Optimization and Modeling

Project Members: LAW Heung Cheung (05689588)
                 TSANG Ching (05604162)
                 CHAN King Him (05690874)

Supervisor: Prof. Vladimir G. Chigrinov
Objective

Liquid Crystal Display (LCD) is a very famous technology in the world and dominates the market in this recent years.

Therefore, our FYP group is aimed to improve the overall performance especially the Response Time of LCD. Besides, we fully utilize the properties of LCD - Controllable Viewing Angle to optimize the function of conventional LCD.

Project Overview

This project is mainly divided into two parts. First part is to continue with the latest FYP group working on optimizing the response time of conventional LCD models. The second part is to optimize two new functions of LCD by controlling its viewing angle.

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Liquid Crystal Display (LCD)
Methodology

In the LCD optimization, we have simulated all the results with MOUSE-LCD (Version 2.6.1). This software is used to optimize the properties of LCD and handle the complicated calculations.

After setting all the optical parameters, it will calculate and simulate the results in form of tables, charts or color distributions.

Results of Part I - Fast Response

Improved Results of the Six Conventional LCD Cells

<table>
<thead>
<tr>
<th></th>
<th>TN</th>
<th>STN</th>
<th>π-cell</th>
<th>ECB</th>
<th>VAN</th>
<th>HAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau_{total}$ (ms)</td>
<td>2.833</td>
<td>28.938</td>
<td>7.129</td>
<td>2.475</td>
<td>1.639</td>
<td>7.121</td>
</tr>
<tr>
<td>Transmittance</td>
<td>0.355</td>
<td>0.3922</td>
<td>0.3636</td>
<td>0.4078</td>
<td>0.3674</td>
<td>0.3942</td>
</tr>
<tr>
<td>Contrast</td>
<td>207.53</td>
<td>236.82</td>
<td>102.1</td>
<td>430.88</td>
<td>325.4</td>
<td>409.11</td>
</tr>
</tbody>
</table>

- Thickness, viscosity, backflow effect are important factors that affecting response time
- ECB is the best for LCD TV application
Results of Part II - Controllable Viewing Angle

i) Switching Viewing Angle LCD Compose of HAN and VAN

High image quality in all directions in wide viewing angle mode diminished a limited viewing angle in the horizontal direction in narrow viewing angle mode, such that the clearest image is protected within 20° and the visible image is limited within 30° of the polar angle in the horizontal direction.

![Angle Dependence of the Contrast Ratio for Optimized Han-Van LCD](image-url)

Actually, the results demonstrated the outstanding effect of viewing angle switching of the proposed device.

ii) Bi-viewing angle LCD Base on Multi Domain

In order to optimize the bi-viewing angle LCD with software MOUSE-LCD, we should maximize the visible area only in the left/right side along the normal incidence of left/right pixels group.

![Simulated Angular Dependence for Left Pixels Group and Right Pixel Group](image-url)