

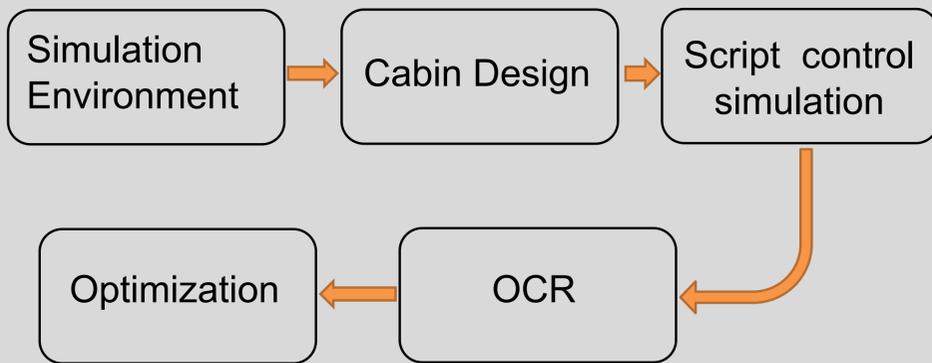
A simulation method for studying the layouts of occupant sensing cameras in fully automated vehicles

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Research Goal

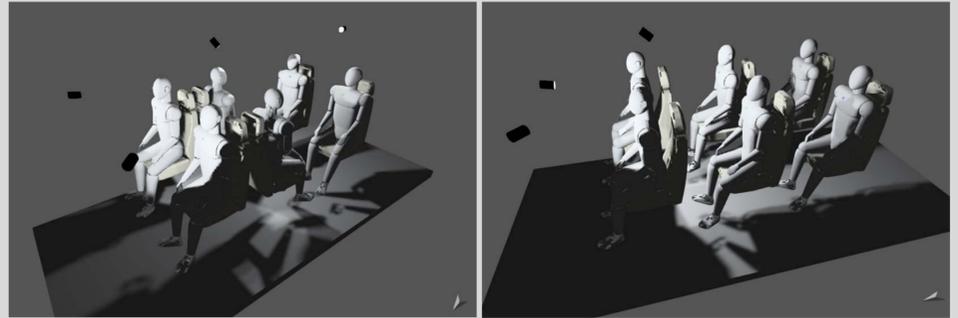
- Simulate camera coverage in highly configurable vehicle cabins for future automated driving era.
- Optimize camera layouts considering occupant body size variations.

Methodology



Simulation Results

- Optimization provides the best positions for the cameras from where they capture most body points
- The simulation results are obtained by constraining the number of cameras and distance between the cameras



Optimized position for 4 cameras (left) and 3 cameras (right) with distance constrain on specific layout

Anthropometric Data

- Occupant body size determined by using anthropometric dataset taken from 2012 ANSUR survey
- Body parts measured are Bi-deltoid breadth, buttock-knee length, knee height and sitting height
- Average of the measured body parts is the input data for simulation



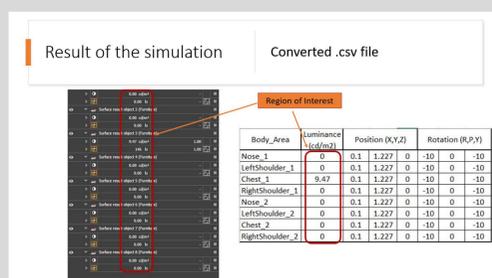
Cabin Design and Script



1. Car cabin is modelled in light simulation software DIALux
2. Cameras are represented by light sources
3. Occupants with desired body sizes are also modelled in the software
4. Total lumens at six body locations are collected for each occupant
5. Results are captured as images

OCR conversion

- The OCR python script reads the region of interest from the screenshot captured and converts the data to excel (.csv) file
- The script batch converts 1000+ images to .csv
- Results are used for future optimization

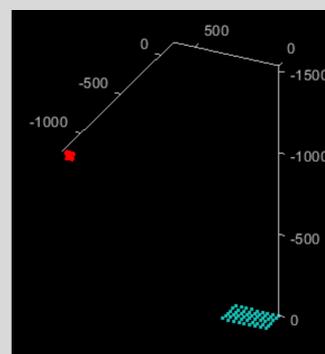


Confirmation of Simulation Results

One selected optimized position from 124 simulation results is shown below:

All values are in meters and degree					
X	0.6	Y	-1.2	Z	-1.5
Roll	-40	Pitch	0	Yaw	5

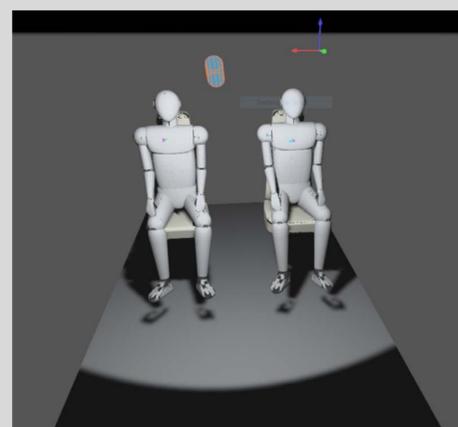
Camera location and angle determined using checkerboard setup



```

location1 =
  1.0e+03 *
  0.6029  -1.2095  -1.5119

angle1 =
  -40.6050  1.0261  5.2666
  
```



The illuminated region in DIALux and the camera coverage match very well.

Future Plan

- Changing occupant sizes from 50% average to extreme values (95% male, 5% female)
- Adding booster seat in DIALux for kids(4 to 7 years old)
- Implementing more optimization constraints