ShipSensorNet - Ships as sensors to help interpreting satellite images in winter navigation

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Outline

• About the needs: Baltic Sea Marine traffic and environmental aspects
• System used at the moment in winter navigation
• Examples of satellite image products
• Use of auxiliary information for interpretation of the situation
• Ships as sensors
• The ShipSensorNet project
Traffic during July 2005 - July 2006
Forecast 2015
(Source: HELCOM)

Icebreakers in the Baltic Sea
- 8 + 1 Finnish
- 7 Swedish
- 3 Russian larger + several smaller ones
- 1 Estonian
- 1 Latvian
- 2 Danish

Use IBPlott
History of IBPlott

ICE → ICEPlott → IBPlott → ViewIce

1988 -90 -95 2000 -05 -10

RADARSAT-1.(-2)
ERS-1/2
ENVISAT ASAR
SENT.-1

NOAA/AVHRR
MODIS
Clouds are a problem
"X-ray" tool
"X-ray" tool
IBPlott - main symbols

Icebreakers

Ships

Auxiliary information

IBPlott showing RADARSAT image with ship symbols on top
IBPLott: auxiliary information

To help interpretation of imagery, the relative speed of all ships within a given time window can be shown as a colored trail.

Speed information comes from the AIS system.
Speed information comes from the AIS system.

Time slider

Speed information comes from the AIS system.

Time slider
Speed information comes from the AIS system
Speed information comes from the AIS system

Time slider
Satellite data is OK, but often not frequent enough

- What about terrestrial radars? (Ship, coastal)
Real time info on Ice field movement

A vision product: Kokkola, Ulkokalla, Raahe lighthouses, 20 nautical miles
A vision product: Ship-borne radar mosaic + performance observations

SAR DERIVED SEA-ICE MOTION

Karvonen et al. 2007
LOCAL ICE DRIFT AND CONCENTRATION FORECAST

Data delivery

ShipSensorNet focuses on coastal and shipborne images, as well as ship location and speed information

Data collecting

Observations from ships
- Ship radar images
- Ship performance (location, speed)

Satellite images

Coastal radar images

Observations
- Mosaiced radar images
- Ice drift
- Ice resistance

Forecasts
- Ice conditions

Data processing, analysis, and modelling

Data delivery

• Icebreakers
• Merchant vessels
• Authorities
• Ice service
Overall architecture of ShipSensorNet delivering observations from ships to server side, and value-added products back to the ships and users ashore:

- Satellite images
- Radar images
- AIS observations

Deletion of data delivery and data server

Delivered to users on board and ashore

Ice model

Ice drift analysis

Transit model

Ship performance analysis

Deployment architecture:

- FIMR
- Satellite image reception
- Ice drift
- Ice model
- Satellite image reception
- Ice drift
- Ice model

On board

Processing and data server

Data delivery

Ship performance analysis

VTT

AIS system

IBNet system

Image capture
ShipSensorNet’s contribution

New innovations in ice navigation

Data providers

Researchers

End-users

- Radarsat
- Envisat
- MODIS
- NOAA
- Ice charts
- Ice thickness maps
- Weather observations and forecasts
- Wave forecasts
- Water level observations and forecasts
- Ice model predictions

New potential data products giving more information about the ice field

- Ship and coastal radar images
- Ice drift derived from radar images
- Ship performance observations

Improvements in end-user systems

- Visualizations of new data
- Ship-specific performance estimation

Summary

- ShipSensorNet studies how information collected from ice-going ships could be utilised in winter navigation
- Special interest is focused on ship-borne and coastal radars.
- One future result product could be a near-real time ship radar image mosaic based on radar images from multiple ships and coastal radars
- Research partners
  - VTT, TKK, FIMR
- Company contributing to the work:
  - Image Soft Oy
- End Users: Rettig Group Ltd Bore, BP Shipping
- 2 years (06/2007-06/2009)
- TEKES category of long and medium term research projects
- Total research volume about 40 mmths
- Joint research project funded by TEKES, Research partners and Companies
Thank you for your attention!

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Bonusmaterial

- Runner IV
- Emissions from shipping
- Current satellite data delivery chain
- System development process
Outside Tallinn, two weeks later, 19 March 2006

Amount of pollution: 150 m$^3$ of oil

Cause: Human factor and ice conditions
Fuel consumption of shipping activities in the yellow area in 2004 was 1.1 million tons (CO$_2$ emissions 3.5 million tons)

=> every 1% improvement in saved transit time in winter navigation would save 4.4 thousand tons yearly in this area alone.

Satellite data delivery chain

- Radarsat
- Envisat
- Aqua/Terra MODIS
- FMI
- ESA
- KSAT
- Finnish Ice Service
- FMA, Finstaship
- SMA

30 Mbyte
30 - 60 min
150 - 400 kByte
< 2 h

Geocorrect
Scale to 8-bits
Mask, crop
Compress
Value added products

SMA : Swedish Maritime Administration
FMA : Finnish Maritime Administration
System development process

Stakeholders
Use Cases & Scenarios
Concerns
Requirements
Architectural Drivers
Tactics
Quality Attributes
Validation
Development Iteration
High Level Architecture
- Domain modeling
- Usage
Detailed Architecture
- Design Patterns
- Class Diagrams
Implementation
Skeletal implementation testing designed architecture validity
Working system satisfying the requirements of ShipSensorNet
Extensible and modifiable architecture enabling development towards the visionary system
GIS Distribution System Prototype
SIS Distribution System Prototype
Also, answers to...
...Is the visionary architecture or even the system feasible?
...Refinements needed to the visionary architecture?
...Is the vision worth pursuing?
...?