OBIA (Object Based Image Analysis) in ArcMap for Multibeam and Backscatter Interpretation

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Imagery and Thematic Maps
Interpretation by Hand

Probably several data sources (including raster imagery)

Needs a digitiser who is:

- Alert and Awake
- With a steady hand
- Having lots of time available
- Willing to change categorisation if needed

Sediment classification (modified Folk et al.)
Image Analysis

Human Interpretation of Imagery:
- **Human eye** good at picking areas of similar appearance
- Areas often have homogeneous level or texture
- Color imagery can be used to show 3 datasets combined (RGB)
- Often considered better than computer interpretation?

Disadvantages:
- Digitizing is **slow**
- **Subjective** (i.e. dependent on interpreter’s mood, skill, color perception, knowledge…)
- **Non-repeatable** and therefore unmeasured quality
- Difficult with more than 3 layers
Hand Interpretation issues
Remote Sensing Object Based Image Analysis (RSOBIA)

OBIA:
- **Quick** (e.g. 250Mb image < 40secs)
- Divides the data into areas of similar appearance (segments)
- Can use **more than 3** data layers (no limit)
- Scale and level of detail defined by numeric parameters chosen by the user – providing high resolution to a generalization
- **Repeatable**

(Dis)advantages?:
- Each segment may have **complex shape**
- Segments may have areas/boundaries identified by previously unseen data
- Maybe confused by systematic imagery artefacts
Example: Landsat Imagery

Segmented result:
“Digitised” in < 10 seconds
By hand in > 1 hour (and a tired interpreter!)

Works with all types of imagery data
But OBIA software can be expensive > € 27,000 ($30,000) per seat

However RSOBIA is written in C++ and Python and is installed easily into ArcMap 10.x and therefore made integral to workflow. Works from either a toolbar or a toolbox.
Version 3 to be released soon.
2 main numerical parameters (for layered data):
- No. of Clusters – in N-dimensional space
- Min Object Size – Minimum areal extent (in pixels)

Layers can be weighted.

The Minimum and Maximum of each layer is calculated and the data stretched. Differences in layer ranges are therefore ignored.
Varying the number of clusters

100 clusters

50 clusters

20 clusters

10 clusters

5 clusters

3 clusters
Usage: Marine Datasets

Multibeam Bathymetry Data: Bathymetry and Backscatter

Bathymetry
- Shallow 10m
- Deep 90m

Backscatter
- High
- Low

Slope
(Derived from bathymetry)
- High
- Low

Roughness
(Derived from bathymetry)
- High
- Low

Example data courtesy of MCA
Layering of datasets

3 datasets layered: Weighting
1. Slope 1x
2. Roughness 1x
3. Backscatter 2x

Datasets combined to create a single file (.img)

Segmentation – but how many clusters and minimum area extent?
### No. of Polygons

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<th>Min. Area</th>
<th>200</th>
<th>2000</th>
<th>10000</th>
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Small polygons (lower minimum size and high number of clusters)

- Shown on a slope map of bathymetry (green is low slope, red is high slope). Note the high slopes and roughness calculations are closely correlated aiding segmentation.

Medium sized polygons (medium minimum size and medium number of clusters)

- Shown on a roughness map of bathymetry (red is high roughness, blue is low roughness). Note the high roughness not always the criteria for segment edge calculations. Backscatter and slope may have more effect in places.

Large sized polygons (large minimum size and lower number of clusters)

- Shown on a Multibeam backscatter mosaic (white is high backscatter, black is low backscatter). Note the backscatter not always the criteria for segment edge calculations. Segmentation more appropriate for larger scale and more generalised maps.

Parameter Specification is dependent on scale of data and level of interpretation required.
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Lidar + Aerial Photos
## Nodule Identification

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<th>Percent coverage</th>
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<td>635</td>
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</table>
RSOBIA on Multispectral Backscatter

Labels show percent cover of nodules
Painting by Numbers

30 clusters (colours?),
minimum polygon size 200 pixels
= 647 polygons

Original (1024*687 pixels)
Installation

Three files to upload:

- RSOBIA_CPPlib32.exe (about 138Mb)
- RSOBIA_10.3.esriaddin (about 350Kb)
  (or) RSOBIA_10.2.esriaddin (about 350Kb)
  (or) RSOBIA_10.1.esriaddin (about 350Kb)
- Read Me.pdf

RSOBIA Library is set to 32bit to match most ARCGIS software installations (even on a 64 bit PC). 64 bit installations are available on request (tlb@noc.ac.uk) but not rigorously tested!

2 stage installation:

1. Run the RSOBIA_CPPlib32.exe and use defaults
2. Double click the RSOBIA.esriaddin

Tested on Windows 7 and 8 (64 bit machines with 32 bit ArcMap 10.3.1, 10.2.2 and ArcMap 10.1)
5 options:  
Segmentation – for the creation of multilayered raster data, the actual segmentation process of creating polygons and labelling each polygon with the raster statistics.  
Derivatives – for the creation of new raster layers from single band raster data (e.g. Slope, curvature, roughness)  
Data (pulldown menu) – To specify the dataset to add a “Class” attribute field  
Classification (pulldown menu or type in) – To specify the classification name (e.g. sand) to be added to a segment  
<paintbrush icon> - To draw an area on the map that is to be classified with the specified classification.
5 options:

- **Slope** – Calculates the slope (in degrees) for a DTM.
- **Terrain Ruggedness** – Calculates the terrain ruggedness in a 3D model within a small neighbourhood. Measures aspect and slope and combines into a single value. Taken from Benthic Terrain Modeller.
- **Northness** – Calculates the Cosine of the Aspect of a slope.
- **Eastness** – Calculates the Sine of the Aspect of a slope.
- **Curvature** – Calculates the curvature of a raster surface. Taken from Benthic Terrain Modeller.
5 options:

Layering – Often data is provided from different sources and for segmentation needs combining into a single raster dataset. No limit on number of layers. Imagery range values need not be similar.

Segmentation – Takes a multi-layered raster dataset and converts into polygons using a region growing and clustering algorithm based on the statistics of the layers.

Add Segment Attributes – Calculates the mean and standard deviation of raster layer within each segment polygon and attaches the data to each polygon’s attributes.

MBES Segmentation – A wizard to take the basic bathymetry and backscatter data and use the standard process to create polygons and attributes.

Ground Truth samples – Adds groundtruth sample data attributes to segment attributes.
Future Work

• Integration into core or extension?
• Further robustness (e.g. Non .img files, try....except functionality)
• Streamlining?

• Correlation of Groundtruth with segmentation classes
• Develop Classification clustering – supervised and unsupervised?
• Can new texture analysis be added to layer interpretation?