How do we extract the Io/I value at the thermocouple from the images?

Because the I_o/I data is stored in a matrix, you just need to extract the elements that are at the TC location. You just need to choose the right rows/columns in the matrix that correspond to the location of the thermocouple (i.e. if the thermocouple covers rows 250 to 280 and columns 390 to 420, then you would just extract Iratio_TC = Iratio(250:280,390:420)). This range of rows/columns should be the same for all of your images (the shuttle didn't move within the camera field of view).

An even simpler way to do this is to do it interactively. You can tell matlab to show the I_o/I image and let you select the location in the image. To do this, do something like:

```
temp_fig = figure;
imshow(Imat{ii,jj})
TC_loc = getrect(gcf);
close(temp_fig);

Irat(ii,jj) = mean(mean(imcrop(Imat{ii,jj},TC_loc)));
dIrat(ii,jj) = mean(std(imcrop(Imat{ii,jj},TC_loc)));
```

This creates a figure showing the I_o/I values to the user. The user then selects a box in the image which corresponds to the region where the thermocouple is located. MATLAB stores the coordinates of this box in "TC_loc", so that the values in that range can be extracted. The last 2 lines take the average and standard deviation of the values located within the selected box. The "ii" and "jj" parts are just because I am looping through a cell array of all of the images for all of the runs. This will be different depending on how you read in the data.

You need to extract it from each image so that you have 9 pairings of I_o/I and T/T_ref values to fit.

Do we use the flow conditions after the shock to find the recovery temperature, Re number, Nusselt number and the heat transfer coefficient?

You need to use the properties after the shock. That is the portion of flow that is exchanging heat with the surface, and therefore driving the heat transfer process. The flow in front of the shock does not interact with the surface directly.

How do we calculate recovery temperature?

Recovery temperature is $T_r = T_\infty\left(1 + r\frac{\gamma-1}{2}M^2\right)$, where r is the recovery factor. This is typically defined as $\sqrt{Pr}$ for laminar boundary layers and $\sqrt[3]{Pr}$ for turbulent boundary layers. You can assume our BL is turbulent.

What exactly is the thermocouple measuring? Is that T_o for the freestream?

The thermocouple measurement gives you the *surface* temperature. It doesn't know anything about the *gas* temperature above the surface (static, stagnation, recovery temperature). So to get the gas properties you need to use the fact that you know the stagnation temperature of the tunnel. It is just the temperature that the tanks are at in WRW 2 (295 K is a good assumption).

Here are some samples of what your plots should roughly look like (these came from your data):