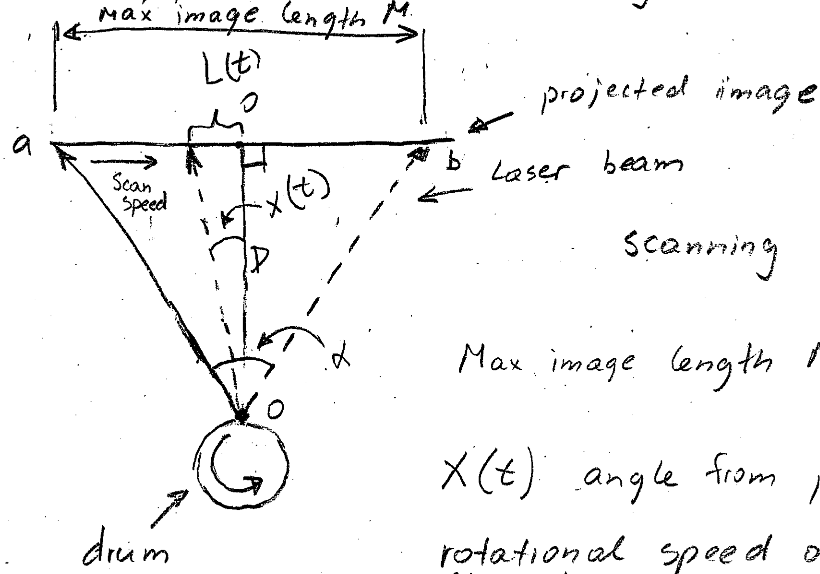
Max Laser modulation frequency expected — 11.20.12

This is attempt to determine how fast laser needs to pulse (worst case) with the given mirror drum dimensions and image's horizontal resolution:

Linear speed of the scanning laser beam on the projected surface!



scanning from b to a

Max image length $M = 2 \cdot D \tan\left(\frac{\alpha}{2}\right)$

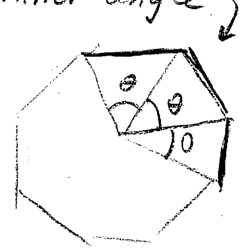
$X(t)$ angle from point O as function of time

rotational speed of the drum: R rad/sec (this determined by frames per second)

$$\tan(x(t)) = \frac{L(t)}{D}$$

$$L(t) = D \cdot \tan(x(t))$$

From eq 1: $\alpha = 2\theta$ $\quad\theta$ – mirror angle



$x(t) = 2\,\theta(t) \qquad R \cdot t = \theta(t)$

$x(t) = 2 \cdot R \cdot t$

$$L(t) = D \tan(2R \cdot t)$$

where R = angular speed of the drum, D = distance from projector to image

→ only $0 < 2Rt < \theta$

Linear Speed: $\frac{d}{dt} L(t)$:

Linear speed of scanning beam on the image is ↗	$\frac{4DR}{\cos(4Rt)+1}$

max happens when $t = \frac{\pi}{2R} \cdot n \quad n = 0, 1, 2 \ldots$

Max speed happens: $\frac{4DR}{\cos(\theta)+1}$

Assuming 25 frames /sec refresh rate, (i.e 25 revolutions per second) $\theta = \frac{360}{12} = 30$ (12 mirrors)

$R = 2\pi \cdot 25 = 50\pi$ rad/sec

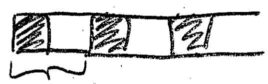
$D \frac{200\pi}{\cos(30) + 1}$ assume $D = 10$ m

$D \cdot 336.7 = 3367$ m/sec linear scan rate

At distanc D image length is

$L = 2 \cdot 10 \cdot \tan(30) = 11.5$ meters

Assume horizontal pixel length at this distance is: 0.01 m

Worst case laser pulse frequency happens when pixels light up every other one:  etc. during single scan (side to side).

$\frac{0.01 \cdot 2}{3367} = 5.94 \times 10^{-6}$ sec period $= 168$ kHz

If pixel size can be bigger $= 0.03$ m (3 cm)

Peak modulation frequency = 56 kHz

56 kHz is practical to achieve