Field Acquisition With Acquire

Robert Quimby
June 4, 2002

1. Overview

Acquire is a package designed to locate where a previously identified object lies on a new image and to determine the distance in pixels to the center of some feature on the image, such as the shadow of a slit. The package has additional features to allow monitoring of the relative motion, seeing, and object flux for a series of images.

The acquire interface is an IDL widget which calls C and IDL routines. The user selects raw images to load through a file finder. The images are surfaced (sky gradients are removed), objects are located forming an astrometry list, and the lists from two images are matched using QUICKMATCH . The program requires a reference image–a finder chart containing the known position of the target, and a new image of the same field. To find the offset to some feature on the new image such as a slit, a third image must also be provided (or the new image can be used if the feature is visible).

2. Loading Images

The reference, new, and slit images can be loaded in any order using the "Load Finder Chart", "Load New Image", and "Load Slit Image" buttons respectively. Clicking on the button will bring up a file finder to locate the images.

The reference image should contain "CANDX" and "CANDY" values in the FITS header which give the (x,y) position of the candidate. If not present, (0,0) is assumed.

Once a reference or new image has been chosen, GET_PHO is called which first surfaces the image, then calls ISOFIND to locate objects. The user is then allowed to add or remove objects by hand. Objects to be included in the astrometry list are shown with yellow boxes. Objects rejected are shown in orange if they are in a bad column, and red if they occur in an over-dense region. The user can left click to unselect an object, and right click to re-select it. Also, clicking along the left boarder causes the objects closest to the boarders to be removed, while clicking along the bottom boarder causes all but one object to be removed. Once the user is satisfied with the selected objects, clicking the middle button over the image ends the process.

3. Finding The Slit

Once a slit image is chosen, the raw image will be displayed, and the user is prompted to select the rough location of the slit by dragging a box around it with the cursor (left click to begin dragging, middle click when ready to proceed); this region should include some space adjacent to all sides of the slit. Next the user is presented with a close up of the boxed region and asked to draw a line parallel to the slit (again, left click to start, middle click when done).

ACQUIRE now tries to determine the slit center and position angle using the boxed region, and using the slope of the dragged line as a guess of the position angle. The slit finding algorithm begins by rotating the boxed image between ± 5 degrees of the users position angle guess, summing the resulting array into one dimension, and fitting a Gaussian to the result. The position angle is found by minimizing the Gaussian σ. This procedure works well provided the slit is thin.

Next the boxed image is rotated by the fitted position angle, summed, and fit with a Gaussian as above to roughly determine the slit center and width perpendicular to the slit. The array is then summed in the direction parallel to the slit across just the slit width. The resultant vector is a step function. To determine the center of the slit, the vector is shifted by 15 pixels and subtracted from itself. This results in a maximum and a minimum at the approximate ends of the slit. Using the mean values before the slit, in the slit, and after the slit, the points marking the half maximums can be found, and averaged to determine the center parallel to the slit.

Once the slit is located, the position is noted in the "slitx" and "slity" fields. The values in the text fields (not necessarily the calculated values) are used for determining a candidates offset from the slit. The user has the option of inserting their own values, or setting either the x or y field and pressing enter which will automatically set the other field using the calculated slit center and position angle.

4. Matching

Once a reference image and a new image have been loaded, the user can match the fields at any time using the "Match Image to Ref" button. This calls QUICKMATCH using the match parameters set using the "Parameters" button. If successful, The squares identifying objects on the ref and new change to circles which show the match. On the new: green objects matched and red objects didn't. The same is true for the ref, however, objects from the new are also marked: green for matched, yellow for not matched. The new image also shows vectors representing the fit residuals (magnified 100 times). See figure 1.

The slit view displays a section of the new image centered on the candidate, with the candidates location determined by transforming the "CANDX" and "CANDY" values from the refimage onto the new image system. The "dx" and "dy" fields denote the distance to the slit center as shown in the "slitx" and "slity" fields.

5. Refining The Match

Objects with a fit residual greater than one pixel are removed by default one by one. The user can add or remove objects from the fit with the "Refine Match" button (left button adds, right button removes). The slit view fields are updated with each change.

6. Slit/Star Monitoring

The "Monitor Stars" button allows the user to monitor the relative motions of stars and a slit on a series of images, such as the guider camera images of the Keck telescope. Seeing and flux ratios are also monitored, suppling the user with basic information on how the conditions are changing.

First, the user should click on the "Pick Fiducial Stars" button, which brings up the new image (the new and slit images must be loaded before attempting to monitor), and prompts the user to select a few stars to determine the seeing from. Each selected object will be assigned a color and a symbol, and displayed on the monitor console. The user can select as many fiducial stars as they like, but only 12 will be displayed. As always, left button selects, right button unselects, and the middle button quits.

After the fiducial stars are selected, a guider image can be loaded using "Load Image", or "Quick Load". The latter tries to load an image with a run number one greater that the previous, and then matches it automatically to the new, while the former lets the user choose which image to load, and does not match until the user clicks on the "Match" button.

When a match is successful, the slit is found on the guider image using the location and position angle found on the slit image as a starting guess. Then the slit and star offsets of the matched objects to the new image are calculated and added to the plot. Seeing is calculated by fitting a 2D Gaussian to the fiducial stars. Red X's mark the drift in the x direction, and diamonds plot drift in the y direction. See figure 2.

The "Show Fiducial Stars" button will bring up a window showing the new image with the fiducial stars labeled. Circles are plotted around the fiducial stars with diameters proportional to the FWHM of each object as calculated on the current guider image. See figure 3.

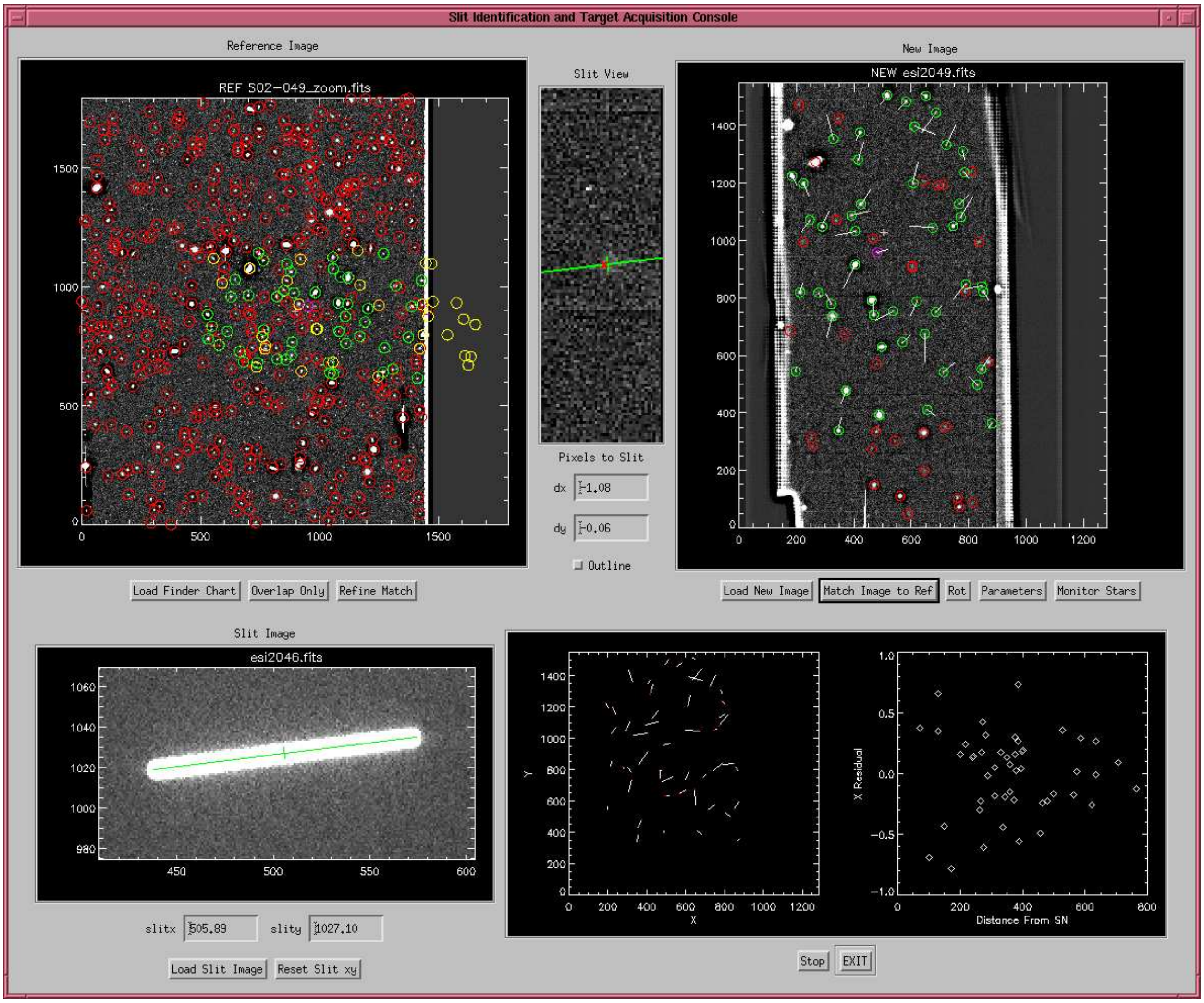

Fig. 1.— The ACQUIRE console showing a match.

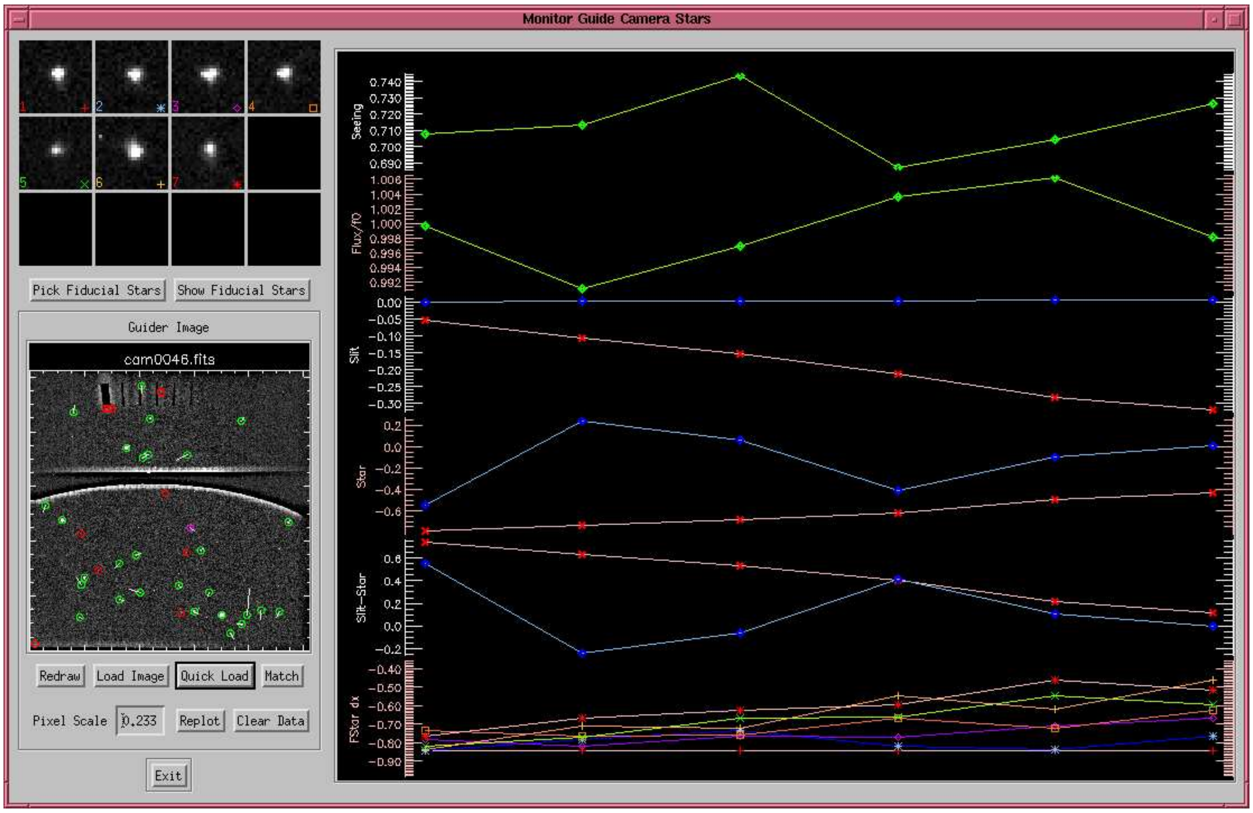

Fig. 2.— The Monitor Star console tracking a series of guider images.

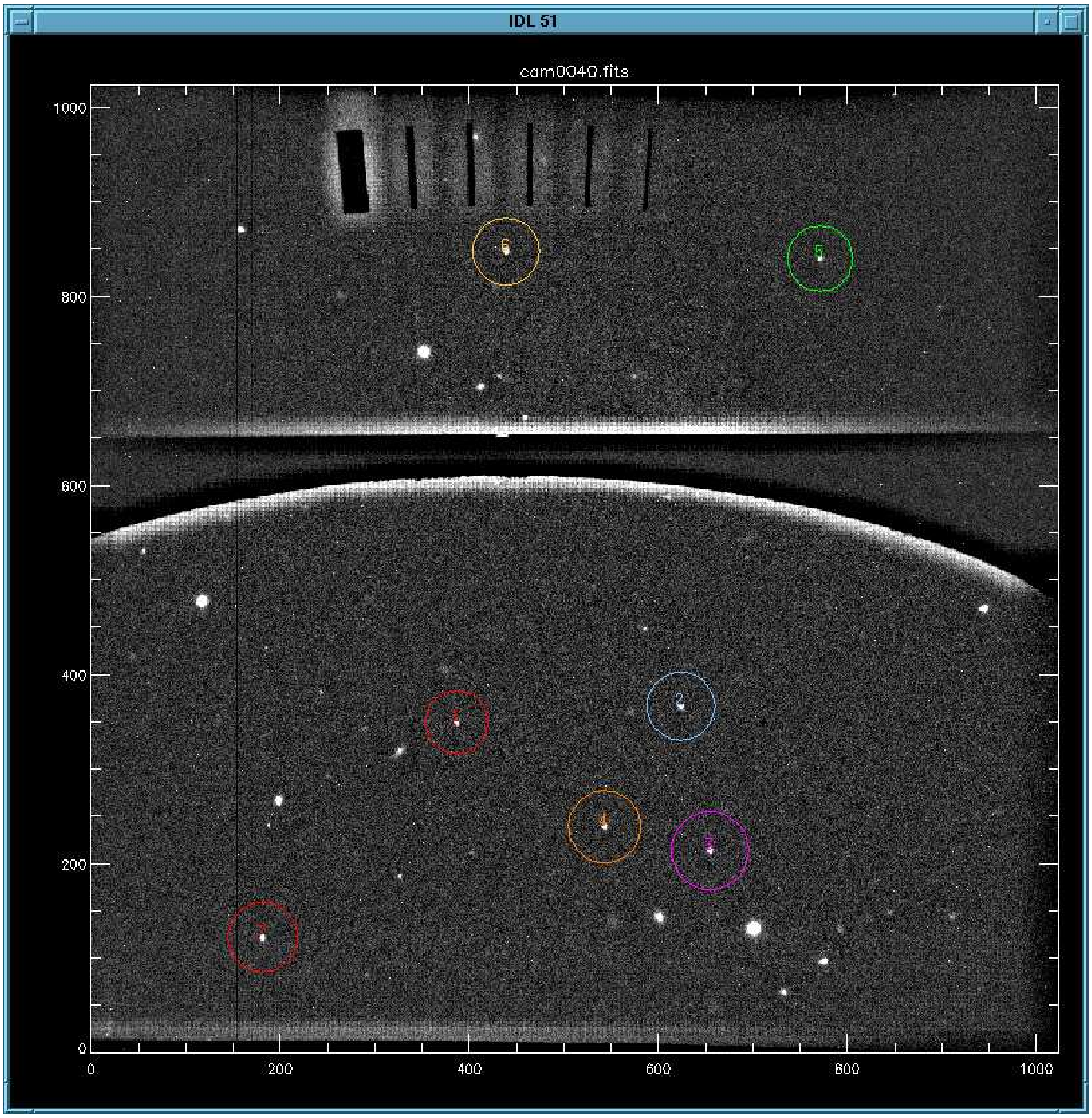

Fig. 3.— The new image with selected fiducial stars. Circles have diameters proportional to the FWHM of the selected objects.