

## QTC IMPACT – single beam acoustic seabed classification software

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**QTC IMPACT is software for processing single beam digital echo trace data to make maps of sediment distribution and habitat.**

QTC IMPACT software processes digital seabed echo data to provide information about the nature and composition of the seabed (or lake bed, river bed etc). The software accepts digital input echo data from:

- all Quester Tangent acquisition systems, for example QTC VIEW
- suitable digital echosounders – a complete list of supported echosounders can be downloaded from [www.questertangent.com](http://www.questertangent.com)

Seabed classification can be done visually, mechanically, and acoustically. All visual methods (divers, video, photography) and mechanical methods (divers, grab samples, cores, probes) are slow and manually intensive, thus expensive and not suited to extensive survey work. Acoustic methods, can cover large areas quickly as there is no need to stop the survey vessel. The power of acoustic seabed classification is the ability to apply visual or mechanical classifications over much larger areas than point data alone would allow; that is, the sediment properties obtained from the point samples can be applied with confidence over entire regions that have been mapped acoustically.

Once the data are loaded a straightforward and simple procedure is followed to move from original echoes through class definition and identification to exporting results for seabed mapping.

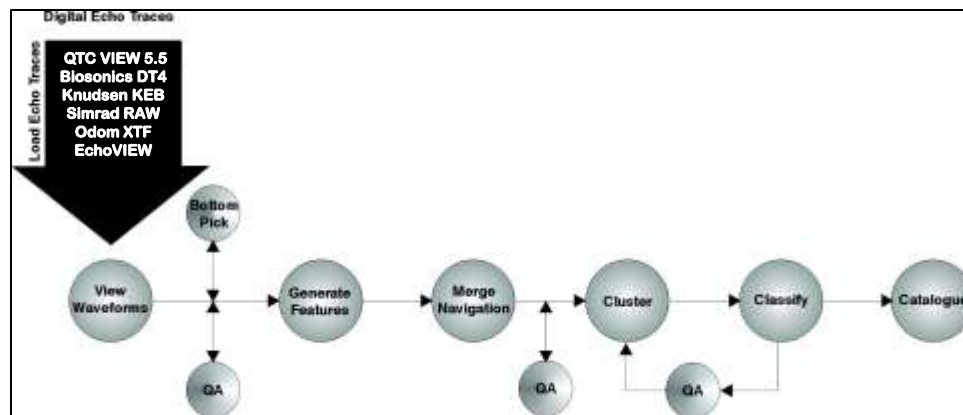


Figure 1: Data Processing Flow

QTC IMPACT applies the following suite of algorithms to generate features from each echo envelope record:

- Cumulative amplitude and ratios of samples of cumulative amplitude
- Amplitude quantiles
- Amplitude histogram
- Power spectrum
- Wavelet packet transform

A set of 166 features, or descriptors, is generated for each record measured. The set of 166 features is called a Full Feature Vector, or FFV. The set of FFV's thus captures the diversity of the seabed via the diversity of the echoes. Principal components analysis is then applied to reduce the 166 features to those three values, called Q1, Q2 and Q3, that best represent the underlying set of features. When plotted in three-dimensional space, echoes from similar seabeds, as represented by their Q-values, will cluster together to form acoustic classes, which can then be referenced back to the seabed by physical ground truthing.

QTC IMPACT can be used in either "Supervised" or "Unsupervised" mode. In the unsupervised mode no prior catalogue of seabed types is required for post processing. QTC IMPACT will generate acoustic classes from the data itself. Data are loaded as one class of acoustic information, and are subsequently processed into different acoustic classes by a three-D clustering routine; i.e. the user builds a map of acoustic diversity of the seabed of the surveyed area. Clustering can be undertaken using a manual process, or an Automated Cluster Engine (ACE) can be utilized to maximize objectivity of the results and reduce operator time at the computer. Data filtering permits the removal of any bad or unwanted data points to prevent biasing the classification, and the clustering processing can be controlled to provide an optimum level of classification.

The geo-referenced classification output identifies where the classes are located on the seabed, and delineates the class boundaries. This information (set of classes) can be correlated with other data types the user may have on hand, such as grab sample data, fish catch statistics, video data, local knowledge etc. Alternatively, bottom type can be related to acoustic classes by limited and directed ground truthing.

The information can also be used to define a catalogue (also termed a library) for classifying future or archived data sets, or for real time survey with a QTC VIEW. This process, supervised classification, speeds up future surveying and processing times, as one would simply log the data and then run it through the catalogue already pre-defined from earlier work to provide a classification of the area surveyed.

QTC IMPACT also provides tools to manipulate and massage the dataset. For instance a dataset collected from a diverse area, e.g. ranging from rock to mud, when submitted to QTC IMPACT for initial classification, may not directly provide classification between different sand types (for example) found within the area. However, by isolating the sands as a subset of data, and then submitting only this subset to QTC IMPACT for processing, the software will then be able to

detect more subtle differences in the acoustic signatures from the sand, and so provide a classification of the different classes of sand within the surveyed area.

QTC IMPACT's final output is a data table in comma delimited ASCII, the \*.seabed file as illustrated below, ready for import into GIS systems or mapping software for correlation analysis, chart production etc.


*Sample output from "seabed" file.*

```
20020629,130044565,459046.64,6391565.26,-16.74,3.50688839,4.80144691,5.53823996,73,31,04,CLASS_04,BRISTOLBAY,20020629,180-1256,1,31598
20020629,130044565,459039.67,6391547.39,-16.74,3.76193619,5.15492630,5.35759115,88,45,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31599
20020629,130044565,459033.18,6391530.71,-16.74,3.94836569,5.56753254,5.36549187,90,16,13,CLASS_13,BRISTOLBAY,20020629,180-1256,1,31600
20020629,130052376,459086.59,6391608.22,-16.74,3.80727029,4.50204706,5.35253811,97,68,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31601
20020629,130052376,459090.17,6391627.22,-16.74,3.56124330,4.87952328,5.34849310,99,45,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31602
20020629,130052376,459093.49,6391644.81,-16.74,3.15812778,5.25479698,5.44480944,88,01,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31603
20020629,130052376,459078.06,6391562.97,-16.74,3.48449183,4.80661488,5.49290037,77,19,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31604
20020629,130052376,459074.50,6391544.12,-16.74,3.69095230,5.09069872,5.34871387,95,58,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31605
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20020629,130100247,459122.39,6391625.94,-16.78,3.64113069,4.96888161,5.33101463,98,56,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31608
20020629,130100247,459127.73,6391643.03,-16.78,3.35211301,5.29924774,5.43109798,96,12,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31609
20020629,130100247,459102.50,6391562.39,-16.78,3.41151595,4.50575972,5.49443102,62,25,04,CLASS_04,BRISTOLBAY,20020629,180-1256,1,31610
20020629,130100247,459096.82,6391544.25,-16.78,3.57588291,4.98137712,5.32614088,98,33,07,CLASS_07,BRISTOLBAY,20020629,180-1256,1,31611
20020629,130100247,459091.48,6391527.20,-16.78,3.77097106,5.52929449,5.33657932,63,09,13,CLASS_13,BRISTOLBAY,20020629,180-1256,1,31612
```

*Description of data in a single line of the file:*

Sample Data	Description	Details
20020629	Date stamp	ccyymmdd
130044565	Timestamp	hhmmsshs
459046.64	Longitude or Easting	Full flexibility in position format
6391565.26	Latitude or Northing	Full flexibility in position format
-16.74	Depth in metres, displayed as a negative	float in metres
3.50688839	Q1 – represents Q-space value Q1	float values
4.80144691	Q2 – represents Q-space value Q2	float values
5.53823996	Q3 – represents Q-space value Q3	float values
73	Represents class Confidence	%
31	Represents class Probability	%
04	Represents class ID	nn
CLASS_04	Represents class Name	string
BRISTOLBAY	Source vessel or survey name	string
20020629	Source date stamp	ccyymmdd
180-1256	Source data set name	string
1	Source FFV channel or file ID	numeric
31598	Source FFV file record index	numeric

Additional processing of the output data can also be done in QTC CLAMS, a suite of utilities provided by Quester Tangent. This software provides for functions such as categorical interpolation, similarity colours and seabed complexity mapping.



**Your Contact:**

**HydroCharting**  
Ølbyvej 185  
DK-4623 Lille Skensved  
Denmark  
Phone: +45 43 77 43 01  
Mail: info@hydrochart.dk