to extracting information from INSAR data.

- Standard INSAR processing, e. g. interferogram filtering, atmospheric effects removal, coherence estimation, phase unwrapping with sparse matrix algorithm
- Differential INSAR processing, e. g. optimisation of interferogram simulation from DEM, generation of 3D velocity vectors from surface displacement maps
- INSAR gradient approach, e. g. generation of topograms, fluxograms, velograms and slope maps
- Permanent scatterers techniques
- Large range of sensors supported:
  ERS-SAR, JERS-SAR, SIR-C, RADARSAT, ENVISAT-ASAR; others (e. g. airborne) as needed

Customised solutions for generating

- interferometric standard products (interferograms, coherence maps, unwrapped interferograms and DEMs)
- simulated interferograms from DEMs,
  surface displacement maps
- topograms, fluxograms, velograms and slope maps

Geocoded airborne line scanner image

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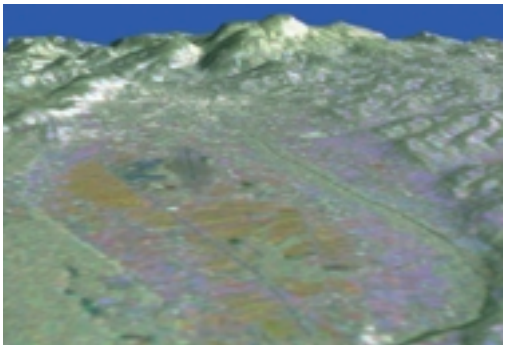
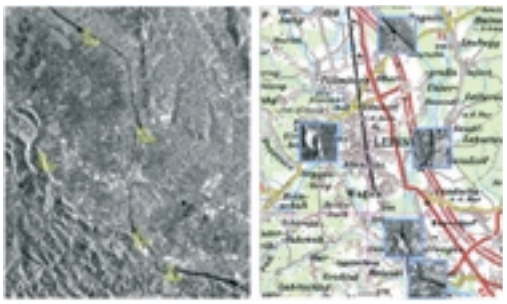
Remote Sensing Software Package Graz (RSG)



Perspective view of multi-temporal ERS SAR images



Automated control point acquisition using chip matching

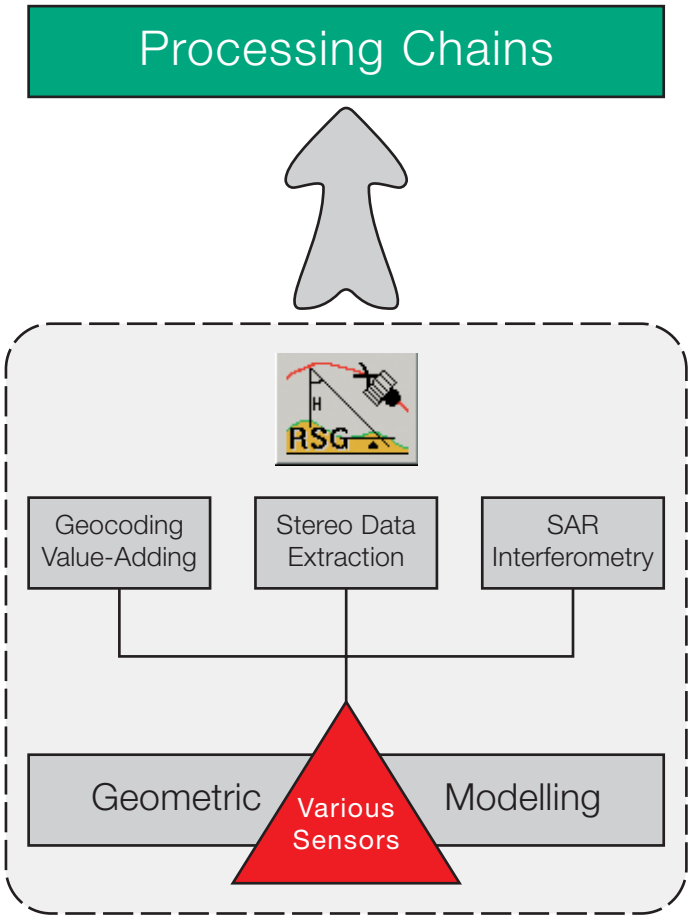
The cutting edge in multi-sensor image processing

The majority of algorithms developed at the Institute have been compiled into the commercial Remote Sensing Software Package Graz (RSG). This easy-to-use tool is tailored to the geometric processing of digital multi-sensor image data irrespective of the acquisition platform and acquisition geometry used. The software is permanently updated to accommodate new sensor systems.

RSG capabilities

- Optical line scanner, SAR and perspective images
- Spaceborne and airborne image products at various processing levels
- Single and multiple images (stereo pairs, image blocks)

Processing Chains



User tailored end-to-end solutions for the geometric processing of remote sensing image data

The modular approach of RSG allows the different modules to be readily combined into operational end-to-end processing chains, which can be flexibly tuned to specific tasks. These processing lines assist both data distributors and users in generating customised end products from raw data on a standardised and fully automatic basis.

Major contractors, such as ESA, DLR, EADS / Dornier or Toposys rely on the Institute's long years of geometric processing expertise, e. g. to implement geocoding processing lines for their data.

Your benefits

- Cost-effective implementation
- Time-effective data processing
- Flexible and modular approaches
- User friendly operation

RGB composite of ERS tandem data for land-use characterisation

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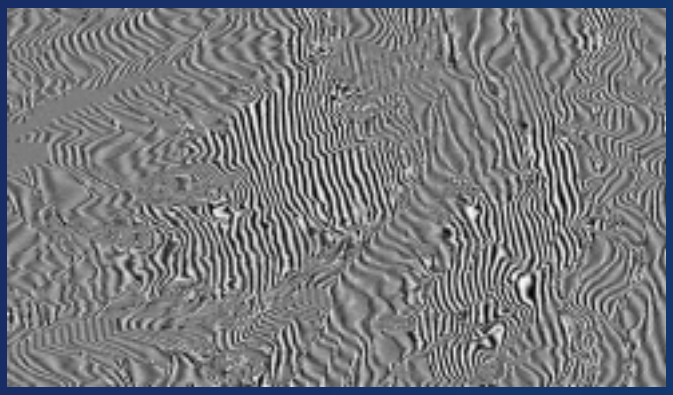
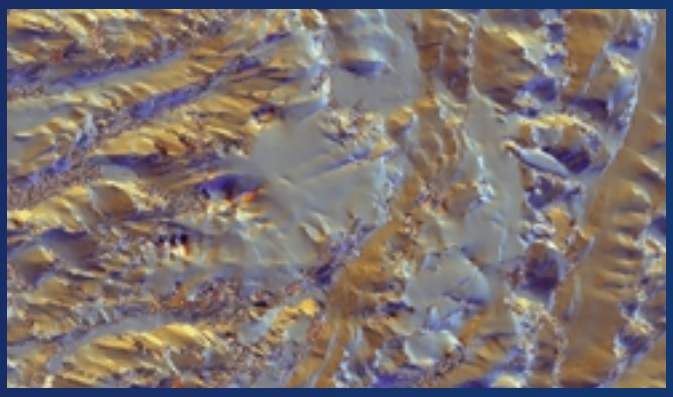
Reference Projects and Activities

Landsat TM satellite image mosaic



a



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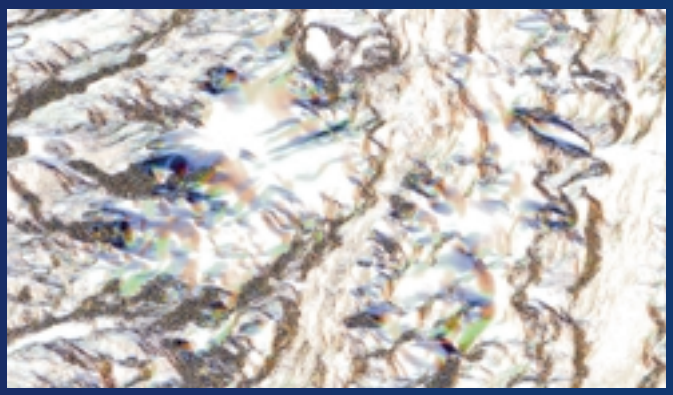
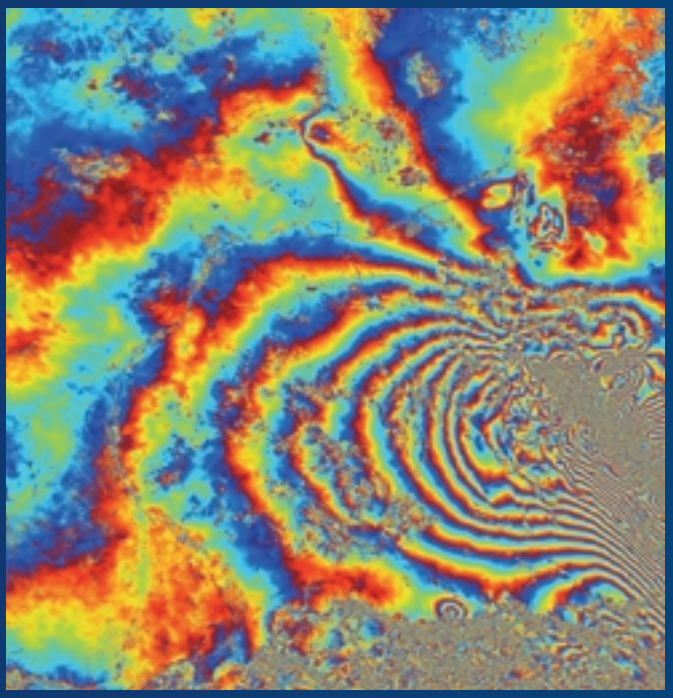


c

GINSAR value-added products of Svartisen Ice Caps, Northern Norway: original SAR interferogram (a), topogram (b), fluxogram (c)

Algorithm Development

- Involvement as principal investigator in many optical and SAR remote sensing missions (e. g. JERS, SIR-C, ERS-Tandem, RADARSAT, SRTM, ADEOS, ASTER, ENVISAT, ALOS)
- Contribution to the geocoding system within the German Ground Segment for the ERS sensors (ESA)
- Radargrammetric and interferometric analysis of RADARSAT and ERS tandem data (Austrian Ministry of Science)
- Feasibility of atmospheric effect in interferometric SAR data and its interpretation (ESA)
- Multi-sensor and interferometric retrieval techniques (ESA)
- Development of block adjustment software for SRTM INSAR data (DLR, German Aerospace Center)
- Geoscientific applications using multi-parametric ENVISAT data (Austrian Ministry of Science, Austrian Space Agency)
- Retrieval of alpine biophysical parameters from E-SAR polarimetric, interferometric and multi-frequency data (Austrian Space Agency)
- INTEGRAL: Interferometric evaluation of glacier rheology and alterations (EU 6th Framework Programme)



Surface displacement map of the Landers earthquake (one colour cycle equals 6 cm)

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Reference Projects and Activities

Fusion of ERS ascending and descending SAR data

Multi-sensor database for urban development monitoring (Graz, Austria)

Aerial photograph (1959)

Corona (1968)

Daedalus (1996)

Processing Lines

- Implementation of geocoding system for ENVISAT ASAR products (DLR)
- Automated geocoding feasibility of image data acquired by the future RAPIDEYE sensors (prototype software for RAPIDEYE, Germany)
- Automated geocoding of airborne SAR image data of the DOSAR sensor (EADS / Dornier, Germany)
- Calibration and automated geocoding of airborne RGB line scanner imagery utilising laser scanner elevation data (TOPOSYS, Germany)
- Applicability of geocoding processing line to future TerraSAR X-Band image data (DLR)
- Automated co-registration and automated geocoding of multi-sensor Radarsat SAR data with respect to pipeline monitoring (co-operation with C-Core, Canada)
- Automated co-registration of land use classifications (Vodafone, Germany)

Geocoding and mosaicking of airborne line scanner images

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one of Austria's largest institutions in the field of applied research and development, offers its expertise to business, industry and administration. With a staff of more than 370 highly skilled experts JOANNEUM RESEARCH is active at national and international levels in all important sectors of innovation.