Earth Observation Maritime Surveillance System

Sergey Voinov, Egbert Schwarz, Detmar Krause, Björn Tings

Maritime Security Lab Neustrelitz

German Aerospace Center (DLR)
German Remote Sensing Data Center (DFD)
National Ground Segment (NBS)

@GEOFORUM MV 2020, Warnemünde, 31 August 2020
Presentation Outline

Background

- DLR Earth Observation Center
  - Maritime Security Lab Neustrelitz
    - Objectives and Applications
    - Sensors and modes

Earth Observation Maritime Surveillance System

- System overview
  - Image processing
  - Thematic processing
  - Product Dissemination
- Use case
Earth Observation Center – EOC

- German Remote Sensing Data Center
- Remote Sensing Technology Institute
- Chairs at 2 universities
- Approx. 350 employees at 4 sites
Objectives and Applications

- **Algorithm** development to derive value added information out of remote sensing data (SAR, Optic) for the **Maritime Domain**
  - in cooperation with Maritime Security Lab Bremen

- **Application** development to derive value added information products by using **different data sources**, mainly remote sensing and AIS to provide maritime information products for **Maritime Situational Awareness**
Sensors and Modes

Optical
- Worldview-1
- Worldview-2
- Worldview-3
- GeoEye-1
- Deimos-2
- Landsat-8
- Worldview-4

Synthetic Aperture Radar (SAR)
- Sentinel-1A
- Sentinel-1B
- TerraSAR-X
- TanDEM-X
- Radarsat-2

Automatic Identification System
- Terrestrial AIS
- Satellite AIS
Sensors and Modes

- SAR: Sentinel-1B
- MR Optical: Landsat-8
- VHR Optical: Worldview-3
Earth Observation Maritime Surveillance System
Earth Observation Maritime Surveillance System

EO Ground Stations
- L1b Processor
  - Local (DLR - NSG) / Partner (EUSI/Maxar)

EO MARISS Processing Environment (Maritime Security Lab Neustrelitz)
- Ingestion Processor
- EO Image Processor SAR & OPTIC
- Thematic detection block
  - Vessel
  - Wake
  - Ice
  - Activity
  - Feature
  - Wave (SAR only)
  - Oil Spill (SAR only)
- Delivery Processor

AIS Stream / Historical dataset

Ancillary data
EO Image Processor | SAR

- Calculates surface reflectance (Optic)
- Pan-sharpening (Optic)
- Automatic histogram stretch

- Mosaicking
- Orthorectification with EU_DEM+TDM-90 DEM / SRTM-X DEM
- Fully automated
EO Image Processor | SAR

- Calculates surface reflectance (Optic)
- Pan-sharpening (Optic)
- Automatic histogram stretch
- Mosaicking
- Orthorectification with EU_DEM+TDM-90 DEM / SRTM-X DEM
- Fully automated
EO Image Processor | OPTIC

- Calculates surface reflectance (Optic)
- Pan-sharpening (Optic)
- Automatic histogram stretch
- Mosaiking
- Orthorectification with EU DEM+TDM-90 DEM / SRTM-X DEM
- Fully automated

No atmosphere correction

With atmosphere correction

WorldView-3 © 2020 European Space Imaging
EO Image Processor | OPTIC

- Calculates surface reflectance (Optic)
- Pan-sharpening (Optic)
- Automatic histogram stretch

- Mosaiking
- Orthorectification with EU_DEM+TDM-90 DEM / SRTM-X DEM
- Fully automated

WorldView-3 © 2020 European Space Imaging
Thematic processing

- **Automated processing**
  - Target detection
  - Data fusion
  - Wind
  - Wave

- **Semi automated algorithms**
  - Target detection
  - Activity detection
  - Change detection
  - Data fusion

- **Operator Interface**
  - GUI with 3D viewer
Thematic processing

- Automated processing
  - Target detection
  - Data fusion
  - Wind
  - Wave
- Semi automated algorithms
  - Target detection
  - Activity detection
  - Change detection
  - Data fusion
- Operator Interface
  - GUI with 3D viewer

EO MARISS Visual Analyst: interactive activity detection

WorldView-3 © 2020 European Space Imaging
Product Dissemination

File delivery

- OGC-standardized
- Custom formats

E-mail: kmz/kml

- Small file size
- Low image resolution

Web-based

- OGC-interfaces (WMS/WFS)
- Web-mapping client
Operational Use Case
Optical Satellite Services for EMSA (OpSSERVE)

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

- Provision of **optical satellite imagery (< 1m)** and derived information at **sea and coast**:  
  - Vessels and wakes,  
  - Oil Spills  
  - Activities

- Direct electronic delivery of information to EMSA Earth Observation Data Centre (EO-DC) in **four temporal response categories**:
  - NRT 1 (< 1 hour)
  - NRT 3 (< 3 hours)
  - NRT 6 (< 6 hours)
  - Non-NRT (24 hours)

- Focus on European seas, as well as neighbouring and world wide waters
Case: Mauritius oil spill 07-09.2020

- On July, 25 the MV Wakashio ran aground on a coral reef
- It carried ~ 4,000 tones of fuel oil
Case: Mauritius oil spill 07-09.2020

- On July, 25 the MV Wakashio ran aground on a coral reef
- It carried ~ 4,000 tones of fuel oil
Case: Mauritius oil spill 07-09.2020

- On July, 25 the MV Wakashio ran aground on a coral reef
- It carried ~ 4,000 tones of fuel oil
Case: Mauritius oil spill 07-09.2020

- On July 25 the MV Wakashio ran aground on a coral reef
- It carried ~ 4,000 tones of fuel oil
- On August 15 the vessel has broken into two sections

Image Credit: https://twitter.com/karmagawa
Case: Mauritius oil spill 07-09.2020

• On July 25 the MV Wakashio ran aground on a coral reef
• It carried ~ 4,000 tones of fuel oil
• On August 15 the vessel has broken into two sections
Case: Mauritius oil spill 07-09.2020

- On July 25 the MV Wakashio ran aground on a coral reef
- It carried ~ 4,000 tones of fuel oil
- On August 15 the vessel has broken into two sections
Summary

- Remote sensing images are well-established in use to support maritime surveillance.
  - Near real time capabilities are amongst others the main requirements for such services.
  - NRT requires automated fast processing of large volumes of data and information extraction within 20 to 55 minutes of image acquisition.

- Main tasks and capabilities of EO MARISS
  - Distributed processing to handle multiply request at the same time (P-Nodes based on CPU and GPU)
  - Advanced development of data mining techniques (deep learning)
  - High degree of automation and state of the art performance
  - Variety of data access options for the end-users
Thank you very much for your attention!

Contact: E-mail: Sergey.Voinov@dlr.de
Phone: +49 (0) 3981 480 231

Our open-source project:

Frontend Libraries for DLR UKIS (Map) Applications

https://github.com/dlr-eoc/ukis-frontend-libraries
German Aerospace Center, DLR

- Germany's national research center for aeronautics, space, energy, transport & security.
- Space Agency
- Project Management Agency
- ~ 9,000 Employees
- 47 Research Institutes and large test facilities at 26 Sites across Germany
- 3 Field stations in O'Higgins (AQ), Inuvik (CA) & Almería (ES)

Maritime Safety and Security
- Bremen
- Neustrelitz
- Braunschweig
- Oberpfaffenhofen