

Lane Model Validation

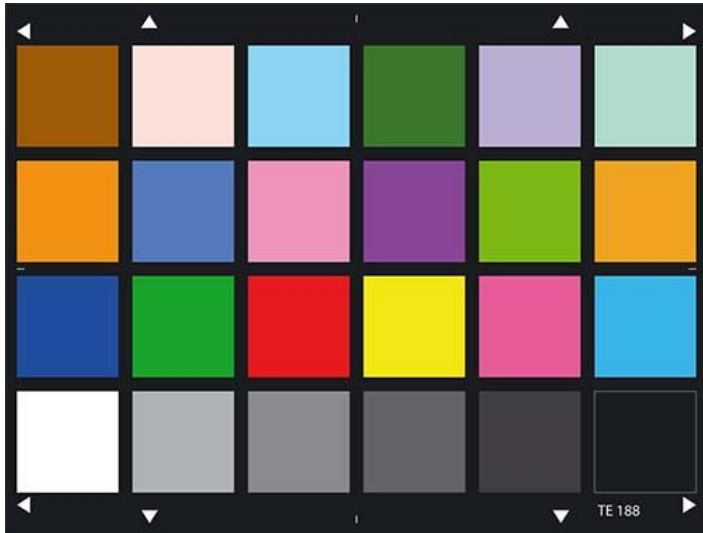
Barnaby Simkin 2021-07-07

Validation

- Camera model
- Sensor System
- ~~Vehicle System~~
- Integrated System

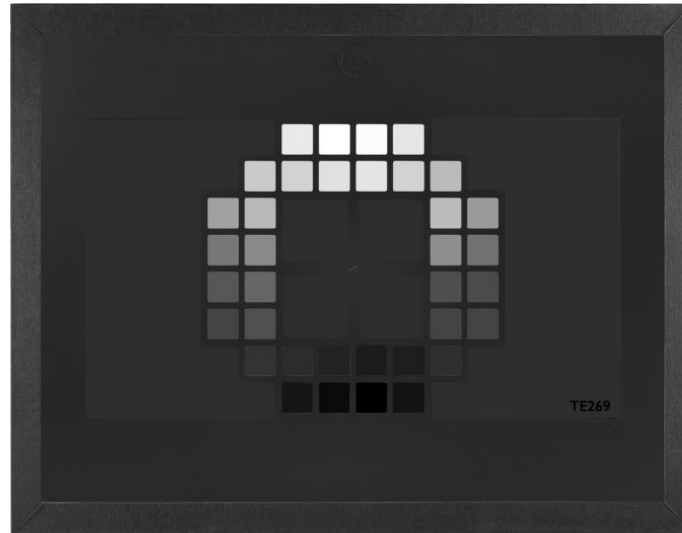
VALIDATION – CAMERA MODEL

Macbeth Color chart Test



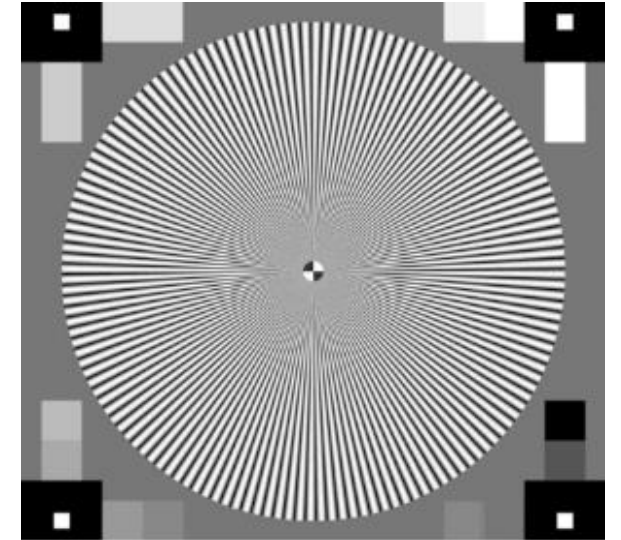
- To determine the camera color space of the camera
- To determine the parameters for camera noise modelling
- To learn about the **exposure characteristics**

OECF chart Tests



- Is designed for evaluating the **opto-electronic-conversion-function** of a camera.

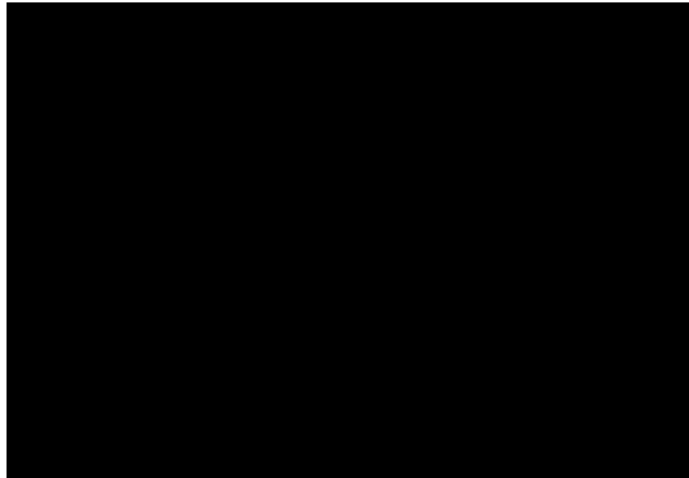
SFR Chart



- To measure **sharpness, contrast and lens effects**

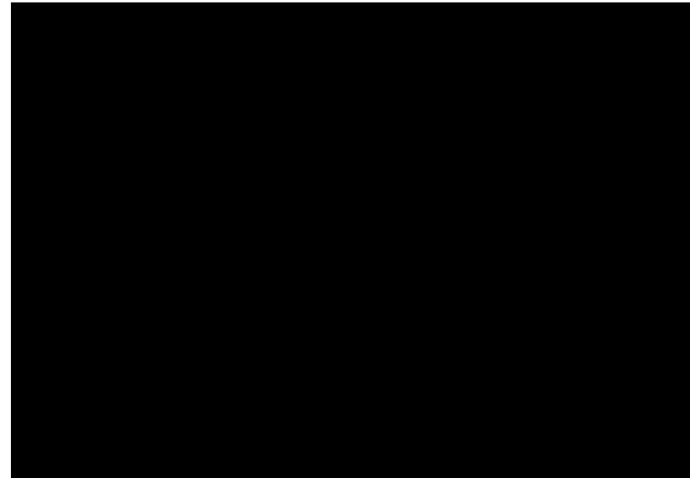
VALIDATION – CAMERA MODEL

Black



- to differentiate the static and the dynamic components (**dark shot noise**) a video has to be recoded

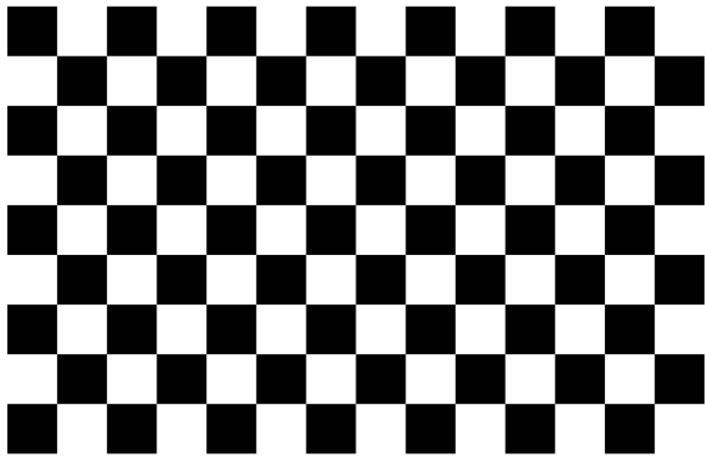
Lens Flare Characterization



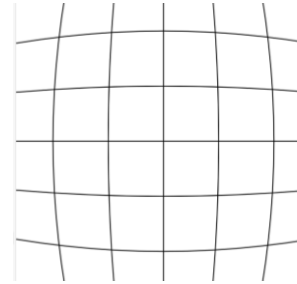
- To determine the lens characteristic for **lens flares** and **ghosting artifacts**

VALIDATION – CAMERA MODEL

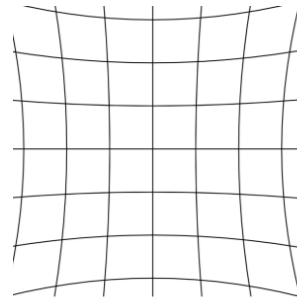
FTheta Calibration



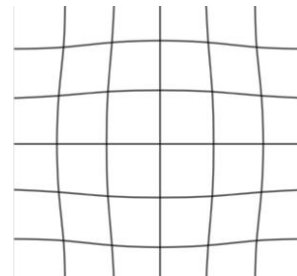
- At every position, tilt the checkerboard target both horizontally and vertically up to 45 degrees
- To determine the **ftheta polynomial** and to compare it with a more precise lens measurement



Barrel distortion, image magnification decreases with distance from the optical axis.



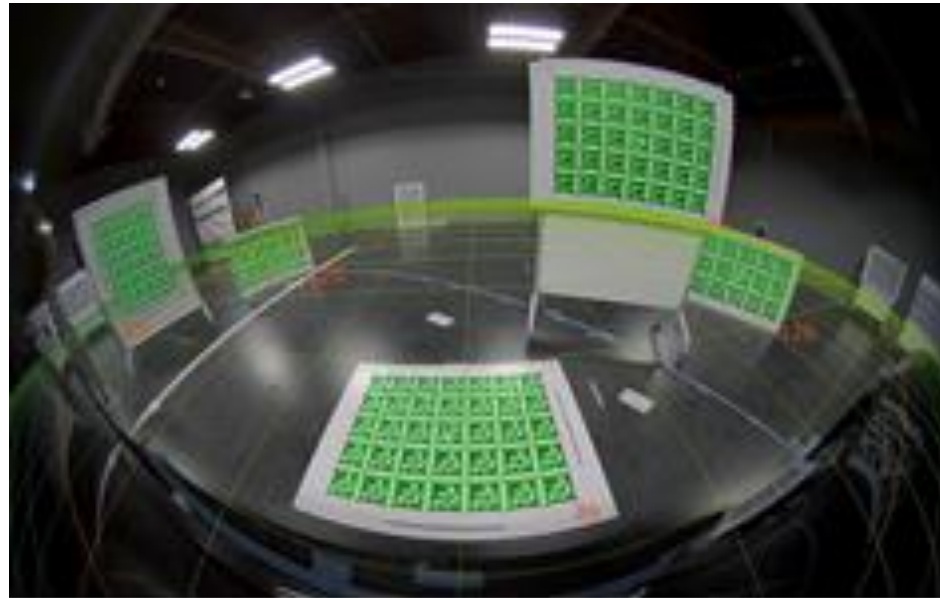
Pincushion distortion, image magnification increases with the distance from the optical axis.



Mustache distortion, sometimes referred to as mustache distortion (moustache distortion) or complex distortion

VALIDATION – CAMERA MODEL

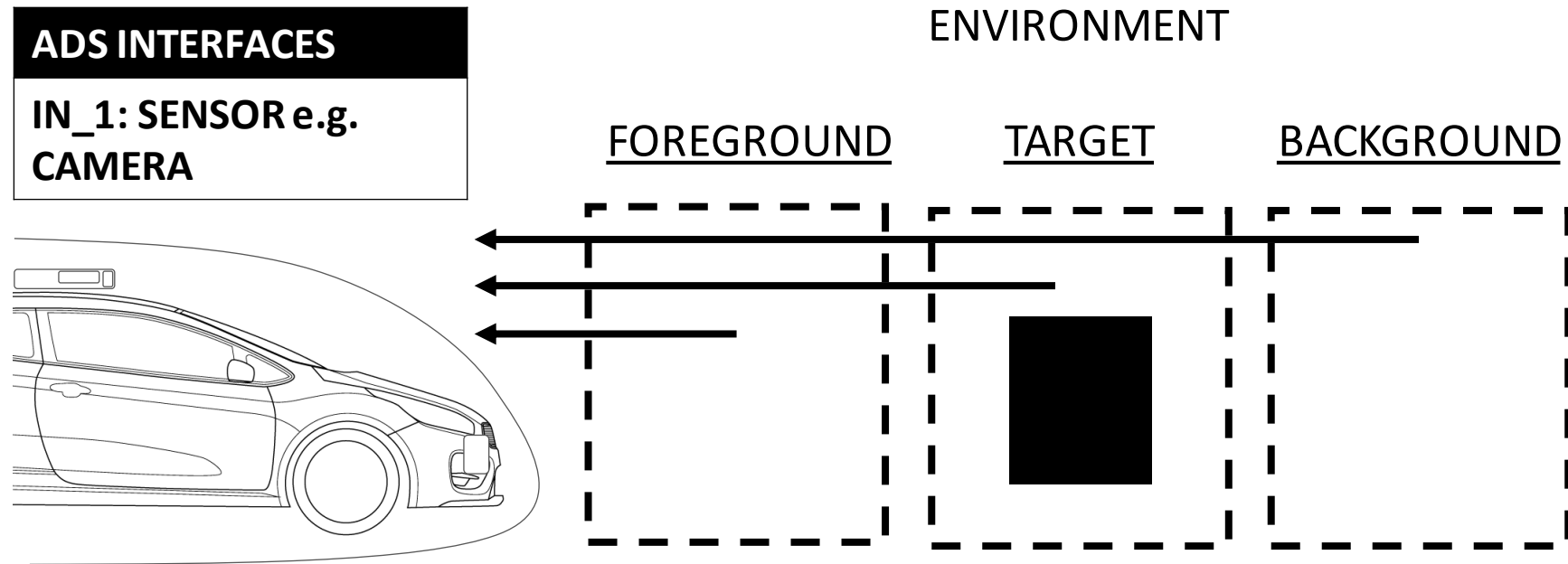
Lens Distortion



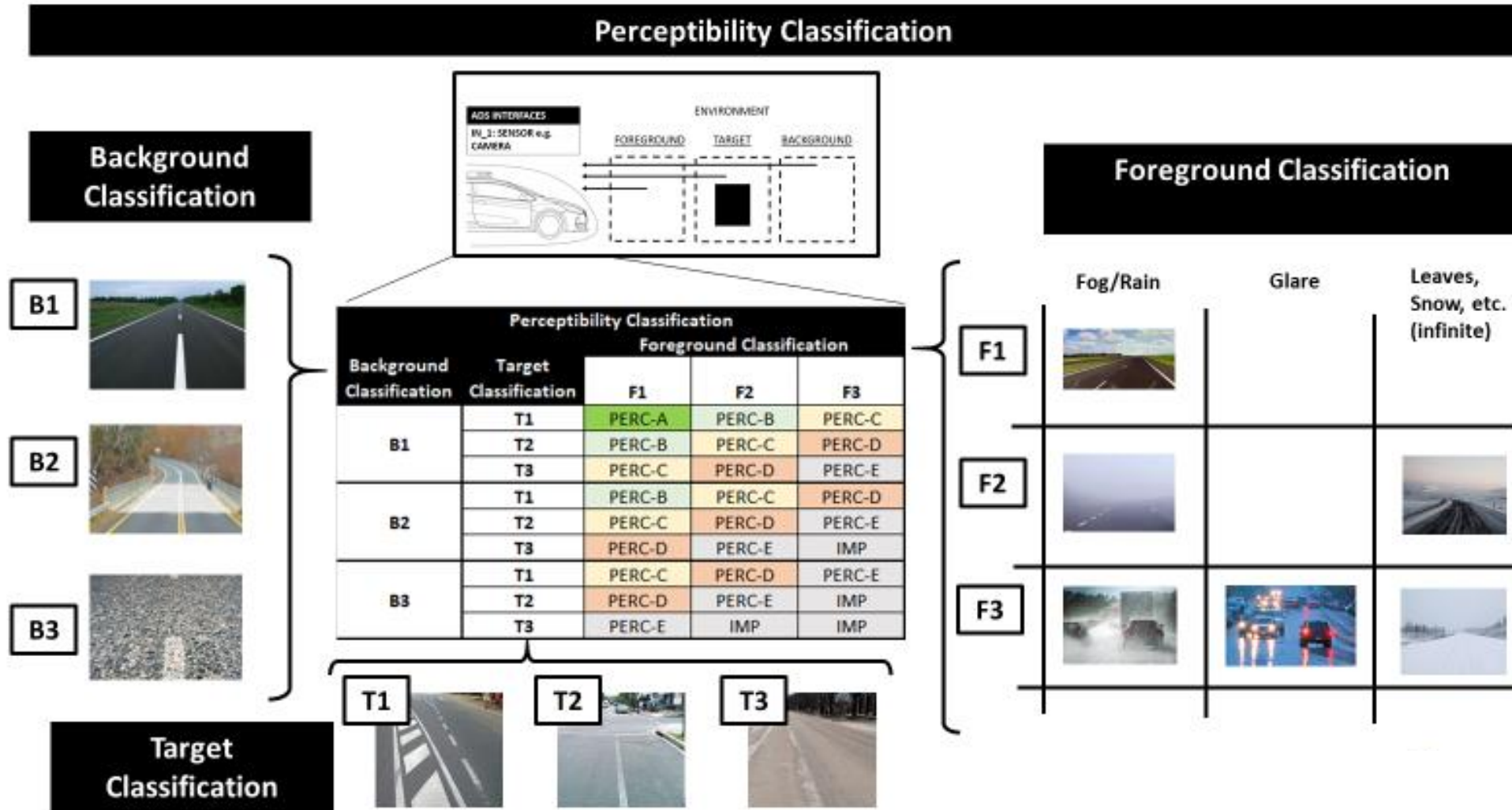
- Creating the multi camera calibration scene to check out **lens distortion** and camera positions

VALIDATION – SENSOR SYSTEM

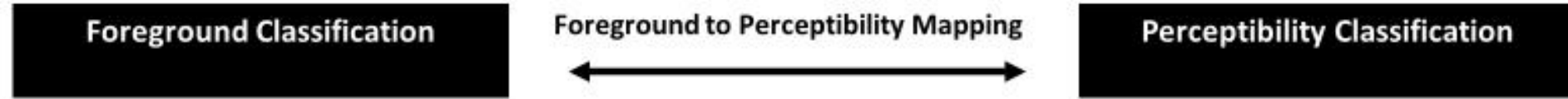
SENSOR-RELEVANT ODD DESCRIPTION



Validation – sensor system

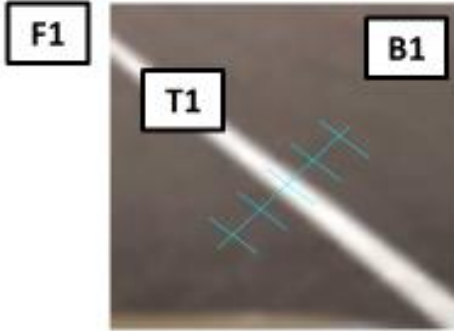


Validation – sensor system



Sample images generated by Mcity's Sensor-Level Augmented Reality

$$\text{Contrast value} = \text{Brightness Value Target} - \text{Brightness Value Background}$$

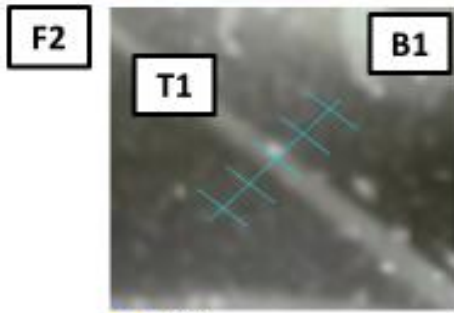


	1	2	3	4	5
1					
2					
3					
avg	87	86	242	92	93

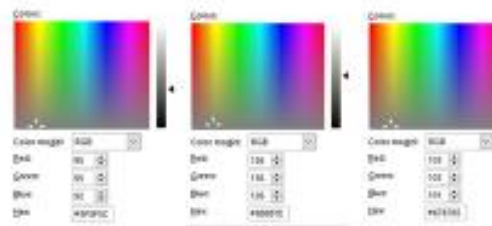


Contrast value: 152

PERC-A
Contrast Values ≥ 41



	1	2	3	4	5
1					
2					
3					
avg	94	95	133	103	104



Contrast value: 34

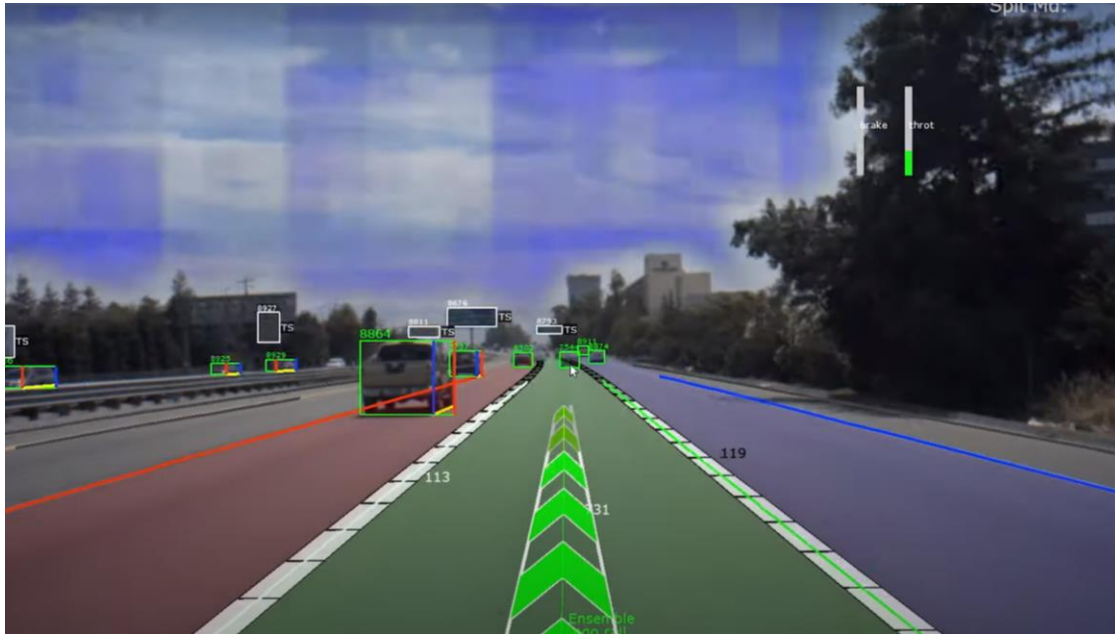
PERC-B
Contrast Values < 41 and ≥ 21

Many more metrics: contrast values, pixel rise distance (fuzzy/sharp), longitudinal std. dev., background std. dev., etc., etc.



With RGB images, results are calculated using brightness values. RGB pixels are converted to brightness values using the formula $V=(R+G+B)/3$, or $V=0.299R+0.587G+0.114B$ if "Weighted RGB Conversions" is checked in *Edit>Option>Conversions*. The default weighting factors are the ones used to convert to from RGB to YUV, the color encoding system used for analog television. The weighting factors can be changed using the `setRGBWeights` macro function.

Validation – Integrated system (ADS in the loop)



Correlation threshold tbd

- Correlation of lane detection performance on synchronized data.
- Exact threshold would determine if lane detection algos are used to support: LDW, LKAS or ADS.

ADS TESTING – LANE DETECTION VIA SIMULATION

