2D-Analysis – Documentation

Figure 1: Army-Navy, December 2007

This document and the accompanying spreadsheet, **2D-Analysis.xls**, enable you to estimate the real world coordinates, (x, y, z), of a feature on the ground from an image like the one shown in Figure 1. Because we work in this document with features that are on the ground, $z = 0$ and we can locate a feature on the ground from a single digital image. See **3D-Analysis** to use two digital images to locate features in the three-dimensional real world. See **The Mathematics of Working with Digital Imagery** for more about the underlying mathematics. You should open the spreadsheet **2D-Analysis.xls** and work with it as your read this document.

The key to using data from digital imagery is being able to convert from two-dimensional image coordinates, (s, t), in pixels to three-dimensional real world coordinates, (x, y, z). In order to do this we need information about how the image was made – information like the camera's position and the direction in which it was pointed. This information is called **calibration data**. In the spreadsheet **2D-Analysis.xls** this data is entered as four three

Image Vectors		Data Points			
(Calibration Data)		Image Coordinates		Real World Coordinates	
		s	t	x	y
Qx	105.743	98	550	-50.34	26.72
Qy	-33.5597	-1992	571	-49.80	-26.67
Qz	14.7827	681	389	-15.12	26.76
				28.08	-4.61
Px	-5765			28.08	-4.61
Py	2148.71			28.08	-4.61
Pz	-1097.38			28.08	-4.61
				28.08	-4.61
Ux	0.341645			28.08	-4.61
Uy	0.938824			28.08	-4.61
Uz	0.0434448			28.08	-4.61
				28.08	-4.61
Vx	-0.179789			28.08	-4.61
Vy	0.0199142			28.08	-4.61
Vz	0.983504			28.08	-4.61

Figure 2: A Partial Screenshot

dimensional vectors. See **3D-Image Calibration** for information on how to find the calibration data. The *Mathematica* notebook **AN76.nb** can be used to create a text file with the calibration data that can be imported in the usual way into the spreadsheet **2D-Analysis.xls** replacing the sample calibration data. The user can also enter the calibration data manually by typing it into the appropriate cells. See the leftmost two columns in Figure 2.

Once the calibration data has been entered, the user enters the two-dimensional screen coordinates, (s, t), for each feature of interest into the obvious cells. The two-dimensional real world ground coordinates, (x, y), appear in the obvious cells. The spreadsheet **2D-Analysis.xls** has several examples already entered. These particular examples were used to calibrate the image. It is a good idea to check that the calibration data has been entered correctly by trying some of the points used for calibration. See **3D Image Marker** for one way to find the two-dimensional image coordinates for features of interest.