

ClearSight™ User Guide



1 System Requirements

1.1 *Hardware Requirements*

- Q9550 (2.83GHz Core 2 Quad-Core x86) or newer
- 2GB RAM
- 120GB disk space

1.2 *Operating System Requirements*

- Windows XP, Vista, Windows 7, 32/64 bit

1.3 *Java Requirements*

- Sun Java JDK version 1.6 update 16 or newer is required for the installation.

1.4 *Limitations and tips for proper scanning*

- Best results are achieved when scanning in straight lines and at fixed speed.
- When scanning, the DIDSON should be tilted relative to the scanned objects in accordance with Soundmetrics scanning guidelines (see also section 5).
- The algorithm does not support mosaicing of zigzag sequences. To mosaic such sequence, the file should be split into ranges that scan in a single direction.
- When the camera does not move at all with respect to the target, no resolution improvement can be achieved.
- Mosaicing of flat surfaces without any “anchor points” may fail.
- Mosaicing of fast scans may fail due to large difference between consecutive frames. Optimal scanning speed should leave approximately 60-70% of the picture in consecutive frames.

2 Installation Instructions

Follow the steps below to install ClearSight™ software.

Currently the installation directory should be C:\acousticview. Any attempt to install in another directory results in an error. This will be corrected in the next version.

1. Close all open windows.
2. Insert the AcousticView™ USB Flash Memory .
3. Change directory to AView_USB\ClearSightDIDSON_Installation on the USB Flash Memory
4. Click on ClearSightSetup.exe
5. On Windows Vista you will be asked to ok the installation.
6. Please read the Software License Agreement.
7. If you accept the terms of the Software Installation Agreement, press accept.
8. The software should be installed in directory C:\acousticview
9. Ok the rest of the installation.
10. A shortcut icon will appear on the desktop enabling access to the ClearSight™ software.
11. When the installation of ClearSight is finished, click on the jre-6u16-windows-i586-s.exe;
This will install a Java runtime environment.
12. When both installations are done, please insert the dongle which was provided with the Software. If you do not have such a dongle, please contact the company to purchase one.
13. Please wait until installation of the dongle is done. The installation takes a few minutes.
14. When the red light of the dongle is on, the dongle has been installed successfully and you are ready to start the software.
15. Keeping the dongle connected at all times, click on the AcousticView shortcut to start the program
16. Click on the first button (directories and files) to choose a directory where the DIDSON files exist.

17. A list of available files will appear, choose the file you want to mosaic by clicking on it.
18. Click on the rounded arrow (second button) to choose the frames from which mosaic should be created.
19. A small monitor window will present processing progress.
20. When mosaic is read, it will appear on the left files list under the file which was chosen.
21. Double click on the sub part which contains the processed mosaic frames you want to view.
22. You can then increase or reduce resolution by clicking on the + or – buttons and then clicking on the picture itself.
23. You can also move the image on the screen, and measure distances.
24. Please provide comments to info@acousticview.com
25. Should you encounter a problem, please provide information about software version and the full details of the problem to info@acousticview.com
26. Thank you for choosing ClearSight™

Before you run the program, please make sure to insert the dongle that you have received when you purchased the software in a SUB slot. The dongle should stay in the USB slot while you run the software.

Please note that a Web version of the software exists now, so that you can upload your DDF file and process frames over the web. In that case you will be paying for the frames you process and will not be required to purchase the software. This Web option will not provide real time or measurement capabilities. It is however a very simple and cheap way to explore the software. For further details, please check AcousticView.com

3 Using ClearSight™

3.1 Main Window

To get started, double click on the ClearSight™ icon that was created during installation. ClearSight™ main application window is shown in Figure 1. The application window is organized in two panes:

- The Project pane
- The Viewer pane

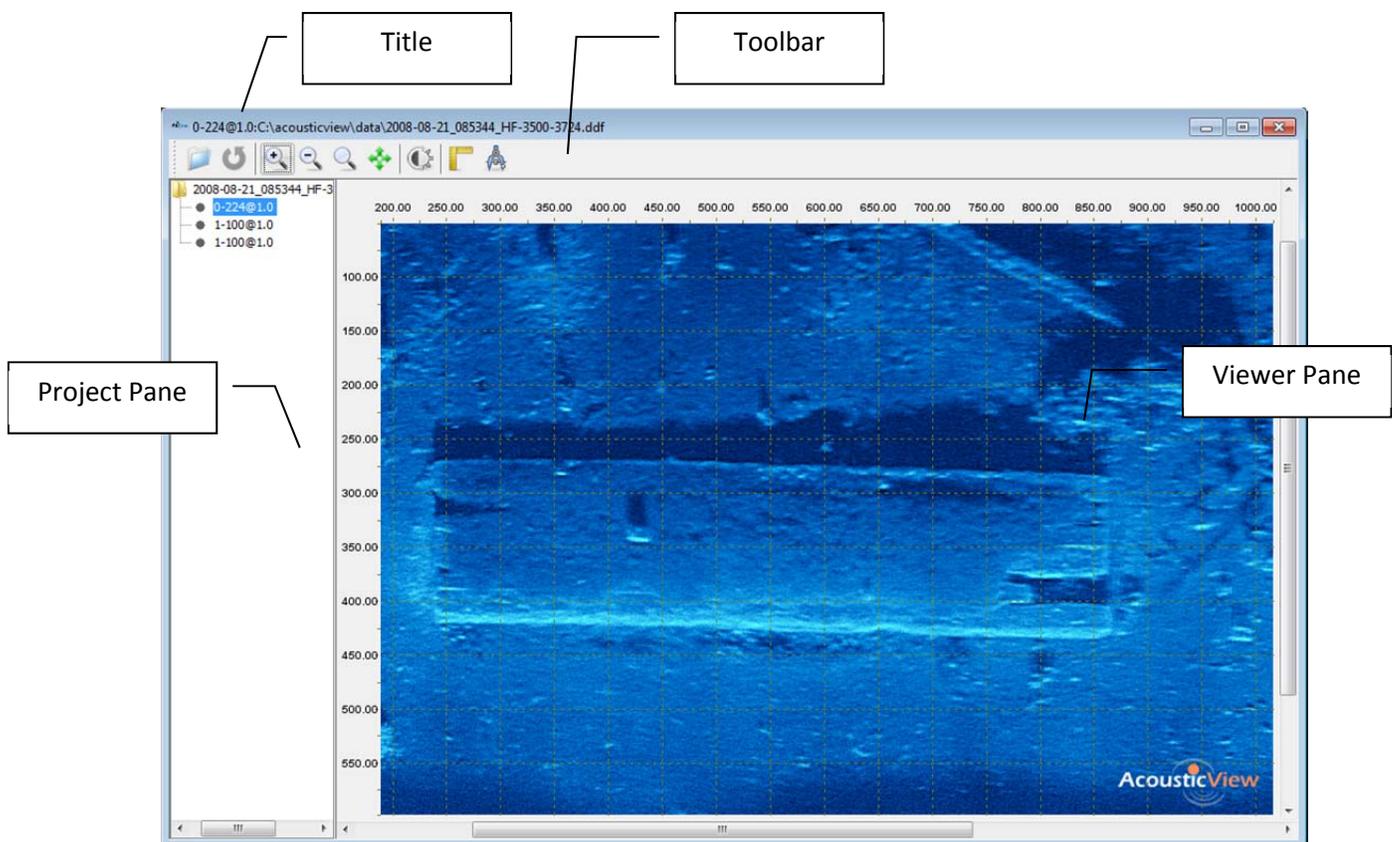


Figure 1 ClearSight™ console

3.2 Project Pane

To view a mosaic that was already created, click on one of the mosaic elements in the Project pane on the left. Please note that this may take few seconds.

Below, each of the elements in the Project management pane is described.

As show in Figure 2, two types of Project pane objects are available:

- Sonar Scan – represent a single sonar movie scan file. The name of the scan is depicted next to the icon.
- Mosaic – represents a single mosaic with a range a frames from the sonar file which appears above. The name of the mosaic depicted next to the icon contains the range of frames and resolution (from-to@resolution).

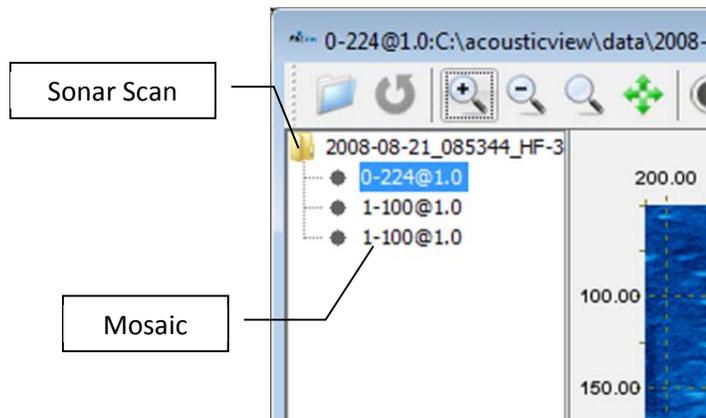


Figure 2 Project pane objects

3.2.1 Adding new sonar scan

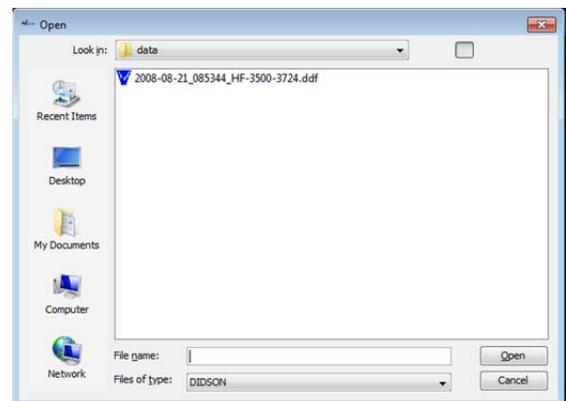
To add a new sonar scan, press



Pressing the button will open a file browser dialog

Browse to the location of the sonar scan and press 'Open'

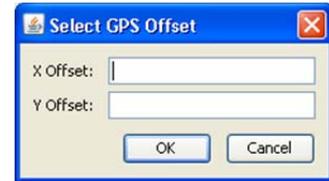
A new Sonar Scan will be added to Project pane.



Another option for adding new Sonar Scan is by clicking on Right Mouse when in Project pane. After clicking on Right Mouse in Project pane, a pop-up menu appears that allows adding a Sonar Scan.

After the new sonar scan is added to the Project pane, dialog box pops up. This dialog box allows adding GPS offset from the pole.

The values should be entered in meters.



3.2.2 Removing a sonar scan

To remove sonar scan from the project, click on Right Mouse after selection Sonar Scan in the Project pane. After clicking on the Right Mouse a pop-up menu appears that allows removing Sonar Scan from the project. When removing Sonar Scan, only project view is affected, the file remains in the file system.

3.2.3 Creating a new mosaic

To create a new mosaic, select the desired sonar scan and press



Pressing the button will open a range selection dialog

Select the frame range, and press 'OK' button

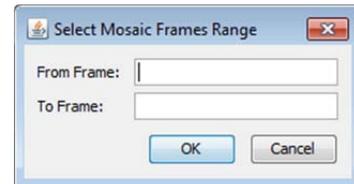
Please make sure to choose an upper range that is smaller or equal to the number of frames in the file. In older versions,

choosing a frame range that is outside the range of frames caused the program to freeze.

After a range is chosen, a progress bar will appear on the screen.

Please wait until processing completion.

A new Mosaic should appear under the chosen sonar scan. Please note that you need to click on that mosaic to see it in the viewer pane.



3.2.4 Viewing a mosaic

To view mosaic, double click on the desired mosaic in Project pane. The chosen mosaic will be opened in the viewer pane.

3.2.5 *Removing a mosaic*

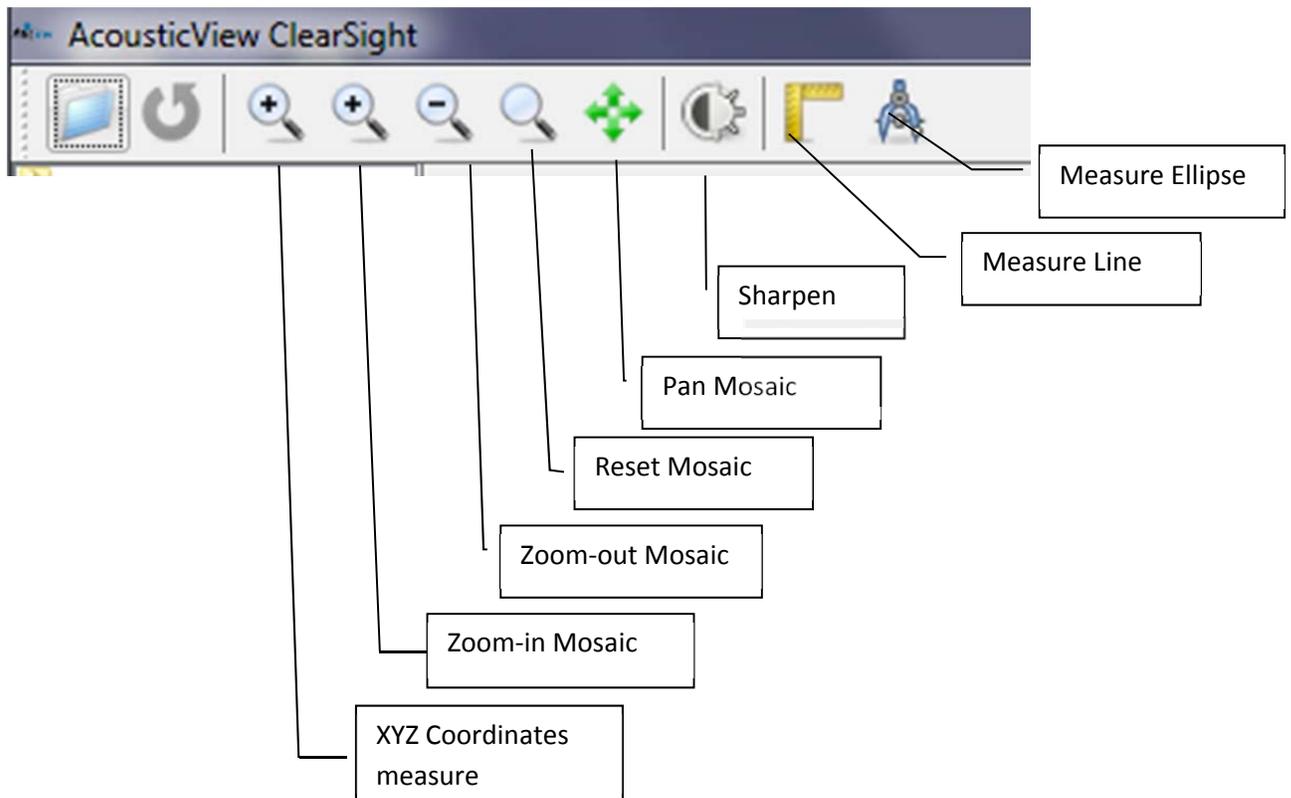
To remove mosaic from the project, click on Right Mouse after selection mosaic in the Project pane. After clicking on the Right Mouse a pop-up menu appears that allows removing mosaic from the project.

3.2.6 *Removing all mosaics from sonar scan*

To remove all mosaics created for sonar scan from the project, click on Right Mouse after selection Sonar Scan in the Project pane. After clicking on the Right Mouse a pop-up menu appears that allows removing mosaics created for sonar scan from the project.

3.3 *Viewer Pane*

Clicking a mosaic in the Project pane on the left reveals mosaics in the Viewer pane on the right. When mosaic is shown in Viewer pane the following tools are available



4 File Formats

4.1 Mosaic File

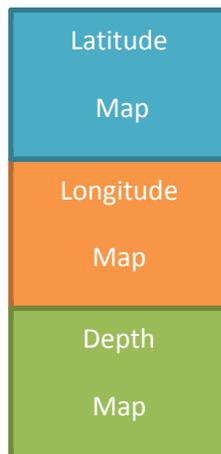
The mosaic file is stored in a BMP file, also known as Bitmap Image File. BMP image file format used to store bitmap digital images. Complete description of the file format can be found in http://en.wikipedia.org/wiki/BMP_file_format

4.2 GEO File

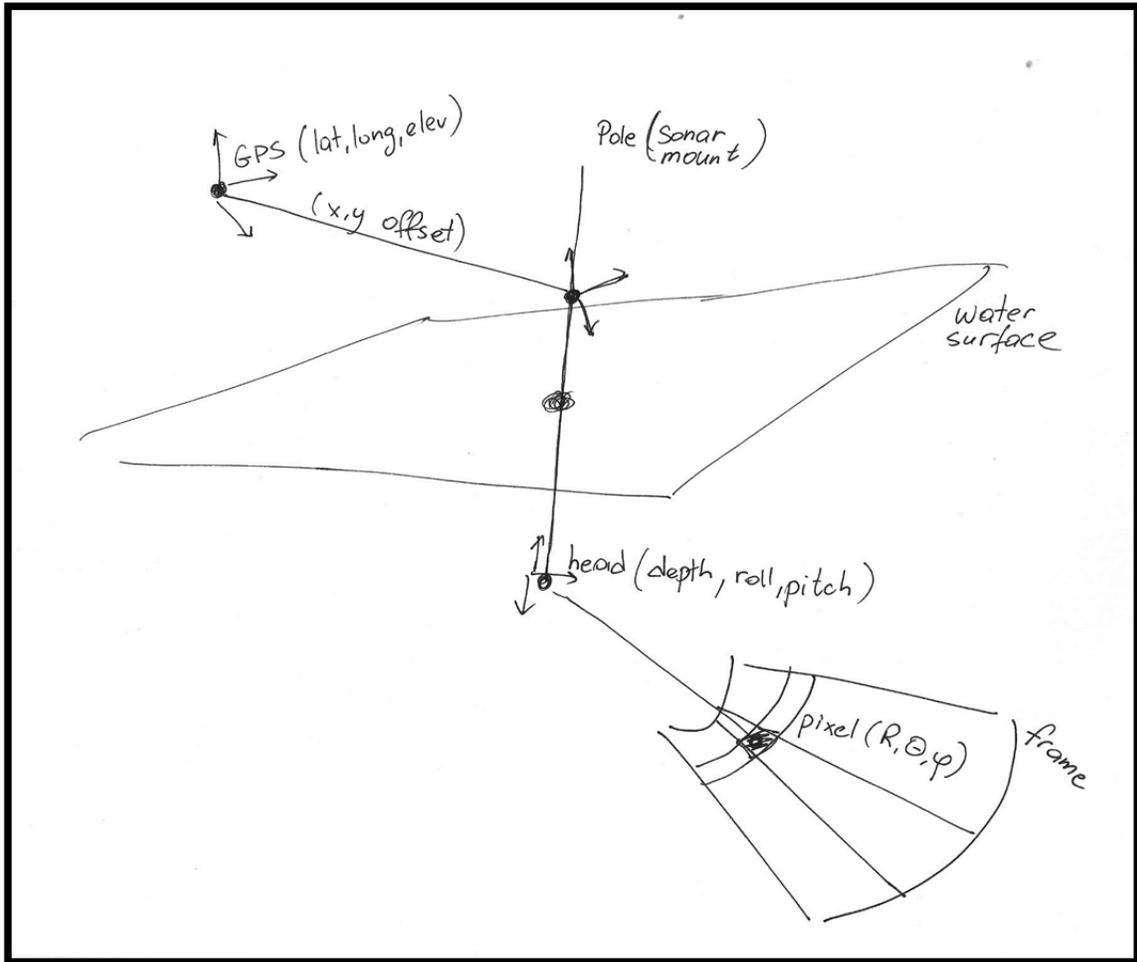
The geo files are stored in a binary file. The file stores three consecutive maps, each map represents latitude, longitude and depth.

The width and the height of each map equals to the width and height of the Mosaic file. Each pixel in the map holds a 'float' value.

The binary file structure is shown below.



5 Transformation

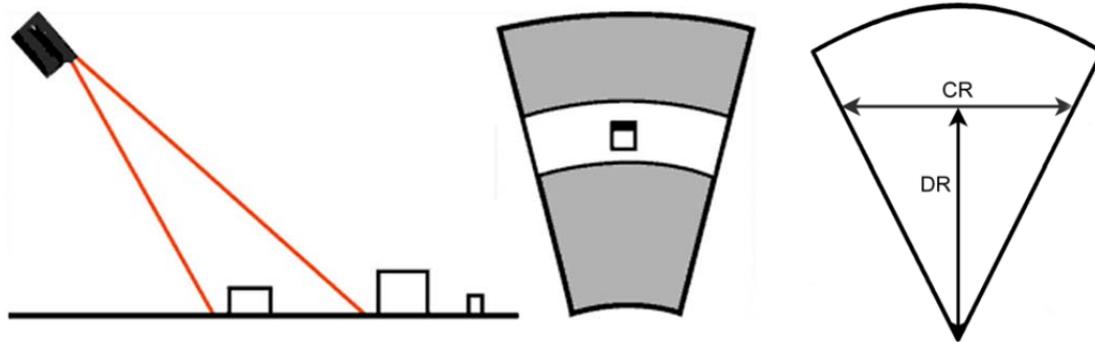


The geometric model which transforms between coordinates measured by the GPS to the voxels on single sonar image is depicted above. In addition to values measured by the GPS, the transformation model considers the offset of the GPS from the pole, sonar tilt and pan coordinates. The results of the transformation model applied are used along with the image registration process to produce a pseudo 3D model (also called 2 ½ D model) for each of the pixels of the mosaic.

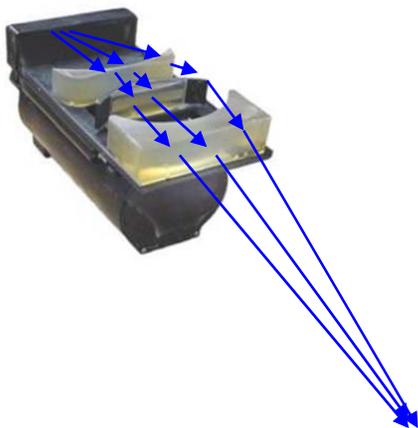
The four steps of image registration are: feature detection, feature matching, transformation estimation, and image resampling and transformation. Feature detection is the process of finding objects such as corners, edges, line intersections, etc., manually or automatically. The features from the sensed image are paired with the corresponding features in the reference image in the second step. In the third step, the transformation is estimated based on the displacement vector of each feature. Once the mapping is established, the multiple images are combined to generate a mosaic image, where each pixel in the mosaic image is geo-referenced.

Data Acquisition

Data with the DIDSON forward looking sonar is scanned as shown below. The camera is pointing towards the target at an angle, and the picture frame that is scanned can be seen on the right hand of the picture.



The cross range (CR) ensioified by DIDSON is one-half the down range (DR).



The DIDSON scans over a range of depth using a moving acoustic lens which changes the focus of the ultrasonic sound to cover the full down range.

Imaging geometry

The transformation between two acoustic camera images can be calculated by putting one image into the coordinate system where the image is on the xy -plane with the positive y -axis along the center line of the image and the center of the arc at the origin (Fig. 1).

During the imaging process, a point denoted by a position vector $\mathbf{x} = (x, y, z)^T$ is projected to the polar coordinates (r, α) as follows:

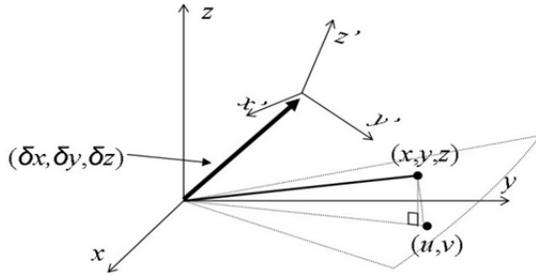
$$\begin{aligned} u &= r \sin \alpha = x \sqrt{1 + \tan^2 \beta}, \\ v &= r \cos \alpha = y \sqrt{1 + \tan^2 \beta}, \end{aligned}$$

where $r_{xy} \equiv (x^2 + y^2)^{1/2}$, or to the Cartesian coordinates (u, v) ,

$$r = |\mathbf{x}|,$$

$$\alpha = \sin^{-1} x / r_{xy},$$

where β is the angle between \mathbf{x} and the imaging plane.



The imaging geometry of an acoustic camera. The camera is located at the origin of the xyz -coordinate system with the pitch, yaw, and roll $(0, 0, 0)$. In the next frame $(x'y'z'$ -coordinate), the camera is displaced by $\delta \mathbf{x} = (\delta x, \delta y, \delta z)^T$ and rotated by $(\varphi, \vartheta, \psi)$.

When the camera is translated by $\delta \mathbf{x} = (\delta x, \delta y, \delta z)^T$ and rotated by $(\varphi, \vartheta, \psi)$, the new coordinates of \mathbf{x} are

$$\mathbf{x}' = (x', y', z')^T = \mathbf{R}_{\varphi\vartheta\psi} (\mathbf{x} - \delta \mathbf{x})$$

where $\mathbf{R}_{\varphi\vartheta\psi}$ is a 3-by-3 rotation matrix. The linear transformation \mathbf{T} between two images should satisfy

$$\begin{pmatrix} u' \\ v' \\ 1 \end{pmatrix} = \begin{pmatrix} x' \sqrt{1 + \tan^2 \beta'} \\ y' \sqrt{1 + \tan^2 \beta'} \\ 1 \end{pmatrix} = \mathbf{T} \begin{pmatrix} x \sqrt{1 + \tan^2 \beta} \\ y \sqrt{1 + \tan^2 \beta} \\ 1 \end{pmatrix} = \mathbf{T} \begin{pmatrix} u \\ v \\ 1 \end{pmatrix}$$

where $\beta' = \tan^{-1} z' / (x'^2 + y'^2)^{1/2}$.

When the reflecting points of the target object are located roughly on a plane such as the sea floor, z can be approximated by

$$z = ax + by + z_0$$

For a , b , θ and θ' that are sufficiently small so that their squares are negligible, we have

$$\mathbf{T} = \begin{pmatrix} R_{11} + R_{13}a & R_{12} + R_{13}b & -(R_{11}\delta x + R_{12}\delta y + R_{13}(\delta z - z_0)) \\ R_{21} + R_{23}a & R_{22} + R_{23}b & -(R_{21}\delta x + R_{22}\delta y + R_{23}(\delta z - z_0)) \\ 0 & 0 & 1 \end{pmatrix}$$

This serves as a first order approximation of the transform between two acoustic camera images. The error due to the second and higher order terms may appear as blurriness in the resulting images.

The six unknown parameters of the affine transform can be obtained by matching features in two images. However, other parameters such as R_{ij} , a , b , or $\delta \mathbf{x}$ in (1.6) cannot be figured out separately because those parameters are coupled and under-constrained. Consequently, under the above approximation, it is impossible to reconstruct the precise motion of the acoustic camera merely based on image registration parameters.

Mosaicing details

Using the above geometry modeling, two sonar frames are mapped between each other so as to obtain the same coordinate system between them. Then anchor points are found in both images, so that registration can take place and the two frames can be combined as is illustrated below.

