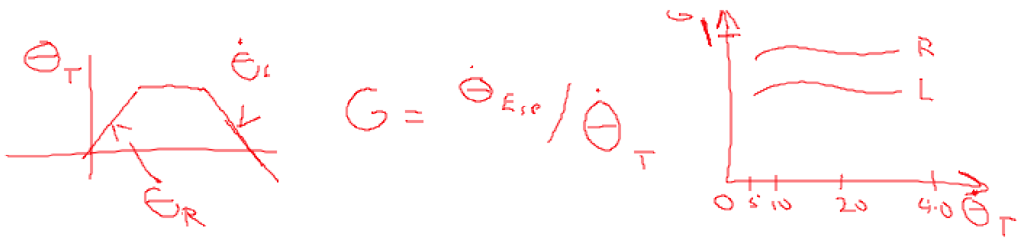
EBME319 Post Lab Notes (last modification 28 February 2011, 07:56)

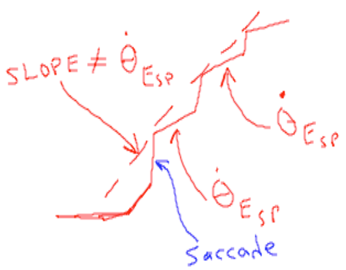
BIG HINT: READ THIS CAREFULLY BEFORE PERFORMING THE LAB!

Question 1:

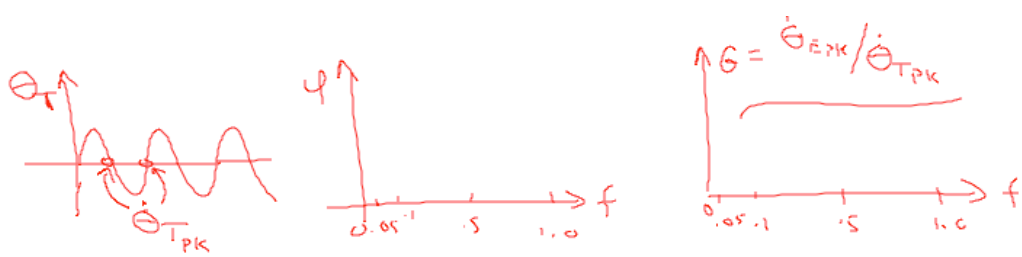
Gain is eye velocity divided by target velocity ONLY at times of smooth pursuit. Plot (and identify!) your results for each DIRECTION (not each eye; you need only plot the data for one eye).



Do NOT analyze across saccades—they will mess up your results. Also, don't analyze across the endpoints (the times when the eye is at rest). Select *only* smooth pursuit intervals that are uninterrupted by fast phases (or by blinks). In the drawing below, you should note that the eye is moving slower than the target, necessitating the generation of "catch-up" saccades. If you were to include the effects of these saccades, you would mistakenly conclude that the eye was pursuing at a gain of 1.



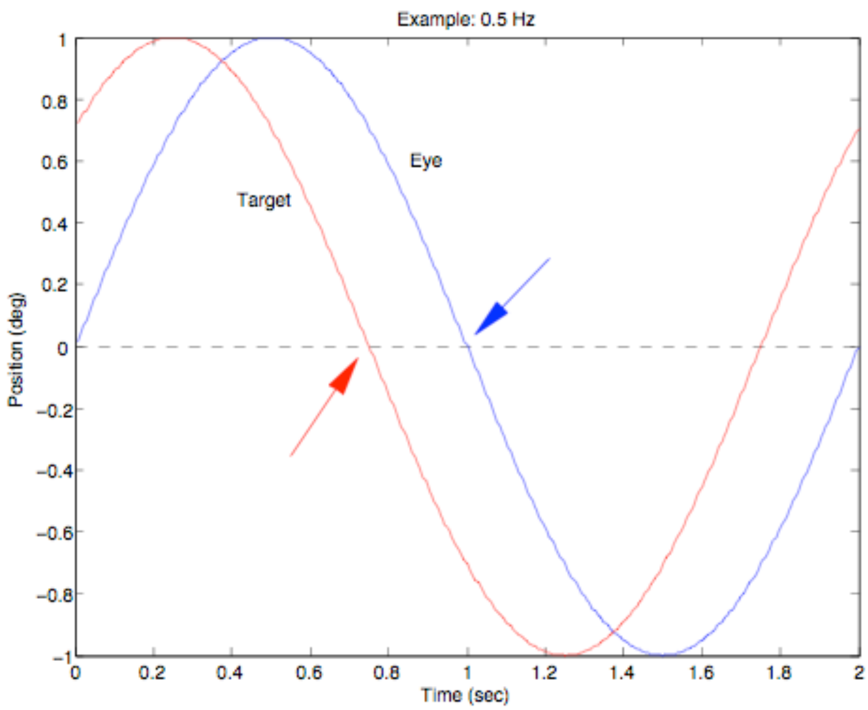
Question 2:



Gain is **peak** eye velocity divided by **peak** target velocity. For a sinusoid, the peak velocity occurs at the point where the position trace is crossing zero (the derivative of a sine wave is a cosine). For about a degree or so on either side of the zero crossing you can essentially treat it as linear and perform a "rise / run" calculation as you did for the purely linear position data in question 1. (You could also perform a mathematical differentiation—e.g. MATLAB's "diff" command—on the eye position data, but you need to be careful not to simply choose the largest resulting value, as it could be due to noise in the position data, or a saccade.)

Phase lead (eye ahead of target, i.e., predicting) is positive, phase lag (eye behind target) is negative.

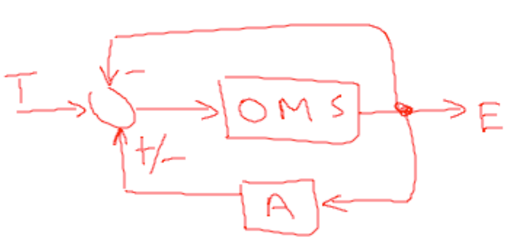
To calculate phase you need to know the duration of a cycle. For example, at 0.5 Hz, one cycle takes two seconds. Since phase is a **relative** measurement (i.e., the value of one thing with respect to another) you must select some equivalent point on the eye and target plots, such as when they cross zero. In the following figure, the eye is behind (lag) the target by 0.25 seconds, which is one-eighth of a complete cycle, or 45°.



(NOTE: This has been a historically confusing question in student lab reports. Why? Probably because of our culture's left-to-right interpretation of progression: at first glance at the figure below, you might be tempted to say that the eye is *ahead* of the target since its trace appears to the right, making it look like it is winning a footrace. To clear up the confusion, look at the points indicated by the arrows. Observe that the target crossed zero at 0.75 seconds while the eye didn't reach that same position until 1.0 seconds.)

Question 4:

Total feedback = -1 +/-A



$FB_T = -1 \pm A = FB_{INT} + FB_{EXT}$

$FB_{Ext} = \pm A$

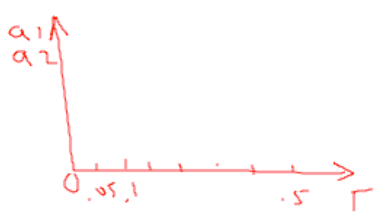
$FB_{INT} = -1$

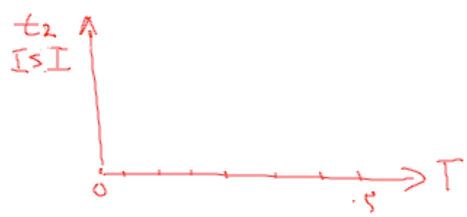
The effect of eye movement on vision gives a built-in feedback of -1 (that is, when we move our eye to the right, the target makes a leftward track across the retina). On top of this stabilization, we added a series of external feedbacks to this by using some fraction of the subject's eye movement to modify the position of the target, thereby acting as a destabilizing influence.

A good way to appreciate what is happening in this experiment is to sit down with pencil and paper (or write a simple program) and simulate the outcomes by taking an initial target position (e.g. 5°) and changing it by the amount of the scaled saccadic response. Then calculate the new difference (if there is one) between eye and target and again move the target by the scaled response. You should work out some special cases to confirm your results. If you are a math fan, you may also write out the input/output equations and derive the transfer function based on the figure above.

Question 5:

We want you to plot two graphs: a1 & a2 vs. T and t2 & ISI vs. T. These quantities are clearly defined in the lab procedures handout.





As you probably made note of during the prelab lecture, I specifically gave the answer to part of this question when I stated that the saccadic system is indeed a time-sampled system. Therefore you need to look at the data and see how it justifies this statement, i.e. that there are times when new visual input (e.g. change in target position) can lead to programming a saccade, and times when that new input will not be heeded.

Question 6:

We want you to evaluate the effectiveness of the VOR under different visual and non-visual conditions. Recall that we performed two groups of three tests. The first one of each group (simple math in the dark) gives you an idea of how the VOR functions when there is no visual or mental demand being made of it.

For the first group of three tests, the second test (light on wall at 0°) shows how well the VOR can function when trying to stabilize gaze while during rotation. Conversely, the third test (light that always stays directly in front of the subject) shows how well the VOR can be countered when trying to maintain a constant gaze position during rotation.

The corresponding trials in the second group (i.e. fifth and sixth VOR records) test these same two things again, but now without any visual input. Compare these two results for peak eye velocity (excluding saccades). Are they different? Did you expect them to be? If so, what is the neural/behavioral mechanism responsible for the difference? (It may help to compare each case to its visually aided version to keep straight in your mind what you'd expect to happen ideally.)