

Optimization on smartphone based vehicle HUD display

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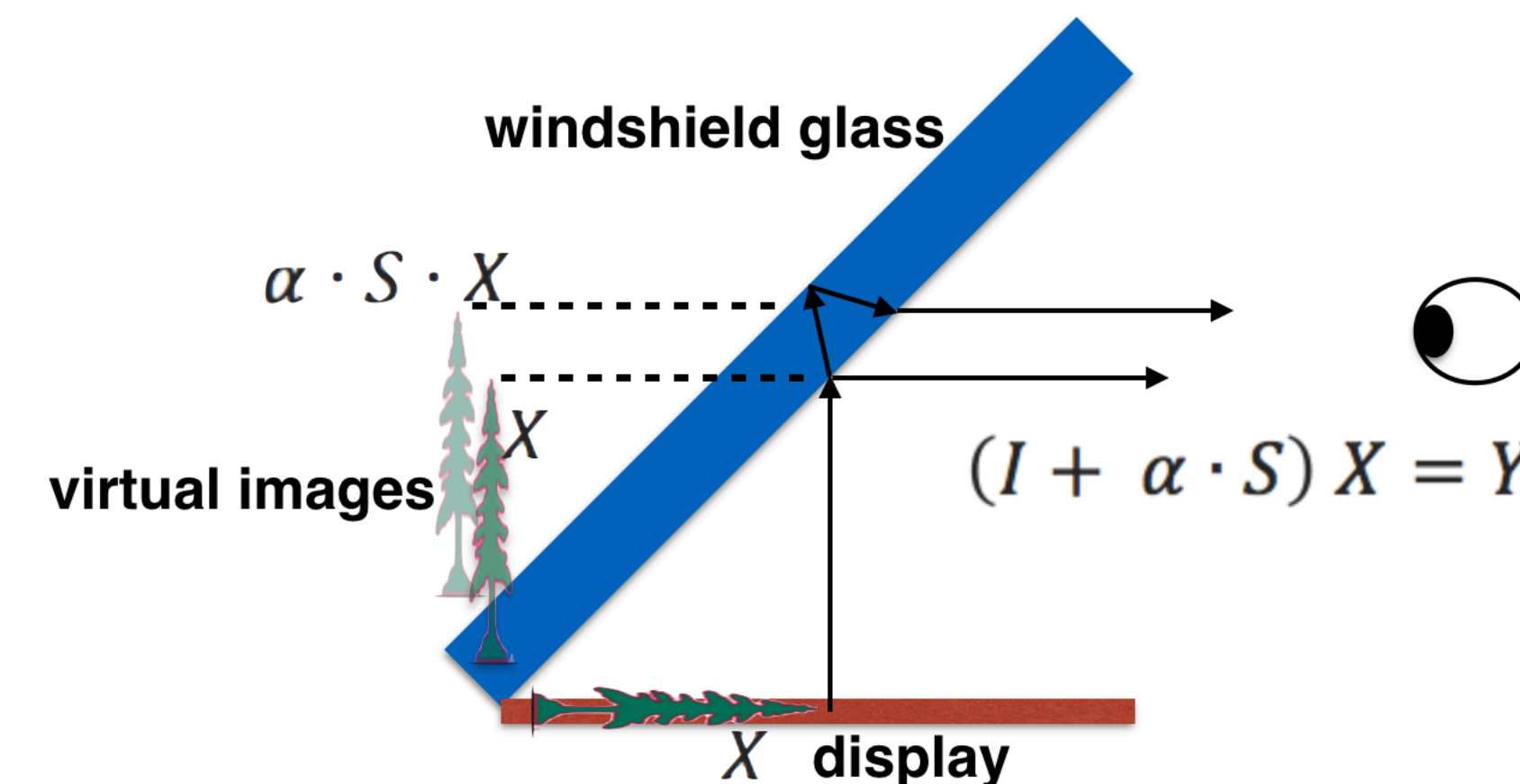
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Motivation

Head-up display (HUD) is available in many luxury vehicles. There are many companies that make cheap alternatives that projects images to the front shield window. But the image quality is so bad that there are two reflections overlaid together, which looks very blurry. So, computational imaging method is being used to pre-compensate the input image and make the output image more clear.

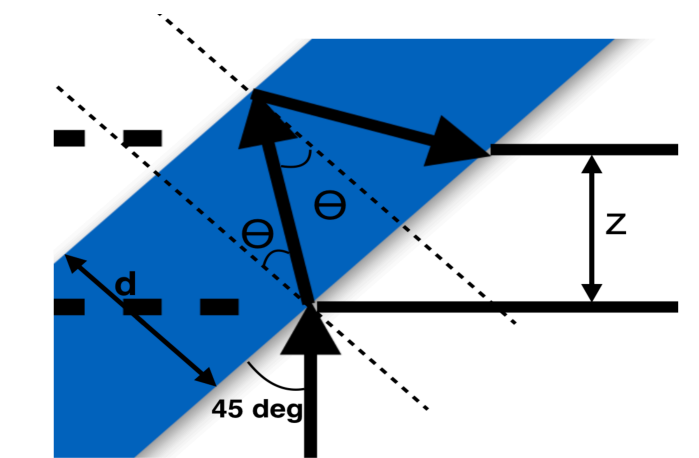


New Technique



- Set Y to be the image we want to display and calculate X with least square solver
- Add constraint on X that X should be non-negative

$$\min_x \frac{1}{2} \|(I + \alpha \cdot S) X - Y\|_2^2 \text{ with the constraint that } X \geq 0$$



$$1 \times \sin 45^\circ = n \cdot \sin \theta$$

$$z = \sqrt{2} d \tan \theta$$

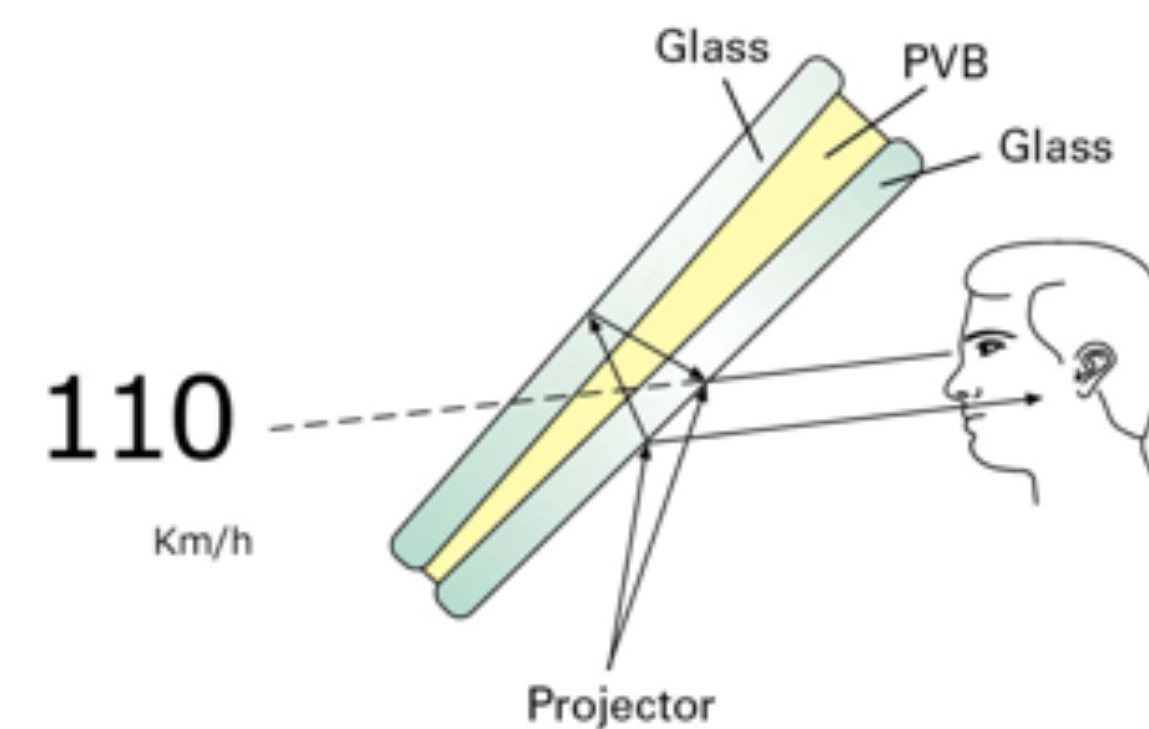
$$m = \frac{z}{\text{pixel size}}$$

$$S = \begin{bmatrix} 1 & 1 & \dots & 0 & 0 \\ 0 & 1 & \dots & 0 & 0 \\ \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & \dots & 1 & 1 \\ 0 & 0 & \dots & 0 & 1 \end{bmatrix}^m$$

Related Work



*Reflector solution by Garmin



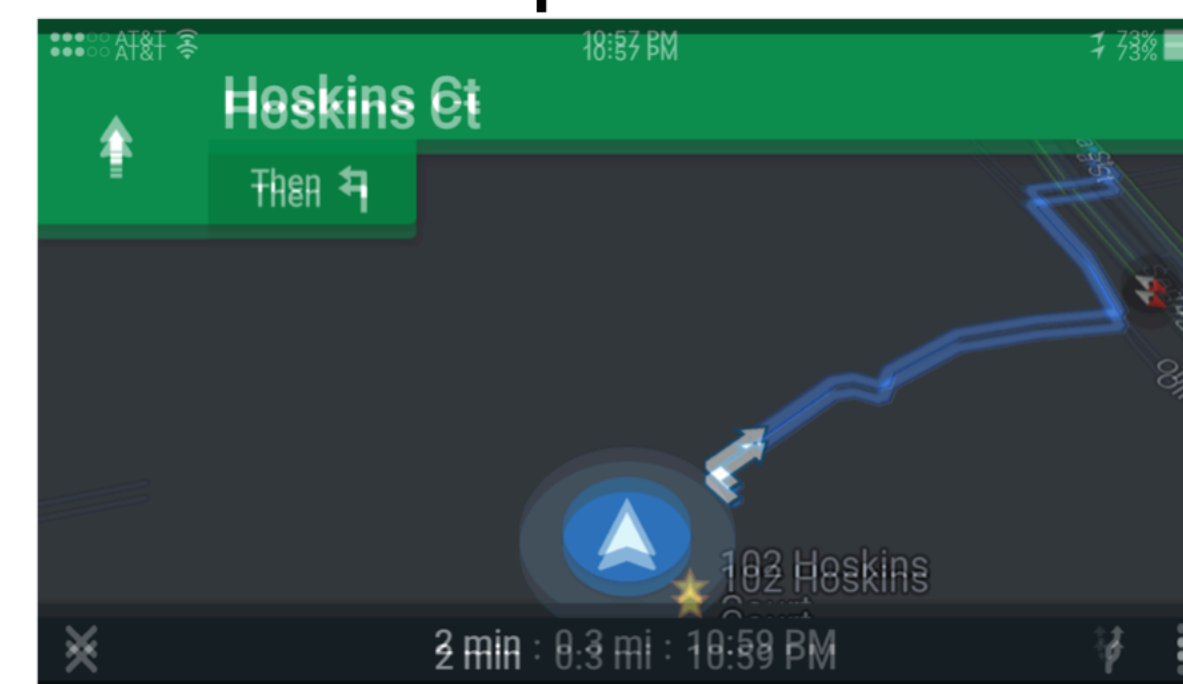
**PVB laminated glass solution

*<https://buy.garmin.com/en-US/US/on-the-road/discontinued/hud-head-up-display-/prod134348.html>

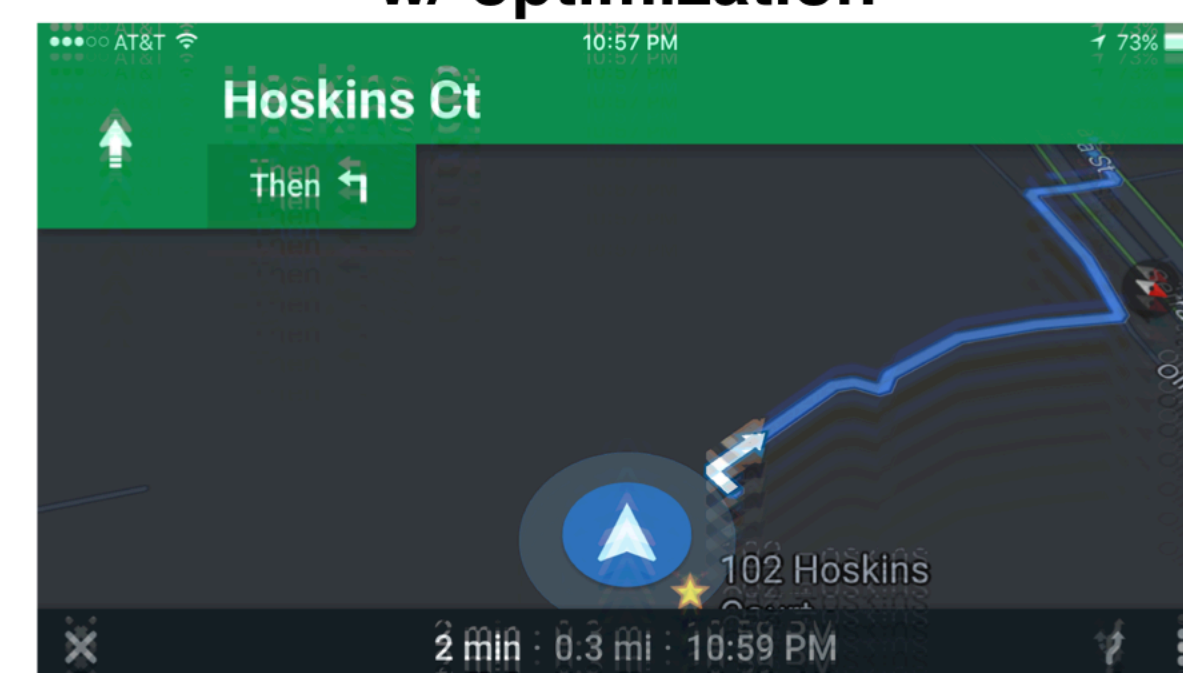
**Díaz, L. "Optical aberrations in Head-Up Displays." Universidad Pontificia Comillas Madrid (2005).

Experimental Results

w/o optimization



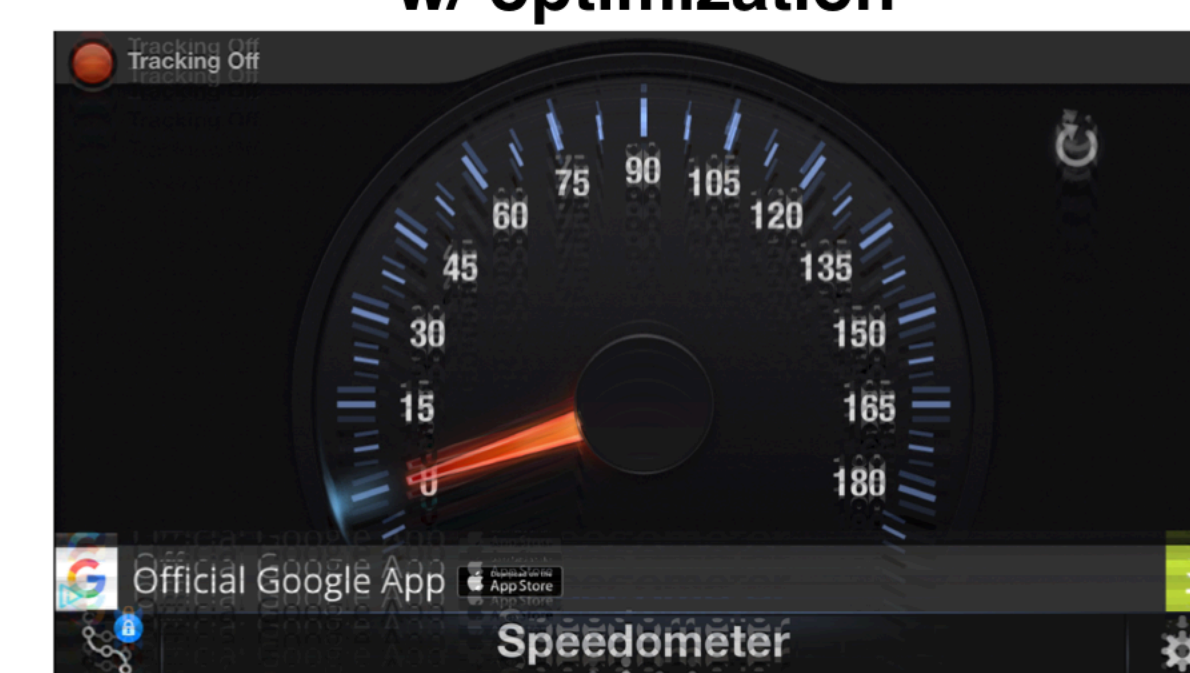
w/ optimization



w/o optimization



w/ optimization



w/o optimization



w/ optimization

