Challenges of Developing 3D Models of the Littoral Zone

3D Mapping and Visualization of the Naval Operation in the Littoral Zone

Ben Drinkwater
17 July 2014
Contents

• Background
• Requirement
• Methodology
  • Data Input
  • Data Processing
  • Development and Enhancement
• Visualisation
• Dissemination
• Conclusions
Background

Helyx are a leading provider of end-to-end Geographic Information System (GIS) solutions for the management and exploitation of information based in Tewkesbury in the UK. Defence, security and public safety are our core markets.

UKHO provide nautical charts and navigational services of the world’s oceans and ports to support world shipping, including the Royal Navy.
Background

- Advanced Geospatial Information and Intelligence Services (AGIS) Task 4 – Creating Urban 3D Environments
  - Methodology based on a consistent approach between UK Specialist Geospatial Centres
  - Interoperability testing between domains (GIS, BIM, M&S)
- R&D by Helyx under contract to UKHO Defence Maritime Geospatial Intelligence Centre
  - UKHO Phase 1 – Apr 13 to Jun 13
    - Provided a methodology for 3D situational awareness of the littoral zone, based in Plymouth, using a port entry scenario.
  - UKHO Phase 2 – Dec 13 to Nov 14
    - Extends Phase 1 to include additional data and use cases
Requirement

• Future Character of Conflict
• Operational Challenges
  • e.g. mobility, transitioning through differing environments

• 3D models can be used to support maritime operations to meet these challenges
• Helyx were tasked to create a littoral model of Plymouth and provide a repeatable methodology within the UKHO Esri focussed workflow
Methodology

- Development of a standardised process
- Based on existing UKHO resources
- Utilising Esri technology and supplementary applications
Data Input

• Data availability and coverage was a key challenge
  • Differing spatial and temporal extents and varying methods of capture
  • Varying sources of data (e.g. mapping agencies)

• Sources: Bathymetry, Imagery, LiDAR, AML, MFDB, AIS, weather, water column, 3D models
Data Processing Challenges

- Integrating terrestrial and hydrographic data
- Varying coverage, resolution and age of bathymetric data
- Maintenance of transparency and trust in underlying data
- Data volume and complexity
Data Processing Solutions

• Creation of a single surface model
  • Prioritisation of bathymetric data based on resolution and age
  • Alignment of vertical datums using the Vertical Offshore Reference Frame (VORF)
  • Maintenance of a metadata log

Source: A model for surveying to the ellipsoid, UKHO
Development and Enhancement

- Evolving the basic model into a more detailed model
- Conversion of 3D models between varying software applications
- Construction of bespoke 3D models in SketchUp
- Generation of representative buildings in CityEngine
- Management of the large volume of 3D models and data
Development and Enhancement

- Model densification methodology
- Creation, conversion and representation of buildings and feature models within ArcGlobe
  - Rule based 3D building generation using CityEngine
  - 3D feature models creation in SketchUp
  - Conversion of 3D models from the modelling and simulation and open source communities using defined methodology
  - Creation of a 3D model repository
Development and Enhancement

• The complexity of 4D information poses a challenge, particularly where parameters are highly temporally variable, or streamed live

• Integration of additional data sources:
  • OSINT
  • Beach reconnaissance reports
  • Automatic Identification System
  • Weather and water column
Dissemination

- Challenges include data volume, level of detail, connectivity/bandwidth and end user expertise
- Helyx have researched a number of 3D dissemination techniques
  - 3D web services are in their infancy and are not mature enough for live system implementation
  - Current options include:
    - CityEngine WebScene, recorded animation, VRML, 3DPDF, 3D Print.
Conclusions

• A number of operational and technical challenges are associated with the development of 3D models of the littoral zone

• Research has demonstrated the feasibility of littoral zone 3D model creation using existing data sources and software.

• Understanding and visualising the littoral zone within a 3D model helps improve maritime situation awareness.

• Availability of data with sufficient coverage and resolution remains a key challenge. However remote collection techniques may provide access to crucial information within constrained environments.
Conclusions

• Continuing work will utilise emerging technologies as they become more stable:
  • Bathymetric LiDAR, stereo imagery and UAV LiDAR data collection can help towards data collection in ‘data sparse’ areas
  • Standards and software improvements: agreement between 3D domains on standardised exchange formats and methodologies will improve collaboration whilst software improvements will improve speed and stability
Thank you

Ben Drinkwater

Tel: +44 (0)1684 273725
Email: b.drinkwater@helyx.co.uk
Web: www.helyx.co.uk

Many thanks to our sponsors
The UK Hydrographic Office