W. M. KECK OBSERVATORY

Next Generation Optical Detectors for Wavefront Sensing
Imager Clocks for the Phase 2 CCD Design[1]

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Another design consideration for the phase 2 CCD is the "error" that we can accept in the row-to-row shift rate when tracking the spot from a pulsed laser. Both the elongation and the apparent motion of a laser pulse are directly proportional to the distance of the subaperture from the center of projection. For a pulsed laser this means that if we don't match the rate at which the spot travels we will effectively re-introduce elongation. In addition, if we want to track multiple pulses then we don't want to smear the charge over more pixels than the spot image actually covers. This will happen if we track too fast or too slow.

The number of different clock rates that we need to provide depends on the amount of centroiding error that we are prepared to accept due to effective "re-elongation" of the spots. If we describe the centroiding error in terms of a percentage increase in the centroiding error, the number of clocks is simply the reciprocal of this error limit.

We can determine the clock number of any subaperture by taking the ratio between the distance of the subaperture to the center of LGS projection and the distance from the center of projection for the furthest subaperture. The clock number for a given subaperture is then:

$$C_D = \frac{D}{M} * \frac{1}{el}$$

where D = distance of the subaperture from the center of LGS projection
M = distance of the furthest subaperture from the center of LGS projection
el = error limit, %

We will have an integer number of clocks, and rounding the result up to the nearest integer forces the clock numbers to start at 1.

Using this approach we can determine the clock number for each subaperture. The result is depicted in figure 1 for one quadrant of a 60 x 60 pixel array. This figure is based on a 10% limit on the centroiding error increase and shows only the active subapertures in the device quadrant for a circular telescope aperture with a central obscuration corresponding to the current TMT primary design.

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			1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10
			2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10
		1	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10
1	2	2	2	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10
2	2	2	2	2	3	3	3	3	4	4	4	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10
2	2	2	2	3	3	3	3	4	4	4	5	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10
2	3	3	3	3	3	3	4	4	4	4	5	5	5	6	6	6	7	7	7	7	8	8	8	9	9	9	10	10	10
3	3	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	9	10	10	10
3	3	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6	7	7	7	8	8	8	9	9	9	10	10	10		
3	4	4	4	4	4	4	4	5	5	5	5	5	6	6	6	7	7	7	8	8	8	8	9	9	9	10	10	10		
4	4	4	4	4	4	4	5	5	5	5	5	6	6	6	7	7	7	7	8	8	8	9	9	9	9	10	10	10		
4	4	4	4	4	5	5	5	5	5	5	6	6	6	6	7	7	7	8	8	8	8	9	9	9	10	10	10			
4	5	5	5	5	5	5	5	5	5	6	6	6	6	7	7	7	7	8	8	8	9	9	9	9	10	10	10			
5	5	5	5	5	5	5	5	6	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	10	10	10				
5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10				
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6	6	6	6	6	6	6	6	6	7	7	7	7	7	8	8	8	8	9	9	9	9	10	10	10	10					
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9	10	10	10	10	10	10	10	10	10	10	10	10																		
10	10	10	10	10	10	10	10	10	10	10																				
10	10	10	10	10	10	10	10																							

Figure 1*: Clock Layout for 1 quadrant of a 60 x 60 subaperture device*