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Scientific Development
Branch

Colour analysis and verification of CCTV images under different lighting conditions

Rebecca Smith
University of Westminster
HOSDB (2006-2007)



Overview

- Introduction
- Lighting
- Camera
- Compression
- Display
- Conclusions

Introduction

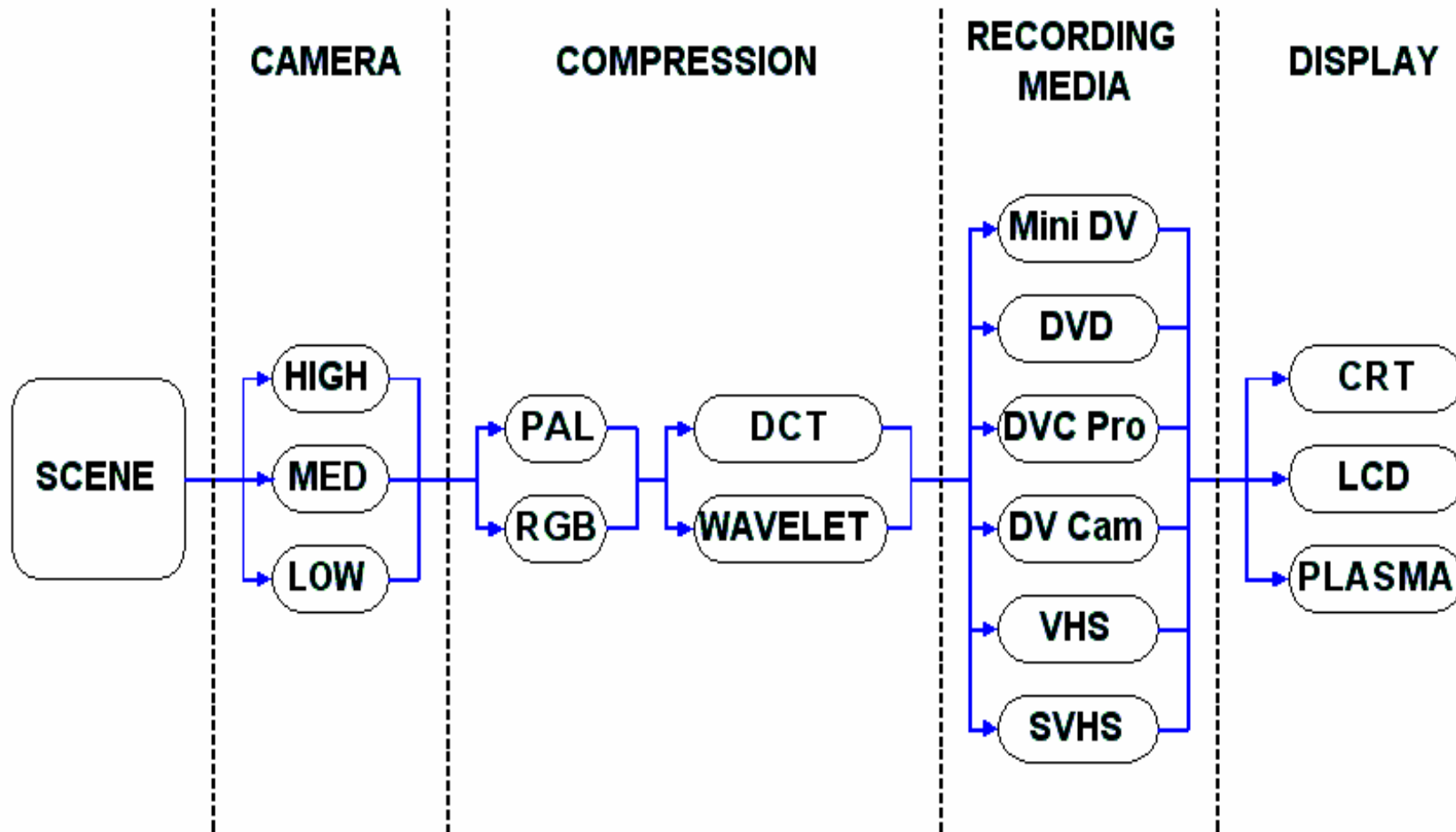


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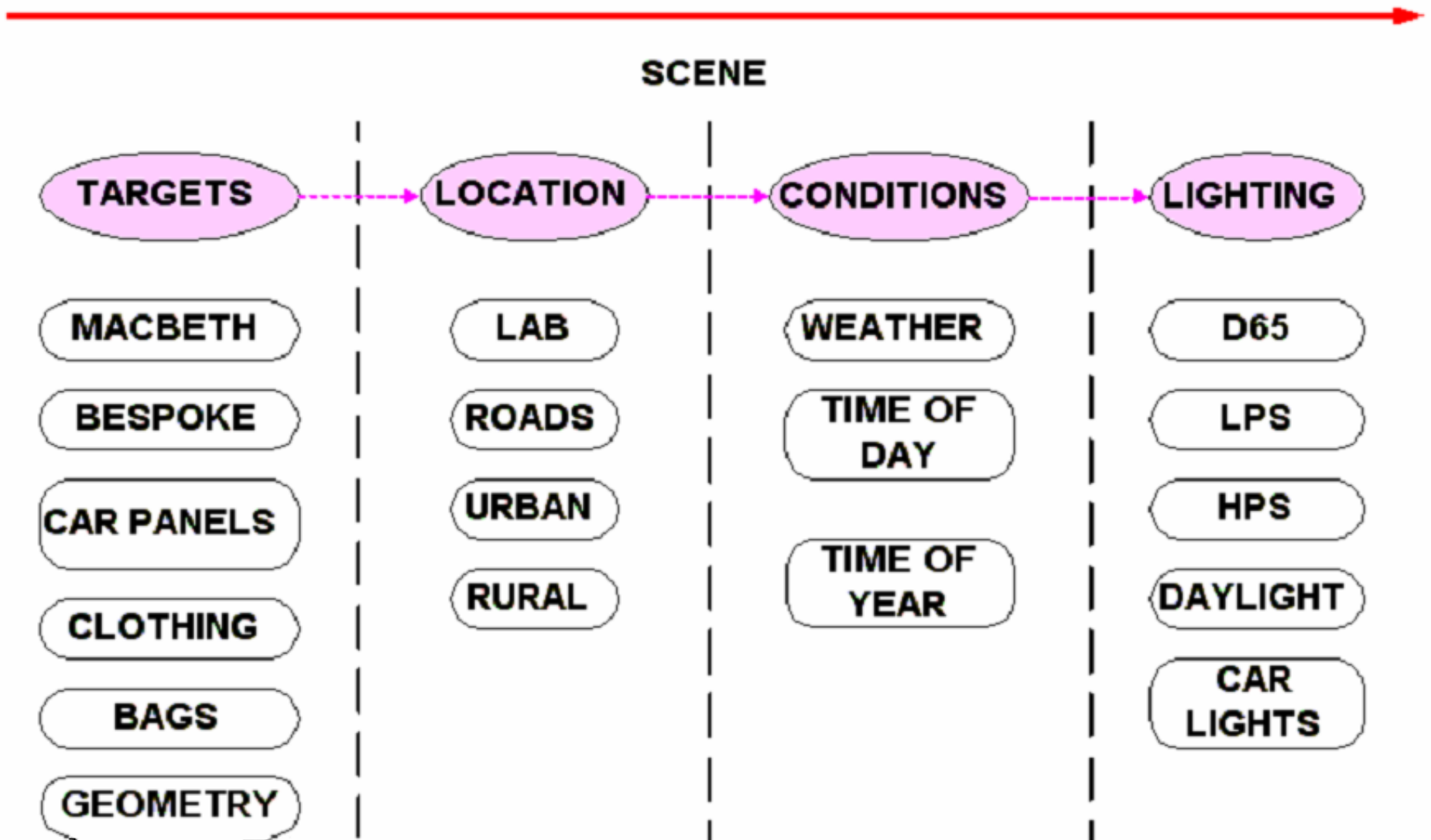
CCTV Imaging Chain

IMAGING
CHAIN



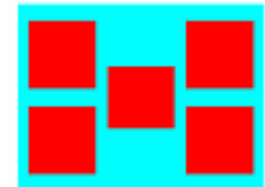
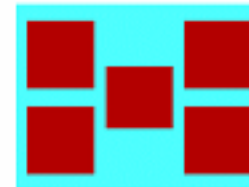
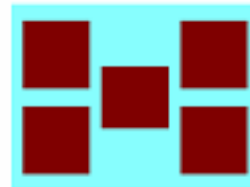
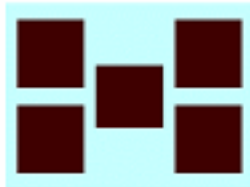
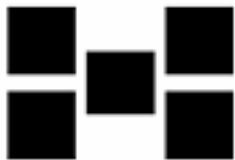
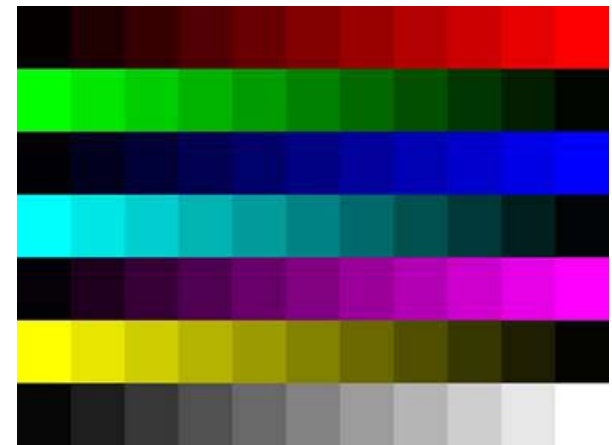
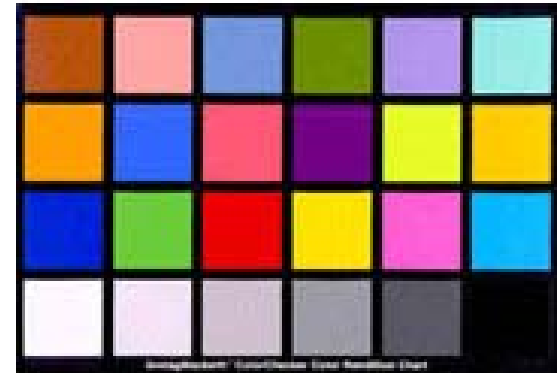
Scene

IMAGING
CHAIN



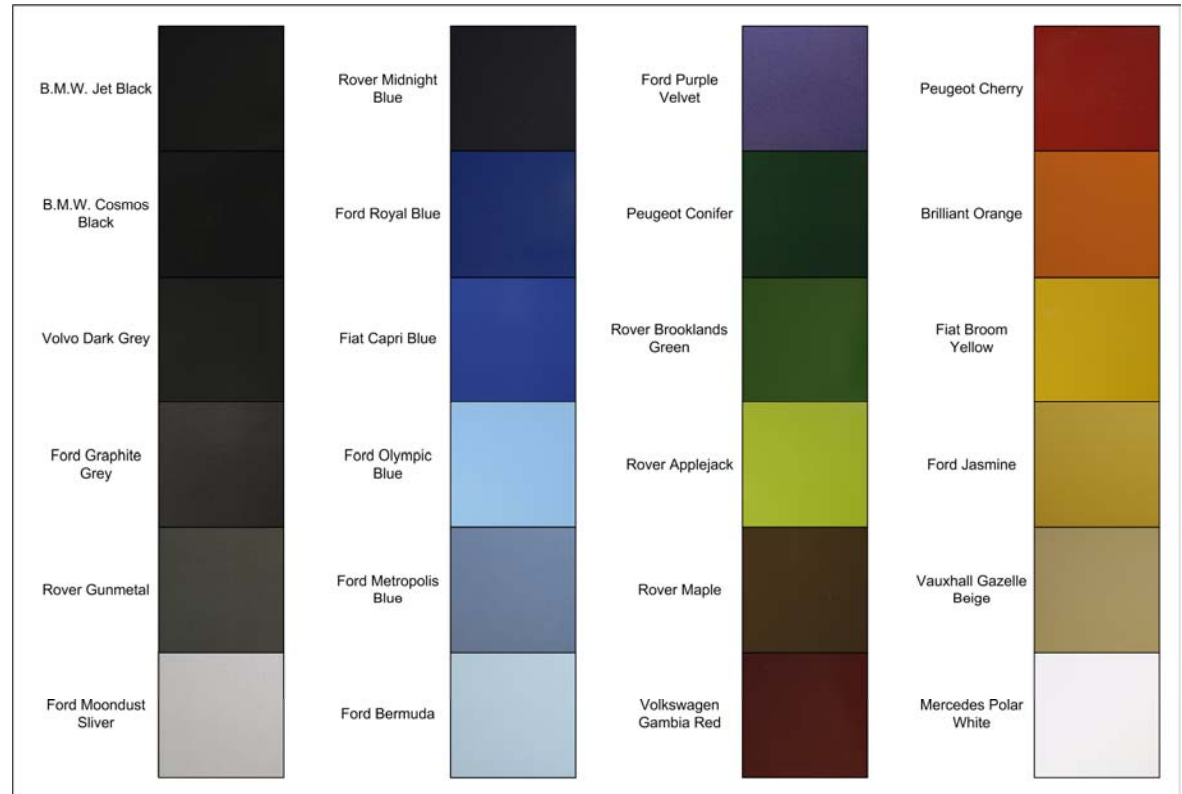
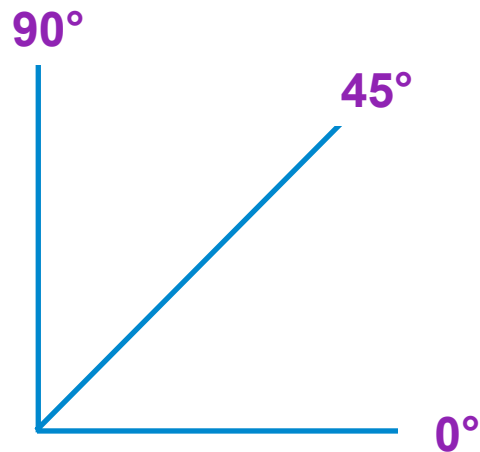
Targets

- Macbeth Colour Checker Chart
- Test Target 1
- Test Target 2



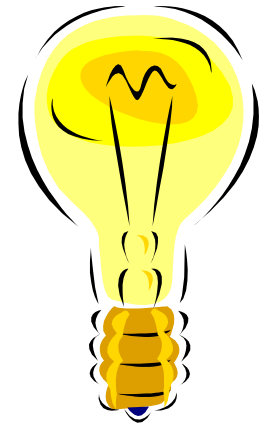
Targets

- Geometry
- Car Panels

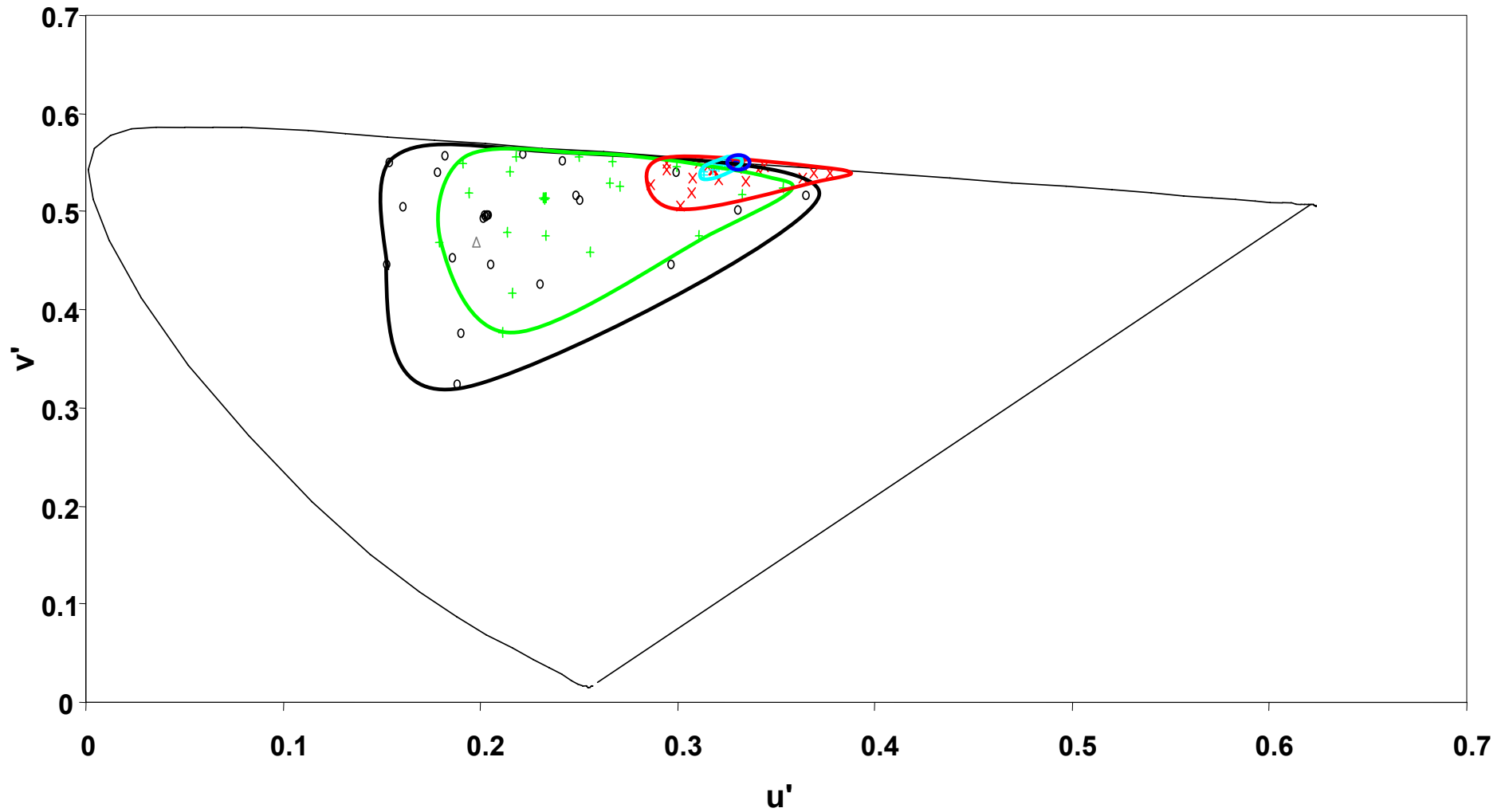


Lighting

- Laboratory based
 - D65
 - Low-pressure sodium
 - Pure bench source
 - Street Lamp
 - High-pressure sodium
 - Fluorescent
- Car Headlights
 - Standard
 - Super Brilliance
 - Laser Blue
- Street Lighting
 - Low-pressure sodium
 - High-pressure sodium

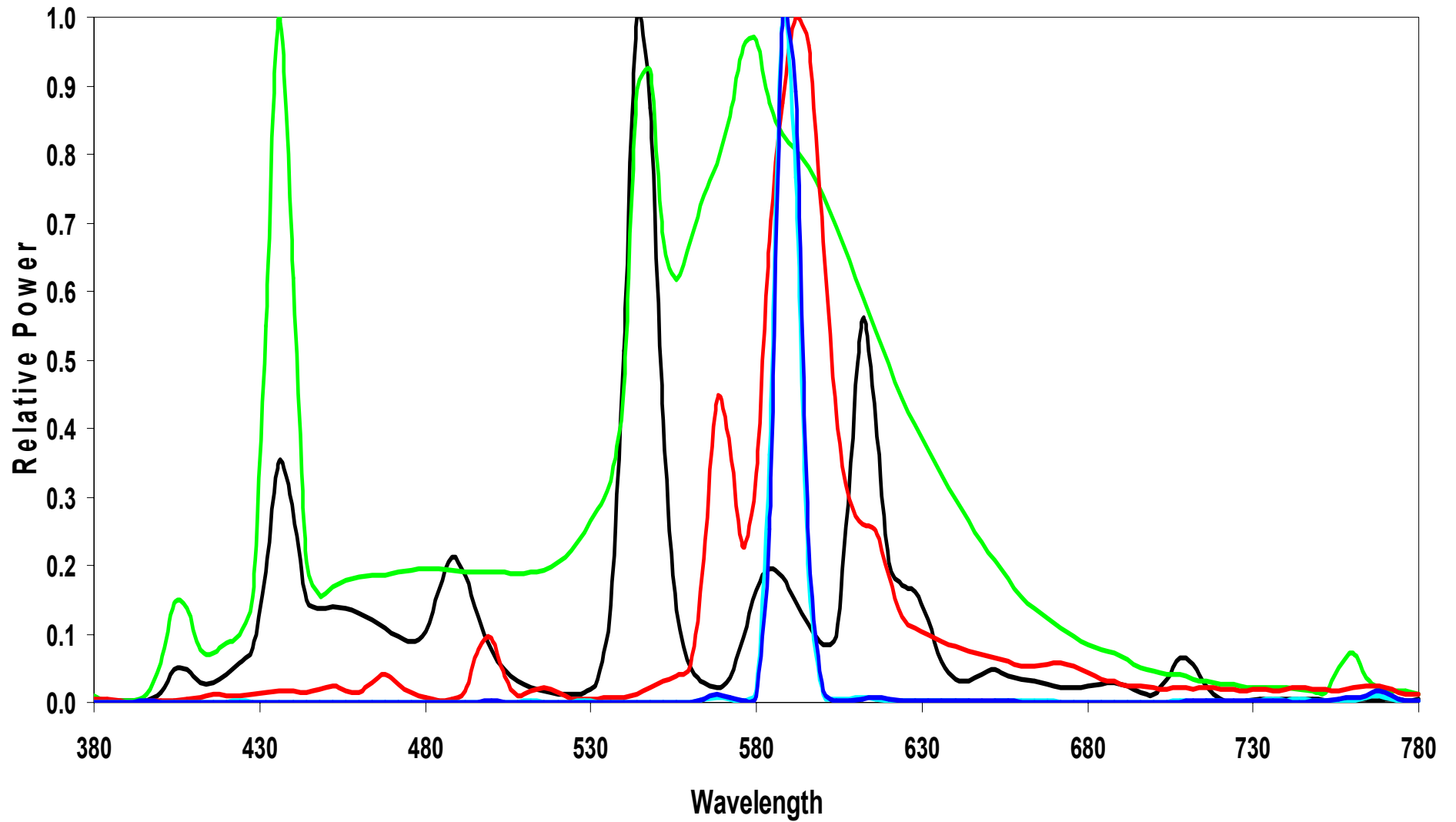


Macbeth Colour Checker Chart under all laboratory lighting conditions



○ D65 △ D65 WP + F × HPS + LPS - Street × LPS - Pure — Locus

Spectral responses of the white patch of Macbeth Chart



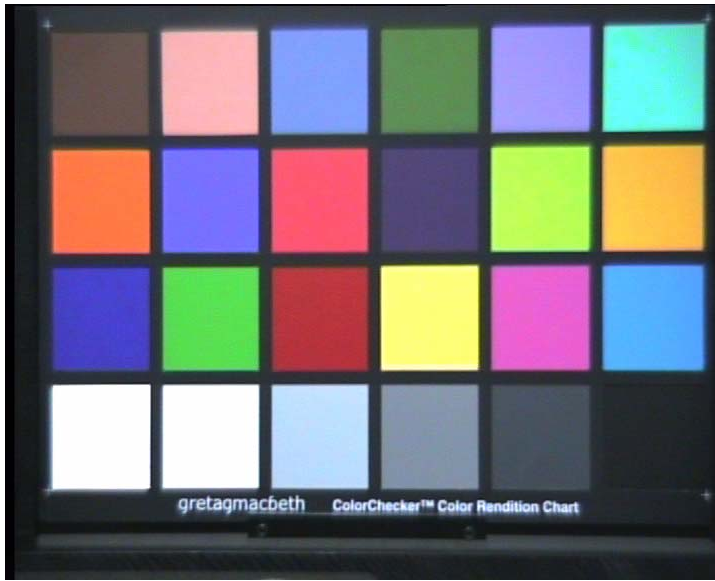
— D65 — F — HPS — LPS - Street — LPS - Pure

Camera

- Four different Colour CCTV cameras
 - Range in price and image quality
- Macbeth Colour Checker Chart
- Recorded on DV CAM
- Stills taken from footage
- Measurements of Target
- Analysis

Camera

Camera
1



Camera
2



Camera
3

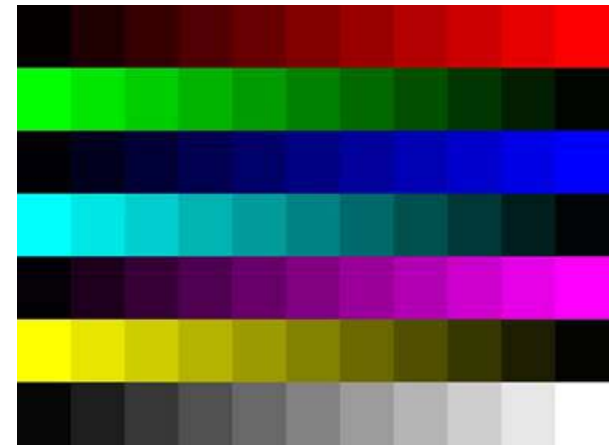


Camera
4



Compression

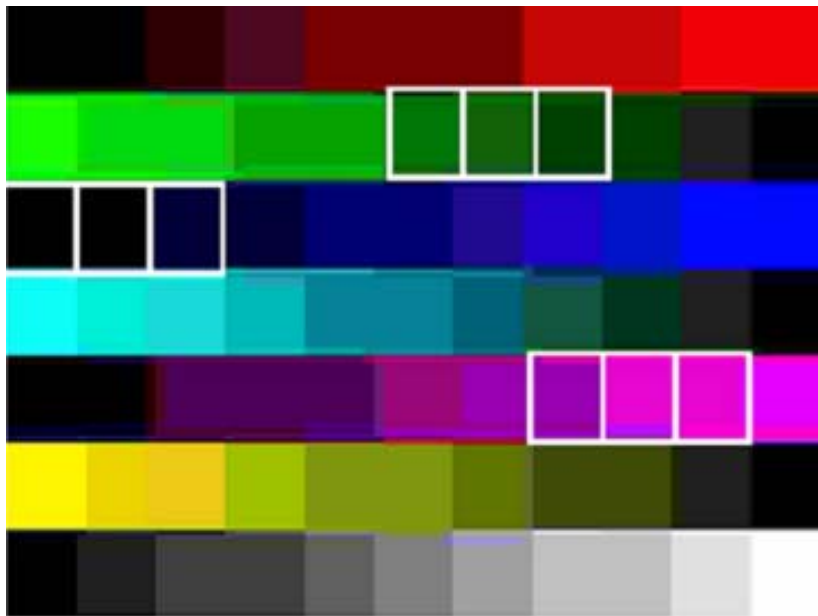
- Test Target 1
- DCT – JPEG
 - Matlab JPEG
- Wavelet – JPEG2000
 - Photoshop plug-in
 - Compressed then converted to bitmap
- Compressed at 5 quality levels
 - Maximum, High, Medium, Low and Minimum
- Analysis in Matlab



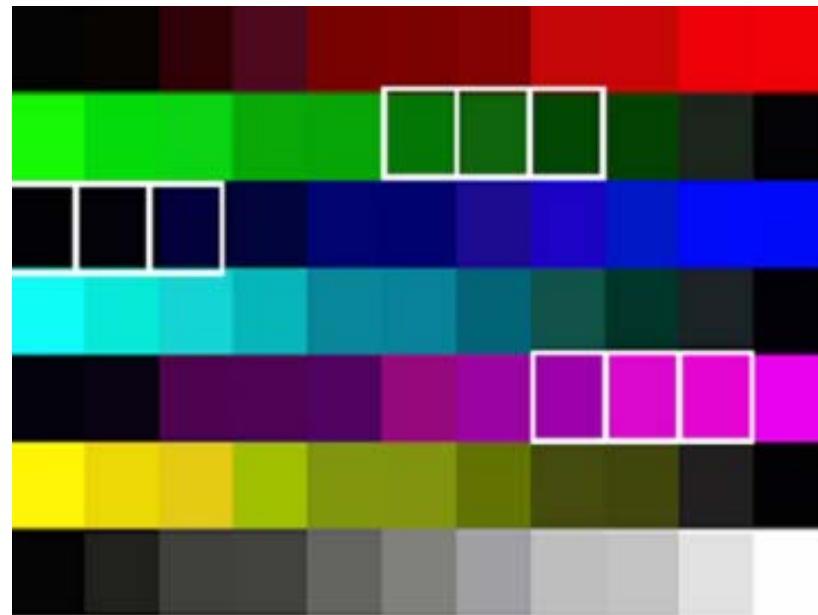
Original Image



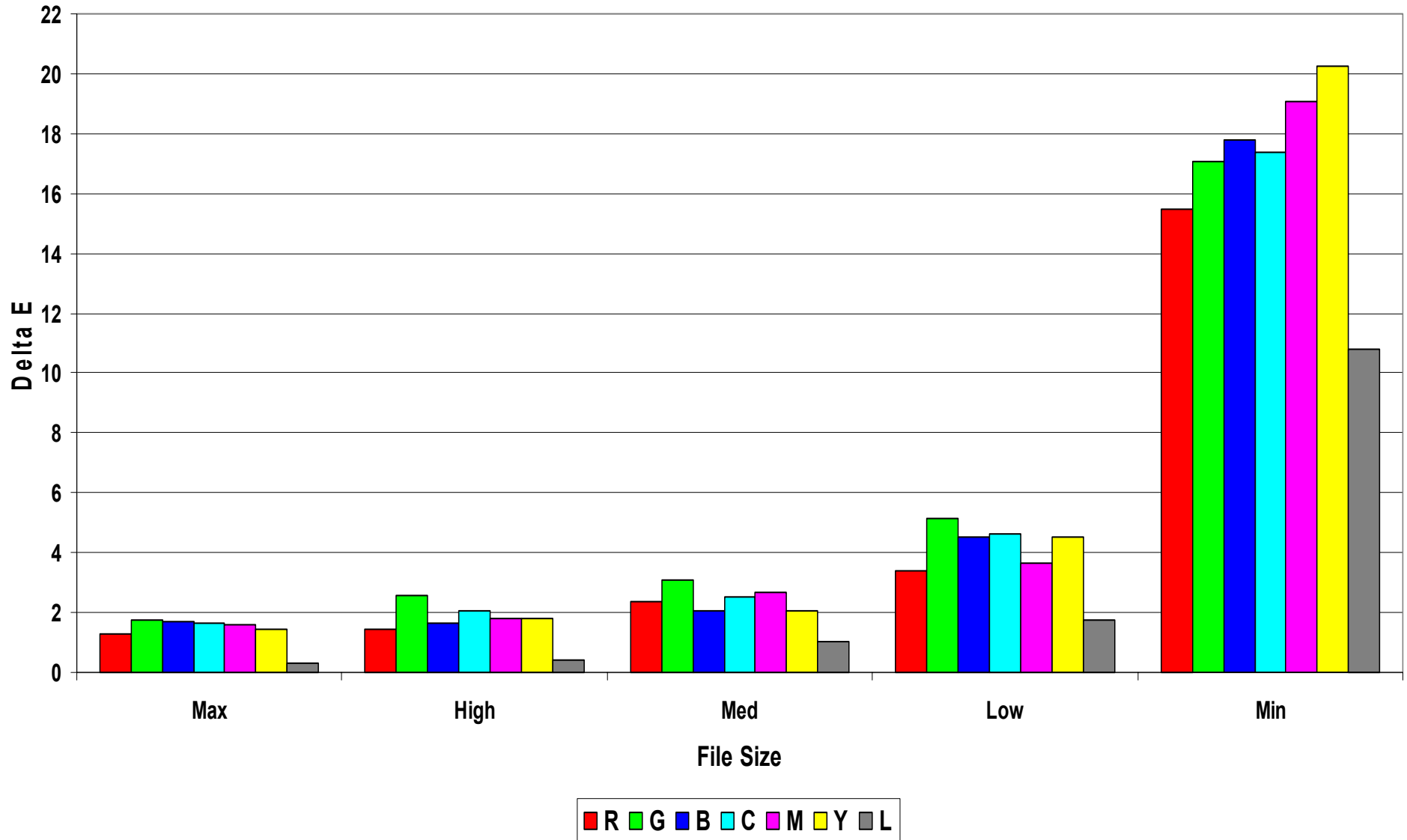
Compressed Image



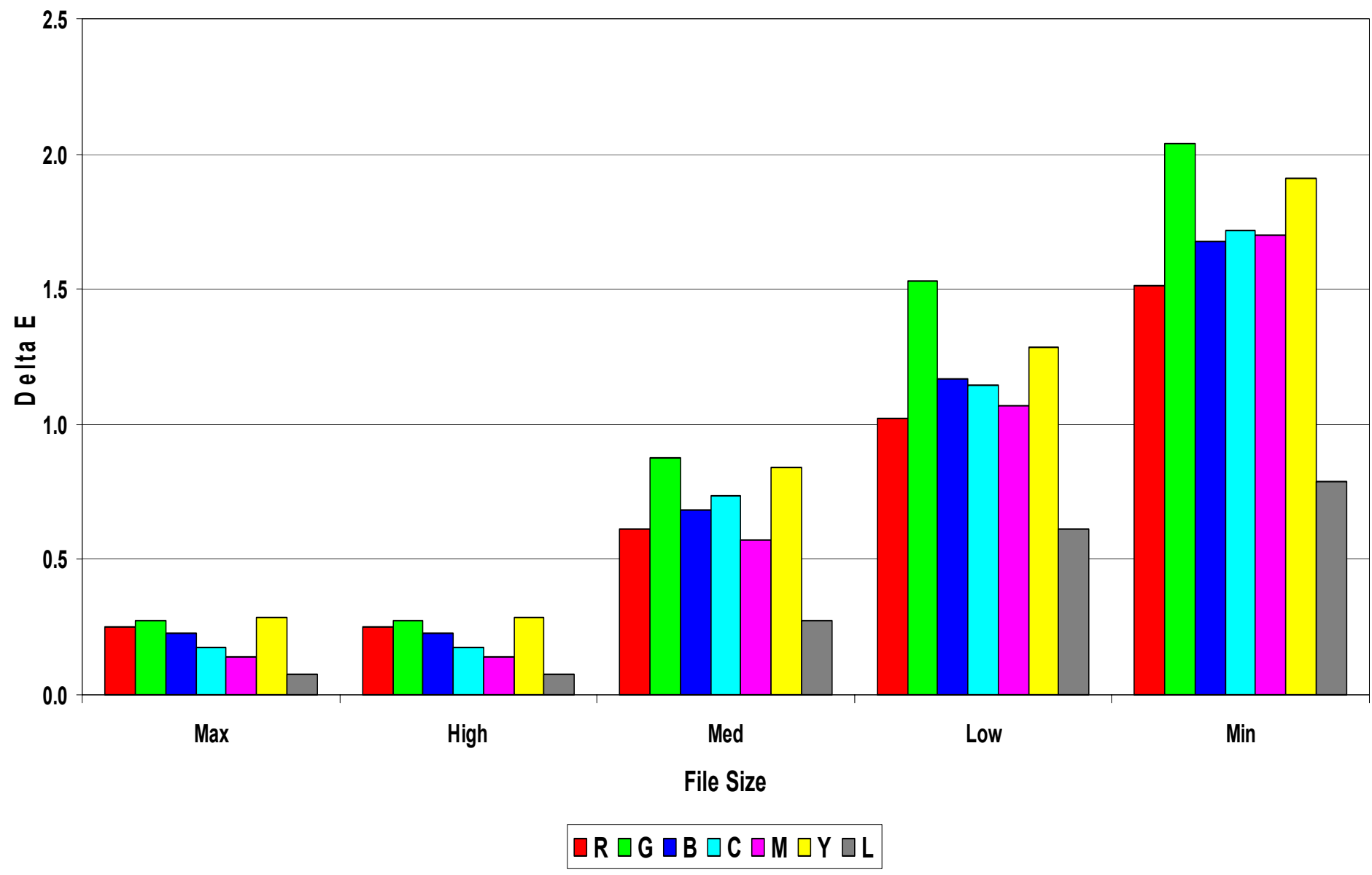
Average Compressed Image



Average of the ΔE for each colour row for JPEG compression

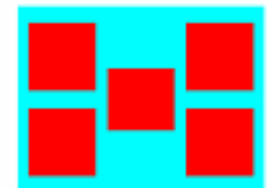
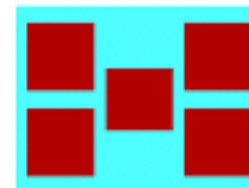
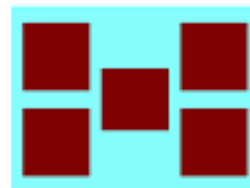
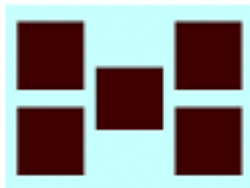
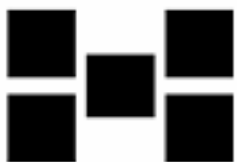


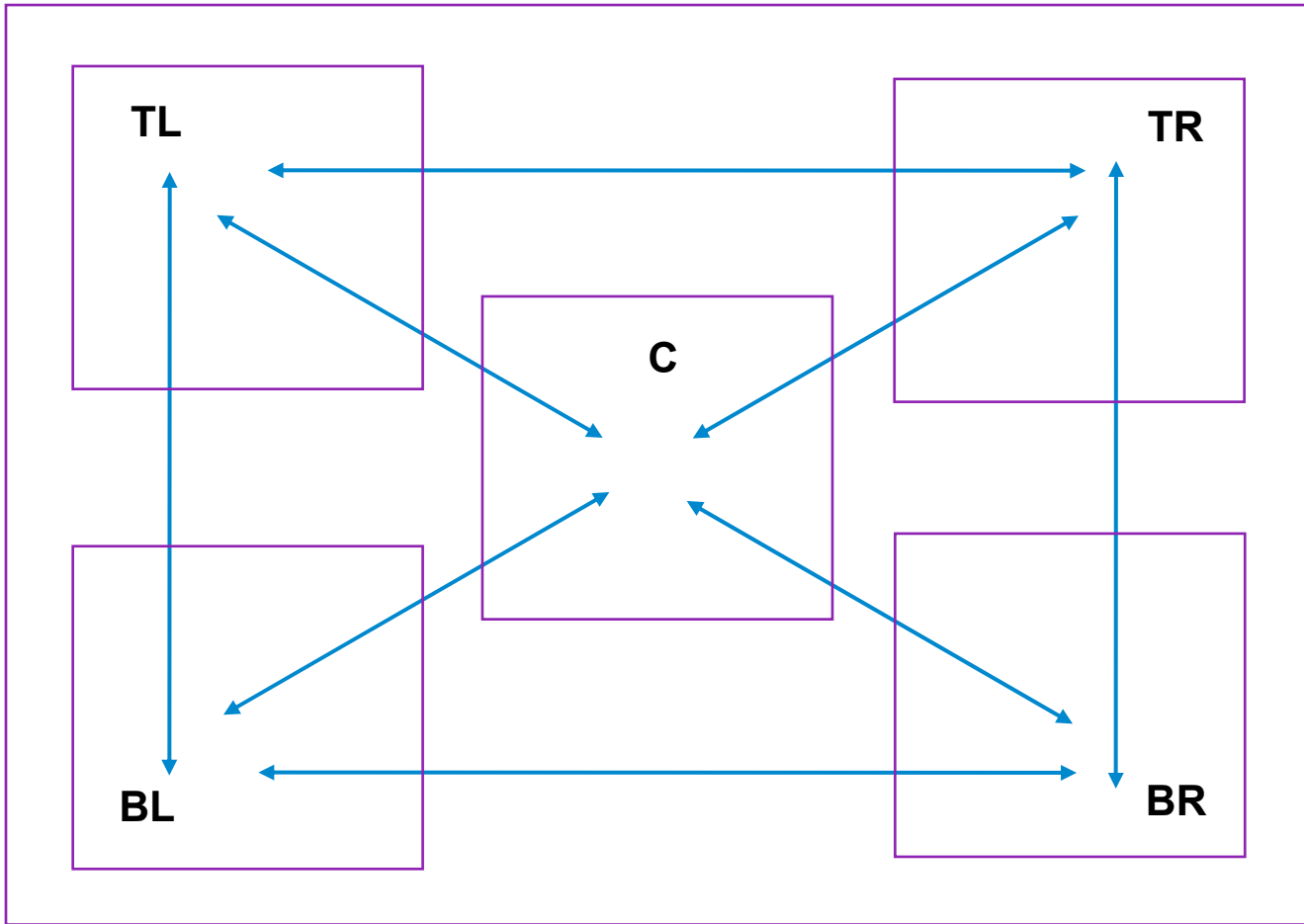
Average of the ΔE for each colour row for JPEG2000 compression



Display

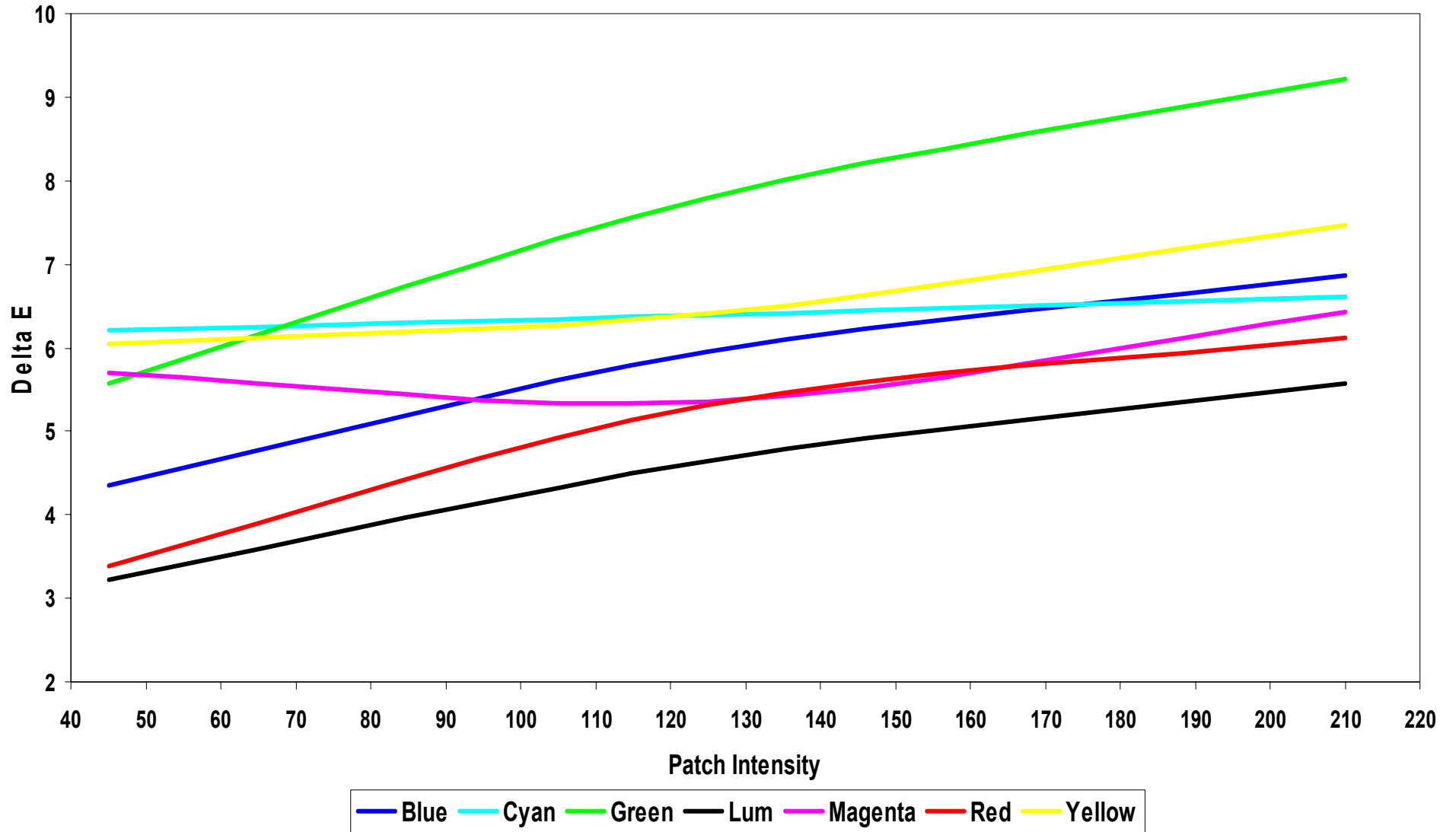
- Two displays
 - LCD
 - CRT
- Test Target 2
- CRT
 - Measurements taken using the spectrophotometer
- LCD
 - Measurements taken using the spectroradiometer
- Analysis of data in excel
 - Delta E
 - Response curve



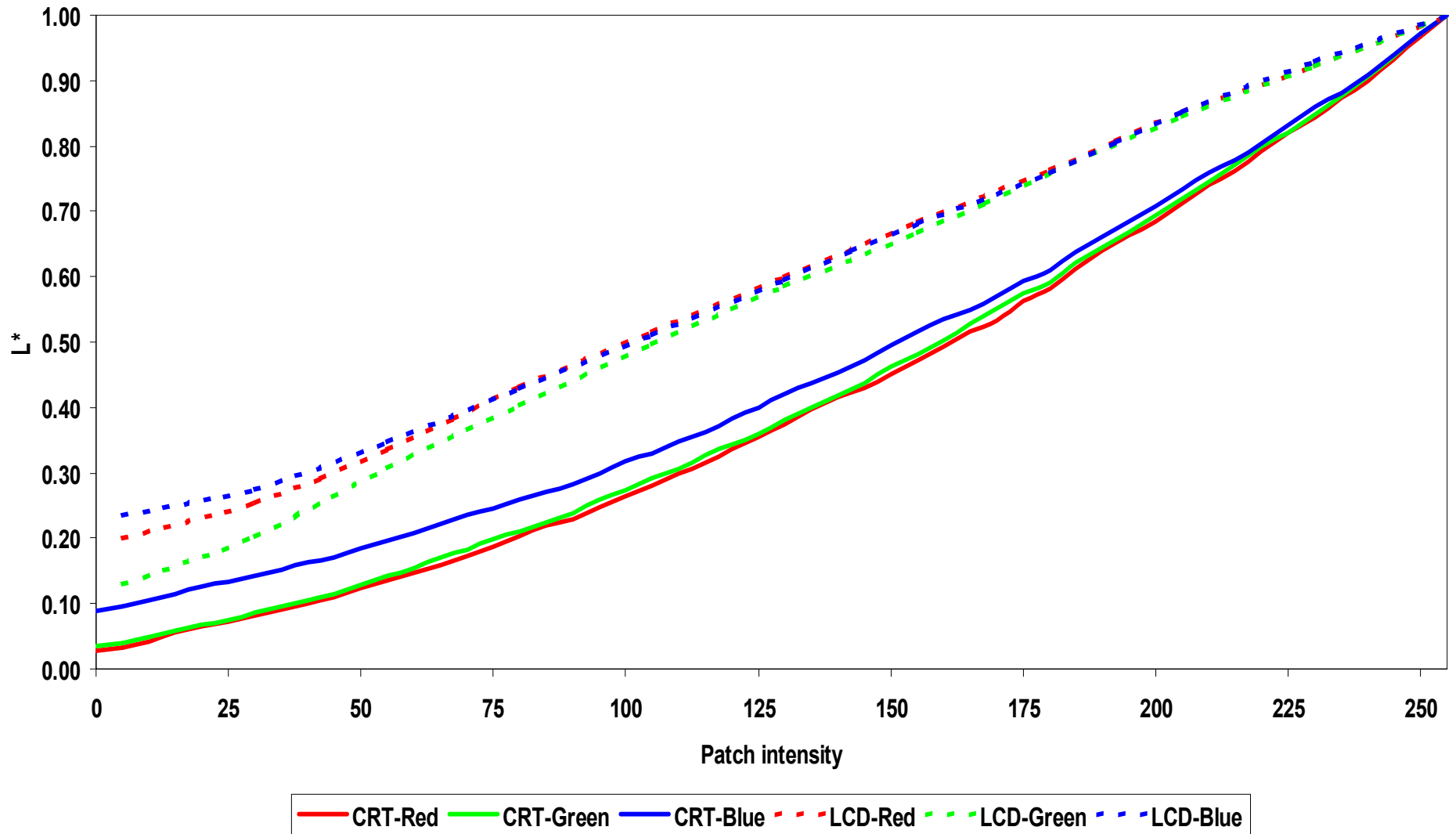


TL – Top Left, TR – Top Right
C – Centre
BL – Bottom Left, BR – Bottom Right

Comparison between the spectrophotometer and spectroradiometer



Response curves for both CRT and LCD Displays



Findings

- Lighting the scene
 - Importance of good and type of lighting in the original scene
- Capturing the scene
 - Good camera able to capture colour under different types of lighting
- Displaying the scene
 - Correctly calibrated display and good reproduction of colour
- Compression
 - At low levels is largely unaffected and is very scene dependant
- Storage
 - Majority of CCTV recorded digitally

Conclusions



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- With thanks to:
 - Neil Cohen, Video Evidence Analysis Manager, HOSDB
 - John Tighe, HOSDB
 - Ken MacLennan-Brown, HOSDB
 - Sophie Triantaphillidou, University of Westminster
 - Lindsay McDonald, London College of Communication

Any Questions?