

# Sediment Classification Software

Underwater site investigation not only demands mapping morphological features and water depth, but also often requires information on the physical properties of sediments. Sediment classification software helps to retrieve these properties fast and efficiently.

The software packages for sediment classification presented in this product survey are used to analyse data from single- or multi-beam echosounder or side-scan measurements that have been acquired for other reasons. This software retrieves the properties of sediments in a cost-efficient way as, in these cases, the expensive survey has been paid for by the morphological mapping.

Sediment classification analyses the response of a returning acoustic signal. This response can be interpreted in different ways. Ground-truthing is often required to relate the signal to real properties of the sediment. In this product survey, we provide you with an overview of commercial software packages and show you their methods and possibilities of acquiring practical information, such as grain size, habitat classes, geological features. The information in the product survey focuses on the parameters that are important for quality control and those that differentiate between the presented products.

We are aware that various scientific institutes work on the development of improved methods and applications of sediment classification. Unfortunately, we are unable to present all available systems. We have therefore limited this survey to the most commonly used and recent systems, using the documentation from manufacturers who sent us the information. Please visit our website for a more complete list.

Our objective with this survey is to show the use and applicability of sediment classification, and we hope that the use of information on sediment properties will increase in the near future. We appreciate the input of all who contributed to this product survey.



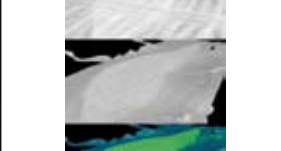
The next survey will introduce a fresh approach; one befitting the new era embarked upon by Hydro INTERNATIONAL!

*Ronald Koomans and Mirjam Snellen, contributing editors, Hydro INTERNATIONAL*

'A seabed will classify as 'unclassified' if the user chooses a low 'decision threshold'. A sea-floor discrimination matrix may be optionally computed to show probability of misclassifying one seabed type as another.



Manufacturer	BioSonics, Inc.
Product	BioSonics VBT (Visual Bottom Typer)
Year of initial development	1994
Latest version (year)	2.0 beta (2009)
Platform (Win, Mac, Unix, other); minimum computer requirements	MS Windows; current version of MS Windows
Standalone or part of another package	Standalone
Coupling to hardware	
Processes proprietary data	Y
Included in hardware	N
Amount of supported systems	Supports only BioSonics echosounders
Open to other data formats	Limited
What is the software suited for?	SBES data
Ground-truthing	
Requires independent samples	N
Possibility of ground-truthing	Y
Amount of derived classes	2-6 standard, more possible
Usage	
Sea-/river-floor parameters extracted	Acoustic class for unsupervised with post-verification, vegetated and unvegetated habitats, sediment class, bathymetry, hardness, roughness
Penetration depth	Surface sediments only
Analysis carried out off-line or real time applicable	Off-line
Spatial resolution	Horizontal resolution depends on beam angle. With standard BioSonics 6-degree transducer, at 10m depth, horizontal sample is 1.1m, at 100m it is 10.5m. Range resolution (depth) is 2.6 cm
Processing method	
Software allows for pre-processing data and quality control	Yes, for supervised classification
Technique used for image compensation (range and grazing angle)	Images NOT processed. Depth compensation is based on TVG and beam angle values. All signal evaluations are based on vertical incidence. Integrated angle data can be used for filtering high-angle data
Employed signal characteristics for classification	
Full-wave form	Y
Derived depths	Y
Backscatter measurements	Y
Other	
Principle at basis of classification	
Modelling of the signal employed	N
Feature extraction (e.g. time spreads)	Y
Segmentation	Y
System is based on finding features	Y
How system finds features	Spectral analyses, fractal analyses, power spectra
Includes confidence indicator	N
Tools for quality control	Yes, bottom class supervision or unsupervised class numbers. Incidence angle selection (pre-processing) available
Charting	
Creates contouring charts	
Creates profile sheets	Yes, ASCII output data
Creates reporting charts	Yes, ASCII format for easy import to any other software
S-57 ENC support	
Supported digital export data formats	XY-class ASCII, KML
Typical applications	Acoustic substrate classification using either supervised or unsupervised analysis methods in large rivers, lakes, and near-shore coastal environments

		
ODIM Brooke Ocean	CARIS	GeoAcoustics, a Kongsberg Company
ODIM FFCPTview	HIPS and SIPS	GeoTexture
2005	1992	2003
4.3 (2008)	7.0 (May 2009)	2009
Windows 2000	Windows® XP, Windows Vista; 2.4GHz; 1GB RAM	Win; Windows XP
Standalone	Standalone	Standalone
N	Yes, supported data formats are converted into the proprietary data structure for efficient processing and analysis	Yes, GeoSwath plus MBES
Y	N	Optionally
One, ODIM FFCPT (Free Fall Cone Penetrometer)	Many, numerous SBES, MBES, LiDAR and side-scan sonar systems	GeoSwath plus MBES 125, 250, 500kHz
N	Many, over 40 industry-standard sonar data formats	Yes, all relevant side-scan data formats
ODIM FFCPT	SBES, MBES, LiDAR, side-scan and phase-detection bathymetric sonar (PDBS)	GeoSwath plus MBES and all relevant side-scan systems
N	N	Yes, ground-truthing is required to link classified image to sea-floor type
Y	Y	Y
7	N/A	
Mean grain size, undrained shear strength, dynamic pore pressure, dynamic penetration resistance, sediment behaviour type	Estimated mean grain size and acoustic roughness. Acoustic classes expected later in 2009	Sea-floor classes, categorised under user supervision, e.g. habitats
Ranging from 2 to 3m	N/A	Surface image classification
Real-time applicable	Off-line on post-processed data	Off-line
0.1m	User-defined number of profiles (pixels along-track) with predefined angular sector (across-track) to create an analysis area ('patch')	Minimum resolution 20cm
N/A	Yes, as part of post-processing (e.g. 3D visualisation with draping of imagery mosaics)	Y
N/A	Geocoder algorithms used to correct for gain, power, pulse width, beam pattern, grazing angle, slant range	The measured beam fn (angle) for a sonar is the primary knowledge required. Then 2 or 3 backscatter fns (angle) may be extracted from sonar records. These fns are combined to attempt to compensate for roll, range, seabed slope
N/A	Y	
N/A	N	
N/A	Y	Normalised backscatter measurements
Measurements are 'in situ'	Yes, angular response	
Y	Yes, uses Geocoder-implemented sediment angular-response models	
N/A	N	
N/A	Yes, expected later in 2009	Yes, supervised feature extraction and image classification
N/A	N	Y
Sediment layering via in situ measurements	N/A	
N/A	Y	Y <sup>1</sup>
Grab sample	Y	
Yes, creates Robertson diagrams for sediment properties	Y	N/A
Yes, depth profiling diagrams	N	N/A
Yes, plots sediment classification on a behaviour type chart	Y	N/A
Yes, S-57 object attribution supported via look-up table	Y	N/A
XY-class ASCII, TXT, XML, bitmap	GeoTiff, XY-class ASCII, S-57 (.000 files), GSF, HTF, BAG, TFW/TIFF	GeoTiff, data image, classified image and characterised textures, jpg, mod mosaic, mof GeoSwath plus mosaic file
For obtaining 'in situ' ground-truth seabed classification while the survey vessel is underway and collecting multi-beam and/or side-scan data of the sea floor for various applications	Processing and validation of bathymetry and imagery data collected by numerous sonar systems. Functionality includes automated filters, 3D visualisation, imagery corrections and bottom characterisation	Normalisation and image classification of side-scan data for bottom classification, feature extraction and habitat mapping

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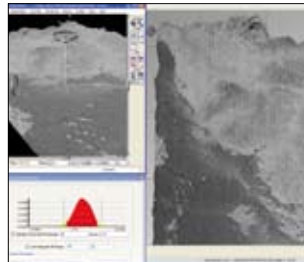
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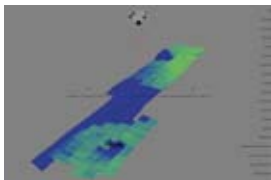
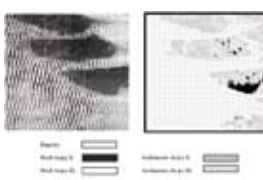
UDT 2009 Stand 268

No1057

<sup>1</sup> Originates from research at the Center for Coastal & Ocean Mapping, University of New Hampshire.



Manufacturer	IVS 3D, Inc.	Quester Tangent	Quester Tangent
Product	FM Geocoder	QTC IMPACT	QTC MULTIVIEW
Year of initial development	2009 <sup>2</sup>	1999	2002
Latest version (year)	7.0 (April 2009)	3.5 (2007)	4.0 (2007)
Platform (Win, Mac, Unix, other); minimum computer requirements	Windows 32- and 64-bit, Linux 32- and 64-bit, and Mac OSX; 1GB RAM	Win 2000, XP; 1GHz, 500MB RAM	Win 2000, XP; 1GHz, 1GB RAM
Standalone or part of another package	Standalone module and as part of FM Habitat and an optional module with all Fledermaus Bundles (Viz4D, FM Hydro, FM Offshore and FM Pro)	Standalone	Standalone
Coupling to hardware			
Processes proprietary data	N	Yes, QTC, Biosonics, Knudsen, Odom, Simrad, Echoview, Atlas	Yes, Atlas Fansweep and Hydrosweep, Elac, Odom, RESON (any, as XTF, HSX, SBD, PDS2000), Seabeam (1180/85), Simrad (any)
Included in hardware	N/A	N	N
Amount of supported systems	Many, Kongsberg raw.all, XTF, GSF, L-3 Klein SDF, RESON S7K	Almost any echosounder	Almost any multi-beam
Open to other data formats	Yes, Kongsberg raw.all, XTF, GSF, L-3 Klein SDF, RESON S7K	Yes, through Echoview	Y
What is the software suited for?	Primarily focused on MBES data, and limited support of side-scan sonar data	SBES	MBES
Ground-truthing			
Requires independent samples	N	Y	Y
Possibility of ground-truthing	N	Y	Y
Amount of derived classes	20	Variable, user-derived	Variable, user-derived
Usage			
Sea-/river-floor parameters extracted	Mean grain size, acoustic classes via statistical processing of backscatter, geo-acoustic parameters, geological features	Acoustic classes, other parameters indirectly	Acoustic classes, other parameters indirectly
Penetration depth	Surficial seabed characterisation	Surface to 10m	Surface to 10m
Analysis carried out off-line or real time applicable	Both	Both are available	Post-processing
Spatial resolution	Depends on sonar frequency, ping rate and depth	Depends on distance travelled between pings	User-selectable, as fine as 9 x 9 pixels
Processing method			
Software allows for pre-processing data and quality control	Yes, this is the critical front-end for sea-floor characterisation. Only after these corrections have been made can sea-floor characterisation be done	Many, including re-pick, reject echoes, stack size, editing	Many, including hydrographic depth cleaning, range and angle masking, position filtering
Technique used for image compensation (range and grazing angle)	The software produces a fully corrected (radiometric and geometric – including local sea-floor slope and angular dependence) backscatter mosaic	Depth compensation is based on standard echo length	Collect amplitude-range-angle data for entire survey, then compensate each pixel using its range and angle
Employed signal characteristics for classification			
Full-wave form	Yes, for beam time series and side-scan	Y	N/A
Derived depths	Y	N	Optionally
Backscatter measurements	Y	N/A	Yes, as image
Other	N/A	N/A	N/A
Principle at basis of classification			
Modelling of the signal employed	Yes, based on angular range analysis	N	N
Feature extraction (e.g. time spreads)	N/A	Y	Y
Segmentation	Y	Y	Y
System is based on finding features	N	Y	Y
How system finds features	N/A	Shape analysis, spectral and fractal analyses, histogram, quantile	Spectral and fractal analyses, grey-level co-occurrence matrices, mean, standard deviation, histogram, quantile
Includes confidence indicator	N	Y	Y
Tools for quality control	Mosaic	Y	Y
Charting			
Creates contouring charts	Y	N/A	N/A
Creates profile sheets	N/A	N/A	N/A
Creates reporting charts	N/A	N/A	N/A
S-57 ENC support	N/A	Yes, in real-time version	N/A
Supported digital export data formats	DXF, GeoTiff, XY-class ASCII, Fledermaus draped backscatter files and ArcGIS grids	GeoTiff, XY-class ASCII, JPEG, PNG, surfer grid	GeoTiff, XY-class ASCII, JPEG, PNG, surfer grid
Typical applications	Used in habitat mapping, site investigation and geological surveys to generate fully corrected backscatter mosaics and calculated statistics, and to characterise the seabed from analysis of the backscatter angular response	Fisheries management, habitat assessment and environmental monitoring; coastal zone management; military (MCM, ASW), hydrographic and route survey, dredging and port construction	Fisheries management, habitat assessment and environmental monitoring; coastal zone management; military (MCM, ASW), hydrographic and route survey, dredging and port construction

		
Quester Tangent	RESON	University of Bath
QTC SIDEVIEW	PDS2000 GeoCoder	TexAn
2003	2008	1993
2.0 (2009)	3.4.0.1 (February 2009)	5.1 (2008)
Win XP, Vista; 1GHz, 1GB RAM	Windows XP, Vista	Windows; Matlab, IDL
Standalone	Part of the PDS2000 hydrographic survey package	Standalone; processing done at University of Bath
Yes, Benthos, Benthos C3D, CMax, Edgetech, GeoAcoustics, Imagenex, Klein, Knudsen, MarineSonic, Odom, SEA SWATHPlus, Unisips	Yes, RESON 7k format	Yes, it can do, on demand
N	N	N
Almost any side-scan	N/A	On request
Y	Yes, XTF and GSF	Y
Side-scan	Multi-beam backscatter data only	Side-scan and MBES data
Y	N	N
Y	Y	Y
Variable, user-derived	20 classes can be derived	User-defined
Acoustic classes, other parameters indirectly	Mean grain size, acoustic classes, geo-acoustic parameters	Acoustic classes, habitats (if ground-truthing adequate), some geo-acoustic parameters, geological features (if ground-truthing adequate)
Surface to 10m	Only surface sediments	All depths
Post-processing	Off-line	Off-line
User-selectable, as fine as 9x9 pixels	Typically an area of 30 pings is used to derive classes for port and starboard side of swath	Identical to input data (no loss in image resolution)
Many, including min and max range, multi-path masking, angle masking, position filtering	Y	Y
Collect amplitude-range-angle data for entire survey, then compensate each pixel using its range and angle	Backscatter is corrected for radiometric and geometric distortions	Proprietary. Range variations and grazing-angle variations will yield identical textural values
N/A	N/A	N
N/A	Y	N
Yes, as image	Y	Y
N/A	N	N/A
N	Y	N
Y	N	N
Y	N	Y
Y	N	N/A
Spectral and fractal analyses, grey-level co-occurrence matrices, mean, standard deviation, histogram, quantile	N/A	Grey-level occurrence matrices
Y	N	N
Y	Y	N
N/A	Y	N
N/A	Y	N
N/A	Y	Y
N/A	N	N
GeoTiff, XY-class ASCII, JPEG, PNG, surfer grid	DXF, XTF, GeoTiff, XY-class ASCII	GeoTiff, XY-class ASCII and others
Fisheries management, habitat assessment and environmental monitoring; coastal zone management; military (MCM, ASW), hydrographic and route survey, dredging and port construction	Classifying the sea floor using multi-beam backscatter data as part of regular hydrographic and construction surveys. Applicable as part of multi-mission operations in combination with bathymetry	Sea-floor characterisation of side-scan (and now multi-beam) imagery

# Sonar IMAGING SYSTEMS



C3D-SBP  
Tow Vehicle

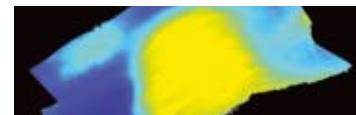
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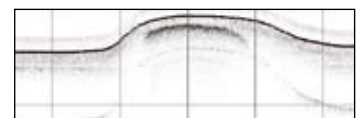
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- Coastal bathymetry
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