3D-Ray-Finder – Documentation

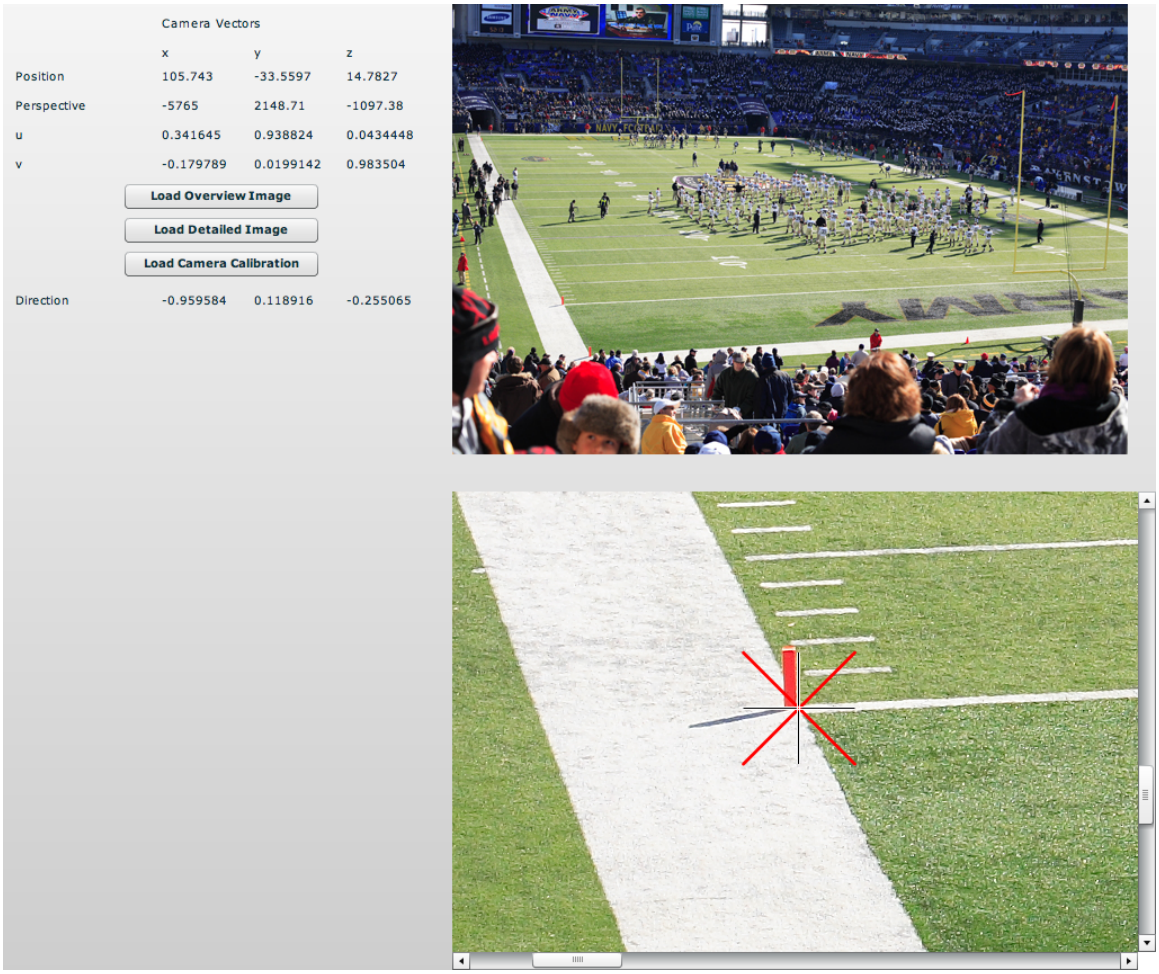

Figure 1: Marking Features on a Digital Photograph

There are many situations in which we have a photograph that shows features of interest. If the photograph has recognizable features whose coordinates are known we can determine where the camera was when the photograph was taken, the direction in which it was pointing, and the focal length of the lens. This process is called **calibration** and is described elsewhere in this collection. This program (see Figure 1) enables you to find the direction from the camera's position to a feature of interest.

In order to use this program you need three files. All three must be located in the same folder (directory) as this program.

- The original full-sized image. This is called the **detailed** image. This image is used in the bottom pane on the right side of Figure 1.
- A reduced version of the original image. This is called the **overview** image. You must make this image yourelf using one of the standard image-processing programs. It should have the same aspect ratio as the original image. Its width should be no more than 600 pixels and its height no more than 400 pixels. This image is used in the top pane on the right side of Figure 1.
- An XML file with the calibration data for the image. This is the result of the image **calibration** described elsewhere.

Follow the following steps to use this program.

- Double-click the file **3D-Ray-Finder.html** to launch the program. This program requires the most recent version of FlashPlayer. This version is available free from http://www.adobe.com/products/flashplayer. The program may not work with Internet Explorer. We recommend FireFox.
- Click the **Load Overview Image** button, navigate to the directory that contains this program and the three files described above, and select the image file with the overview image.
- Click the **Load Detailed Image** button and select the file with the detailed image.
- Click the **Load Camera calibration** button and select the XML file with the image calibration information.
- For each feature of interest –
  - Click on the feature of interest in the upper (overview) image panel. The image in the lower (detailed) image panel will scroll to give you a high resolution view of the area around the feature.
  - Click on the feature of interest in the lower (detailed) image pane.
  - Read the information of interest. The position of the camera is given at the top of the left panel and a unit vector pointing from the camera toward the feature of interest is given in the last line in the left panel.

In Figure 1 the camera is located at the point $(105.743, -33.5597, 14.7827)$ and the direction is $(-0.959584, 0.118916, -0.255065)$. For this particular example the units for the camera position are in yards with the origin in the center of the field, midway between the two sidelines on the 50 yard line. Thus, the location of the feature of interest is on the ray

$$\vec{r}(t) = (105.743, -33.5597, 14.7827) + t\ (-0.959584, 0.118916, -0.255065).$$

Because the feature of interest is on the ground we know that

$$14.7827 - t0.255065 = 0.$$

This implies that

$$t = 57.9566$$

and the feature is at the point

$$\vec{r} = (105, 743, -33.5597, 14.7827) + 57.9566(-0.959584, 0.118916, -0.255065) = (-26.67, 50.13, 0).$$

According to the NFL regulations this point should be at $(-26.67, 50.00, 0)$.