Near Real Time Applications for Maritime Situational Awareness

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Presentation Outline

Background

- Maritime Security Lab Neustrelitz
- Component of Service Chain

Application Status and Future Development

- Ship Detection
- Oil Detection
- Wind and Wave
- Iceberg Detection and Classification
Earth Observation Center – EOC

Consists of the Remote Sensing Technology and the German Remote Sensing Data Center

- Appr. 350 employees at 4 sites
- Chairs at 2 university

Bremen
Maritime Security Lab

Neustrelitz
National Ground Segment Maritime Security Lab

Berlin

Oberpfaffenhofen
Ground Stations
- Data Management
- Realtime Services
- Maritime Security Lab
- Calibration- and Validation Testsite DEMMIN
Ground Station and Processing Facility Neustrelitz

- Support of currently 12 different Satellite missions
- Main reception and processing facility for SAR Mission TerraSAR-X
- Collaborative Station for European Sentinel missions
- Radarsat-2 Regional Ground System for science purpose since Summer 2015
Synthetic Aperture Radar enable applications for following Products:

- Bathymetry
- Land-Water Line
- Wave groups & Forecast
- Wave breaking
- Surface Currents
- Sea State
- Wind
- Ship-detection
- Oil Spills
- Iceberg-detection, Ice classification
Objective

Research and development of **integrated applications** enabling specific value added **Maritime Information Products for the Maritime Situational Awareness**
Objective

Research and development of **integrated applications** enabling specific value added **Maritime Information Products for the Maritime Situational Awareness**

System engineering to enable...

- efficient use of the processing environment (parallel processing)
- operational use of research findings
- processing of different sensors and modes
- operational data fusion of different data sources like EO data and terrestrial AIS or AIS from space
- product development
- dissemination systems development
L0 Processing
NRT – Front End Processor (Sentinel-1)

- Implementation of Ingest and Process Units
- GUI for Monitoring and Control (M&C)
- Integration into Stations M&C System
- Provide data quality information
- Handling of Station Metadata
- Development of device driver (CORTEX demodulator)
- Product generation
  - L0 processing (slicing) and distribution

S1A_IW_RAW__0SDV_20150504T051957_20150504T052022_005768_007683_44E4.SAFE
S1A_IW_RAW__0SDV_20150504T052015_20150504T052040_005768_007683_F47A.SAFE
S1A_IW_RAW__0SDV_20150504T052032_20150504T052057_005768_007683_60DD.SAFE
S1A_IW_RAW__0SDV_20150504T052050_20150504T052115_005768_007683_5F32.SAFE
Level 1 Processing

DLR Processing System Management System (PSM)

- Request or data driven workflow
- Product handling and cache management
- Development of Control System based on Processing System Management (PSM)
  - TerraSAR-X
  - Sentinel-1
- Integration of CORE Processor
  - TMSP (TerraSAR-X)
  - ESA IPF (Sentinel-1)
Level 2 Processing and Product Generation

DLR Processing System Management System (PSM)

- Rule based
  - L2 - value adding processing (SAR, Optic)
  - Data fusion
  - Operator Interface

- Product generation
  - L1b product (EOPO, EMSA)
  - L2 product (shape, netCDF, KMZ)

- Product dissemination
  - ftp/ sftp
  - GeoServer
  - e-Mail
Product Dissemination

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Web Mapping Service: FMS Neustrelitz

**GeoServer**

- Version: 2.7.1
- Website: [http://geoserver.org/](http://geoserver.org/)
- Features:
  - Open Source
  - JAVA application
  - Works on Apache Tomcat 7
  - PostGIS Database

**Integrated View**

- Functionality extension is only limited to developers’ fantasy

**Catalog View**

- [UKIS](http://dlr.de/)
- [AngularJS](http://angularjs.org/)
- [Leaflet](http://leafletjs.com/)

**Overview**

- **Provider tier**
- **User tier**

**Diagram**

- EO Products → PSM → RAW Data → FTP Server → Internet → Geoserver → Web Server → Web Client App

**Related URLs**

- [http://dlr.de/](http://dlr.de/)
- [http://angularjs.org/](http://angularjs.org/)
- [http://leafletjs.com/](http://leafletjs.com/)
Ship- Detection Application

Available for:

- TerraSAR-X, TanDEM-X
- CosmoSkyMed
- Radarsat-2
- Sentinel-1

Value added products

- SAR/ AIS merged products (in case of available AIS Data)
- ASCII ; KMZ, GML; DER (EMSA);
- ESRI shape; json;
- GeoTIFF (MRES_L1b; HRES_L1B)
Ship- Detection Application
Joint Research Center JRC
Project PMAR-MASE 2015

Project support during August and September 2015:

- Acquisition planning for TerraSAR-X based on the Region of Interest, defined by the project

- SAR/AIS Ship detection processing AIS Data provided by JRC, (Data Exchange Agreement JRC/DLR)

TSX1_SAR__MGD_RE___SC_S_SRA_20150809T135517
Application Example

Sentinel-1 Acquisition and Downlink – Alphasat TDP-1 Test

Partners involved:

- ESA ESRIN
- ESA ESTEC
- ESA ESOC
- TESAT
- Eutelsat
- Airbus
- DLR Space Management
- DLR Earth Observation Center
  - Oberpfaffenhofen
  - Neustrelitz
LCT-Link and data reception

- Reception in Oberpfaffenhofen via Alphasat Ka-Band Antenna
- L0 Processing in Oberpfaffenhofen
- Transfer to Neustrelitz and QRT processing and automated ship detection
- End-to-End time: 18 min (further optimization possible)
Alphasat NRT Demo:
L2 ship detection product at Google Earth
Optical Satellite Services for EMSA (OpSSERVE)

**Partner:** EUSI (contractor) and DLR (subcontractor)

- Provision of Vessel- and Activity- detection service
  - Optical satellite imagery (< 1m)
    - Worldview-1; Worldview-2 (0.50m)
    - GeoEye-1; EROS-B; Ikonos; Quickbird; Worldview1; Worldview-2
    - Derived information at sea and coast:
      - Vessels, mainly < 15m
      - Vessel activities

NRT Delivery ≤ 1 hour*
NRT Delivery ≤ 3 hours*

Non NRT Delivery ≤ 24 hours*
Archive Delivery ≥ 24 hours*

WorldView-2, Mogadishu, Somalia, 28.08.2012
Oil Spill Detection Application

Control system implemented using the DLR Processing System Management (PSM) part of the Data Information Management System (DIMS)

- Interactive processing
- Operator interface via Virtual Network Computing (VNC)
- Automated qualification processor, Core function is the qualification algorithm developed by the Maritime Security Lab Bremen based on Neural Network (S. Singha et al.)
- Automated product delivery within 30 minutes
Application for Wind field products based on TerraSAR-X

- Core function is the XMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction (Jacobsen et al., 2013)

- Forecast model is implemented to provide wind direction, the netCDF output is generated, containing the wind direction and intensity (WD10)

- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

The wind forecast and the Level 1 quicklook product in the background is overplayed by the DLR SAR WIND product (rectangle) derived from the TerraSAR-X StripMap image
Application for Wind field products based on Sentinel-1

- Core function is the CMOD-2 algorithm developed by the Maritime Security Lab Bremen to derive wind speed and direction (Jacobsen et al., 2013)
- Forecast model is implemented to provide wind direction, the netCDF output is generated, containing the wind direction and intensity (WD10)
- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

The Level 1 quicklook product (background) is overplayed by the DLR SAR WIND product (rectangle) derived from the Sentinel-1 image
Application for Wave products based on Mission TerraSAR-X

- new XWAVE-2 algorithm developed by the Maritime Security Lab Bremen to derive wave height and wave length (Pleskachevsky et al., 2015)

- Level 2 Produktformate
  - ASCII
  - netCDF
  - Google (KMZ)
  - GIS, png, wld, png.aux.xml
  - ESRI Shape Layer Files (shape)

The L1 quicklook product in the background is overplayed by the DLR SAR WAVE product (rectangle) derived from the TerraSAR-X StripMap image.
Ice Classification

- Currently being developed by the Maritime Security Lab Bremen (Ressel et al., IEEE, TGARS)

- Planned value added products based on TeaarSAR-X (DualPol)
  - ASCII, png, KMZ,
  - ESRI shape;
  - ECDIS (S411) Ice Chart
Conclusion

- Remote sensing SAR images are more and more in use to support maritime surveillance.
  - Near real time capabilities are amongst others the main requirements for such services.
  - NRT application for SAR processing enables automated fast processing of large volumes of data and information delivery within ~10 to 20 minutes of image acquisition.

- Main tasks for **Solutions for Maritime Situational Awareness** (not complete)
  - Use of multiple information sources to enable integrated solution of maritime picture
  - Data sharing, data fusion and big data handling,
  - High availability of fully automated processing chains
  - Product and interface standardization
Thank you for your attention!