AVIATION VISION SERVICES

The Colour Assessment and Diagnosis (CAD) test and how it works

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Plan

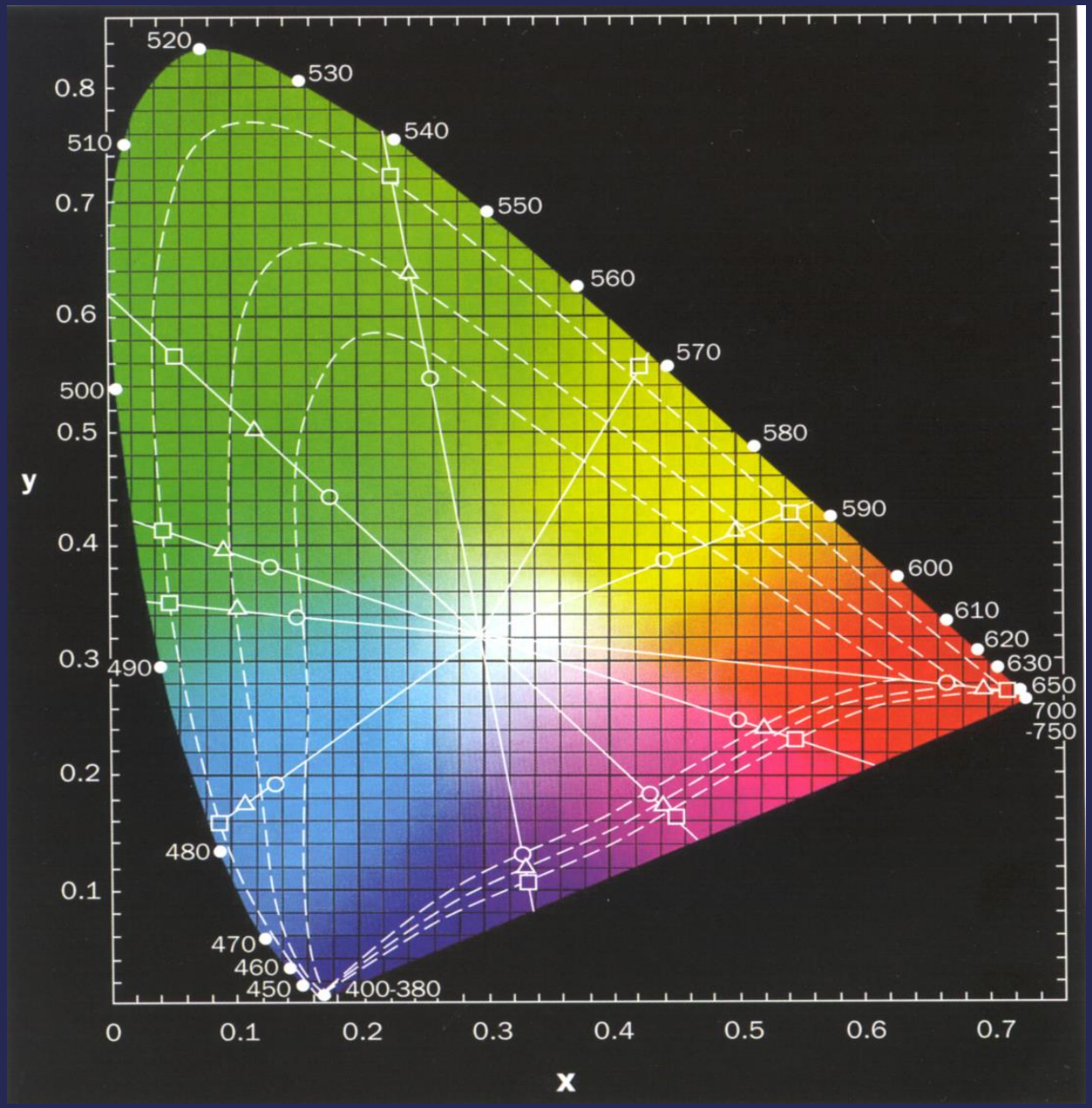
- Principles behind CAD test design
- What it measures and how
- Testing protocol
- Demonstration of CAD test

Terminology

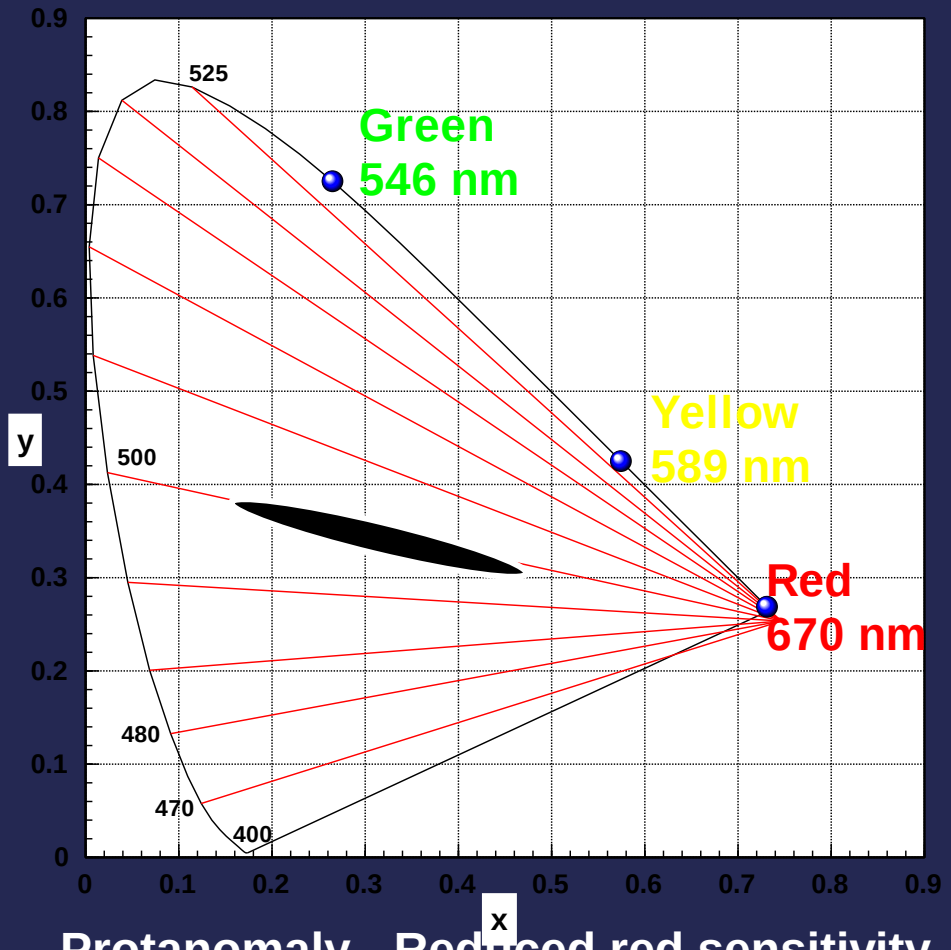
- Normal Trichromat
- Anomalous Trichromatism
  - Protanomaly or protanomalous trichromat (red deficiency)
  - Deuteranomaly or deuteranomalous trichromat (green deficiency)
  - Tritanomaly or tritanomalous trichromat (blue deficiency)
- Dichromat

  - Protanope, deuteranope, tritanope

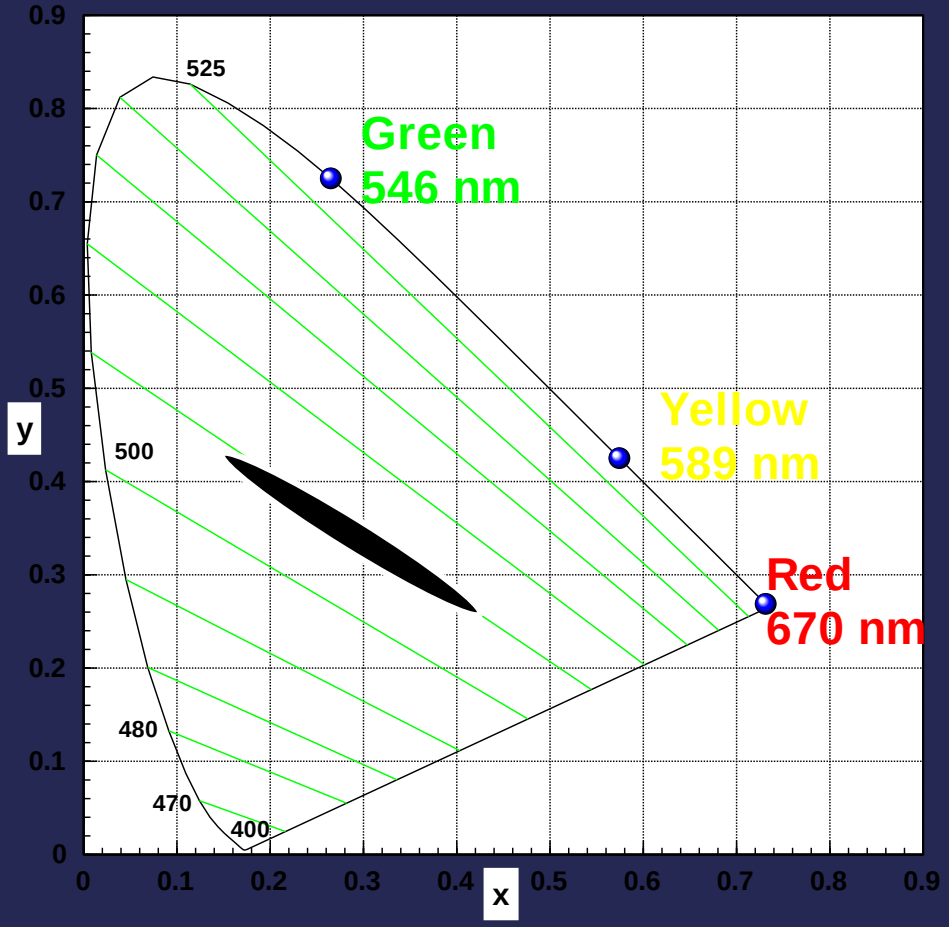
CIE (Commission Internationale de L'Eclairage) 1931 x,y chromaticity diagram



Dichromatic confusion lines



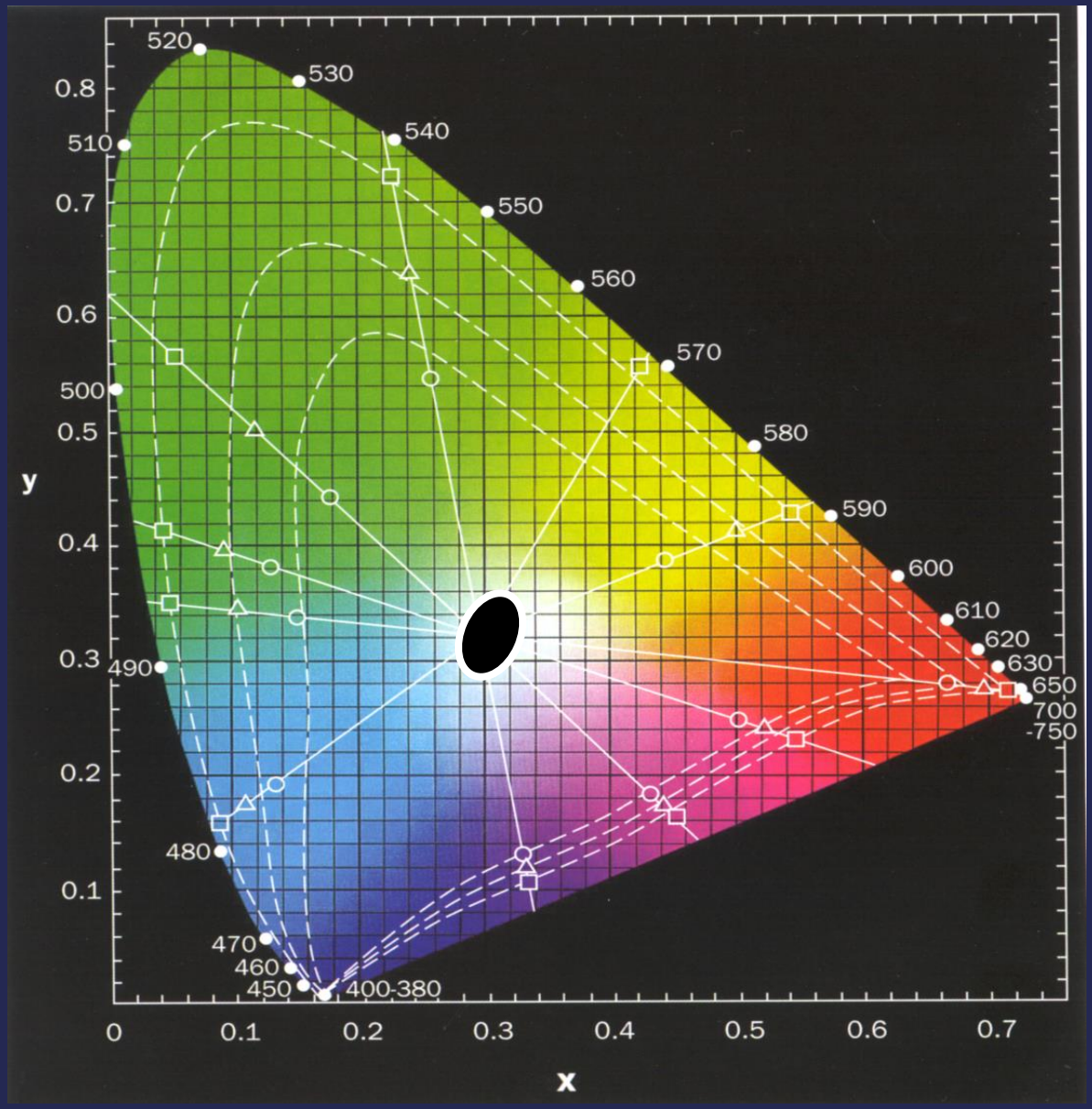
Protanomaly - Reduced red sensitivity



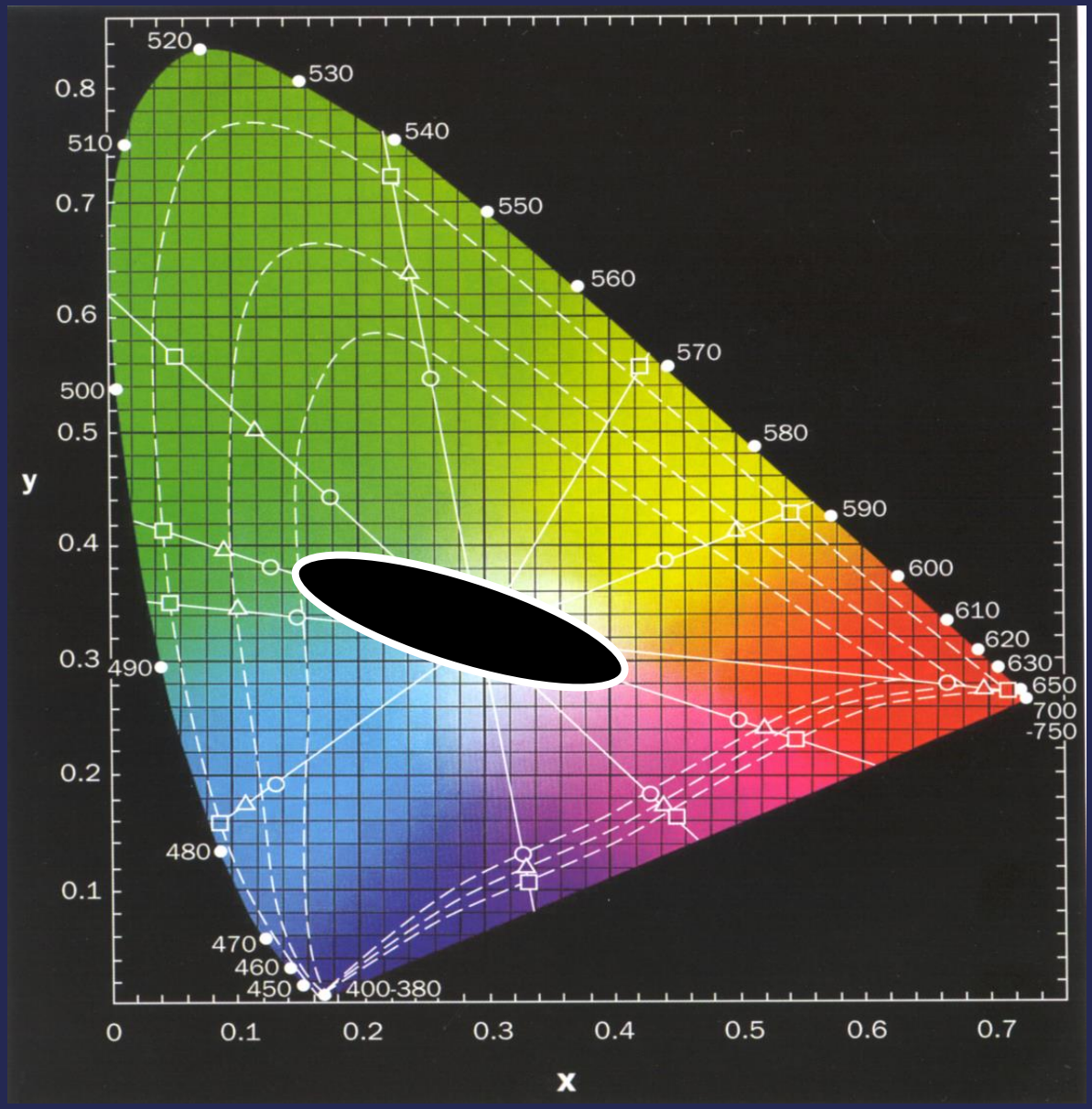
Deuteranomaly - Reduced green sensitivity

Both – Reduced red/green discrimination

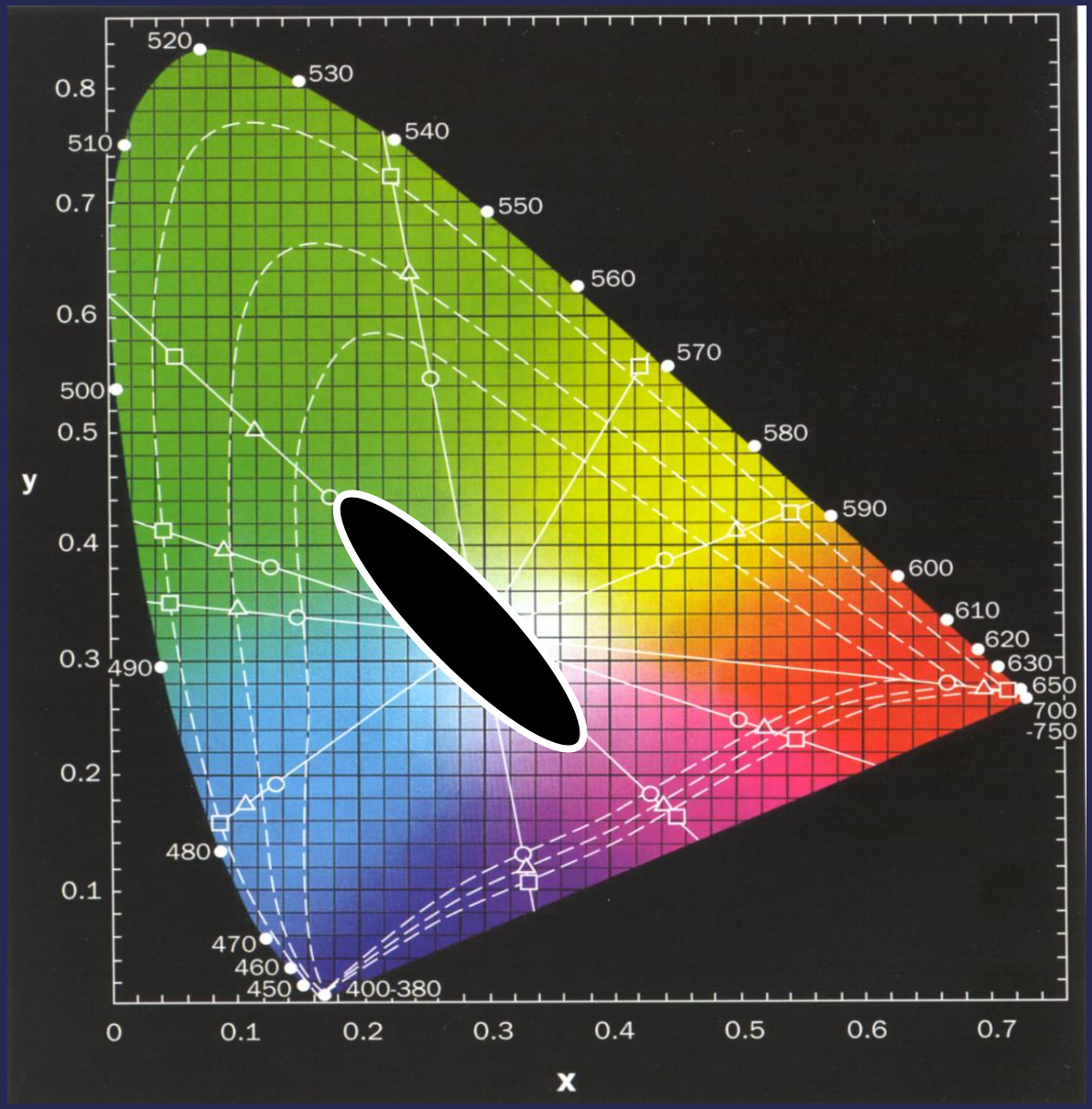
Normal


520
530
540
550
560
570
580
590
600
610
620
630
650
700
-750
510
500
490
480
470
460
450
400-380
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
y
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
x

Protanomaly



Deuteranomaly



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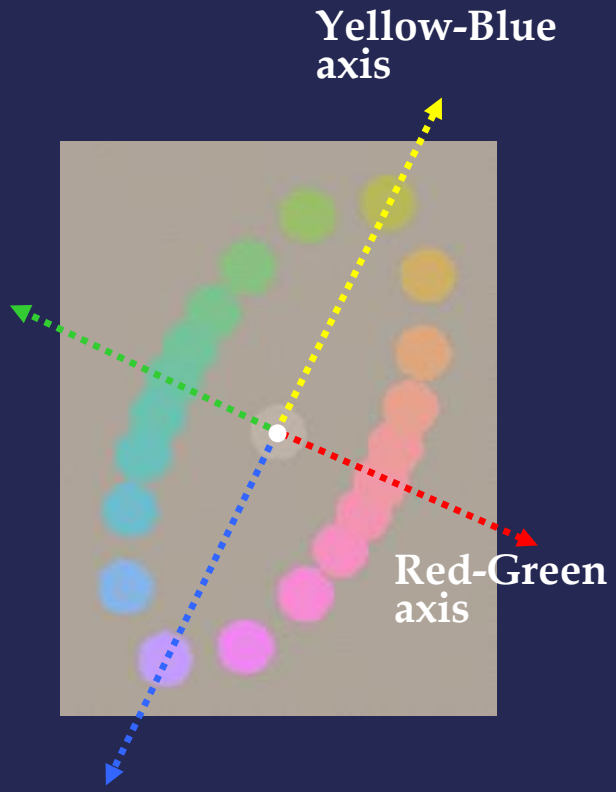
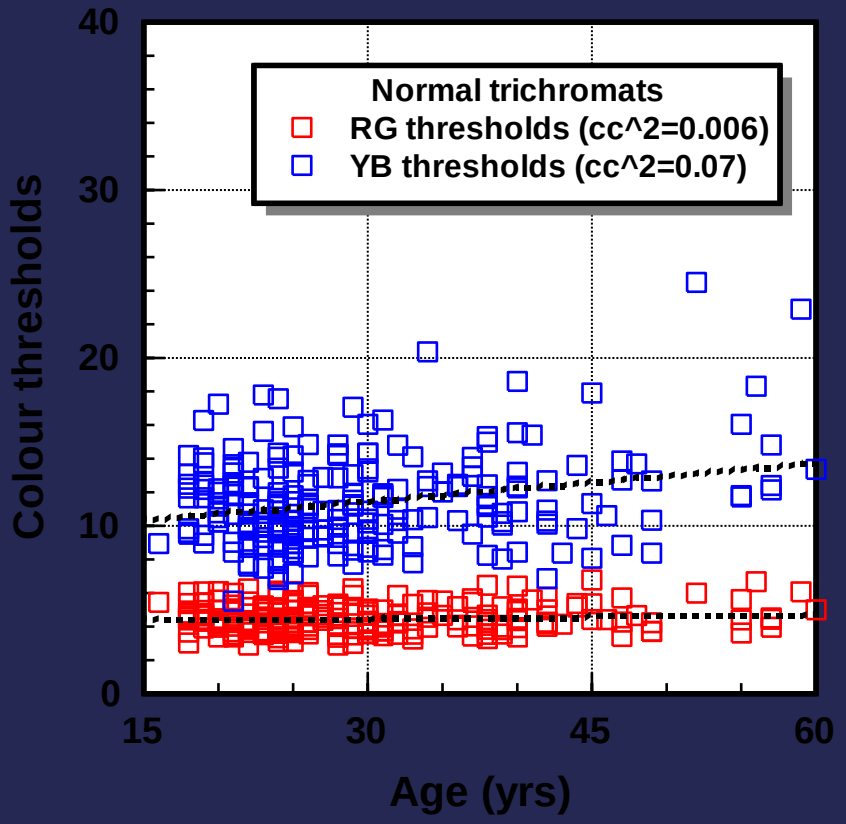
MEASUREMENT OF COLOUR DISCRIMINATION

The "Normal" subject





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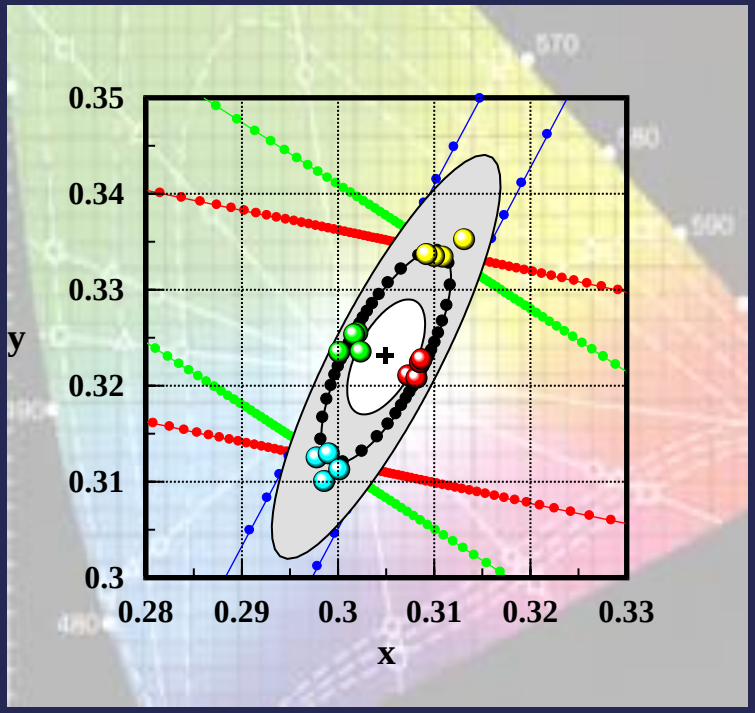
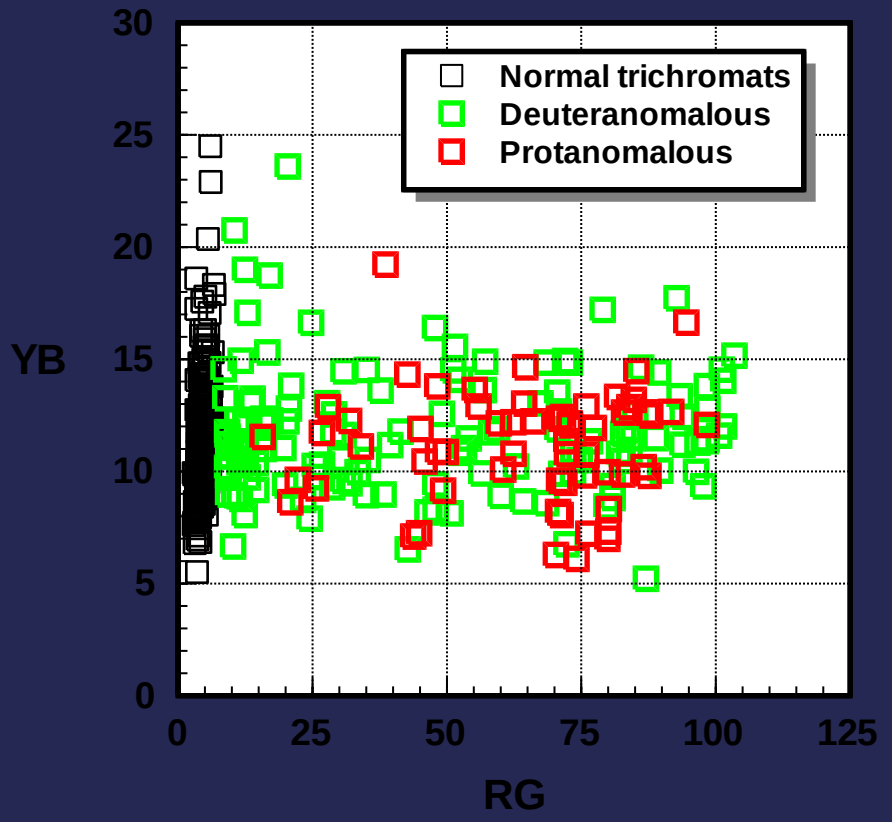
MEASUREMENT OF COLOUR DISCRIMINATION

The colour deficient subject





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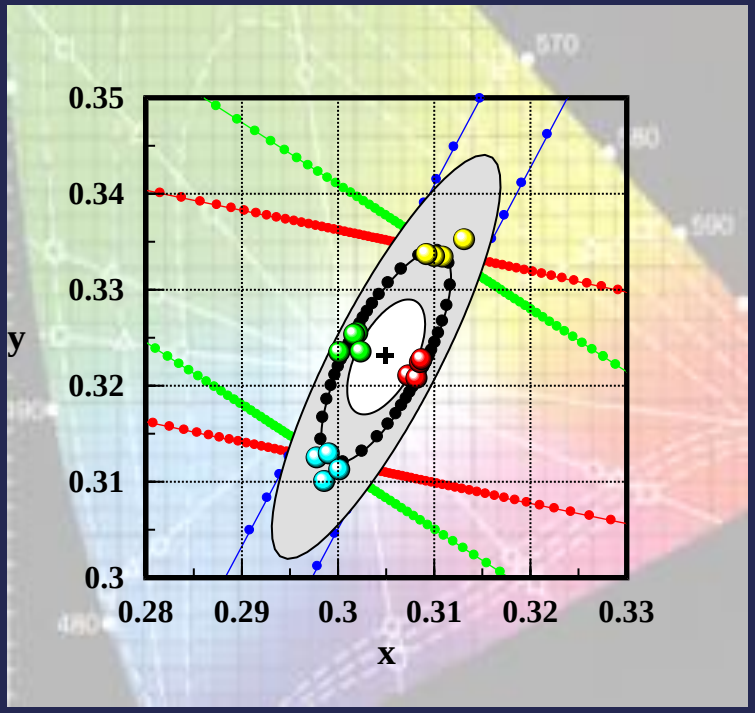
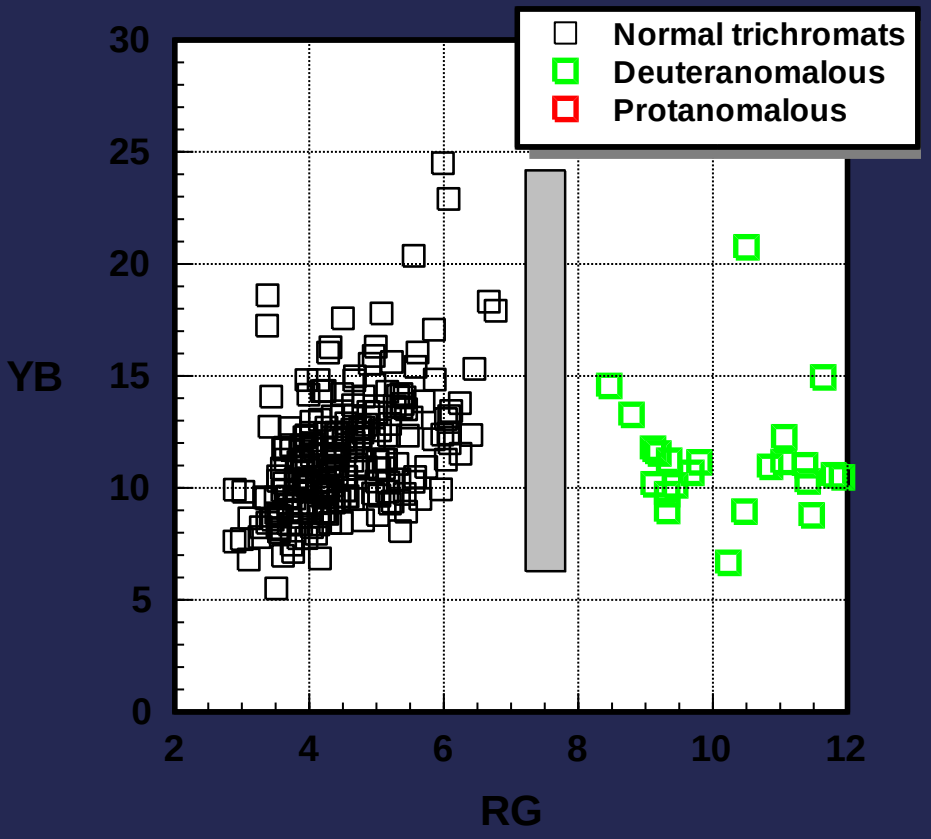
MEASUREMENT OF COLOUR DISCRIMINATION

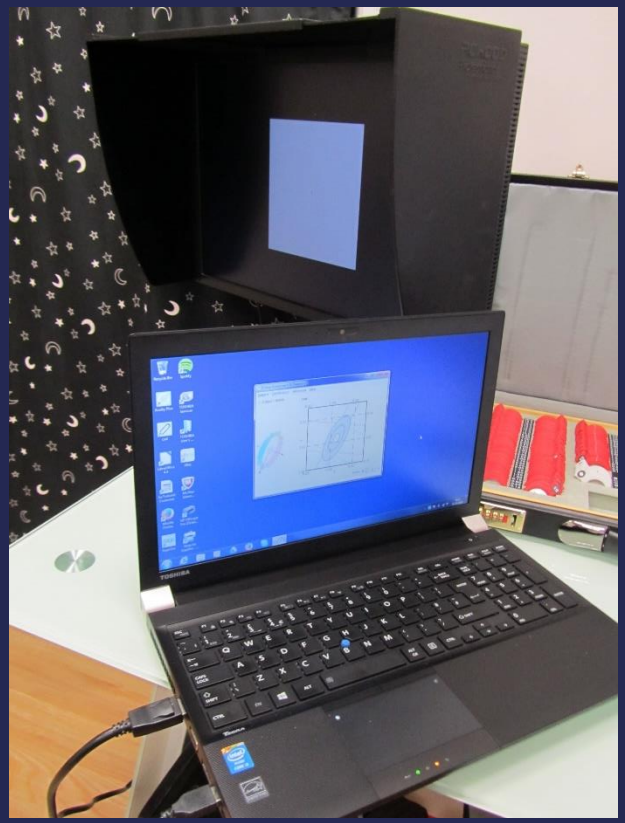
The colour deficient subject





The CAD test hardware

- Run from Laptop with second LCD calibrated screen with hood
- Bluetooth / wired keypad for patient responses



Principal of CAD test

- Pixelated square area which has same overall luminance as background
- During presentation each pixel randomly alters luminance but overall luminance remains constant
- Colour signals are isolated and small square target presented at a particular saturation

CAD test protocol

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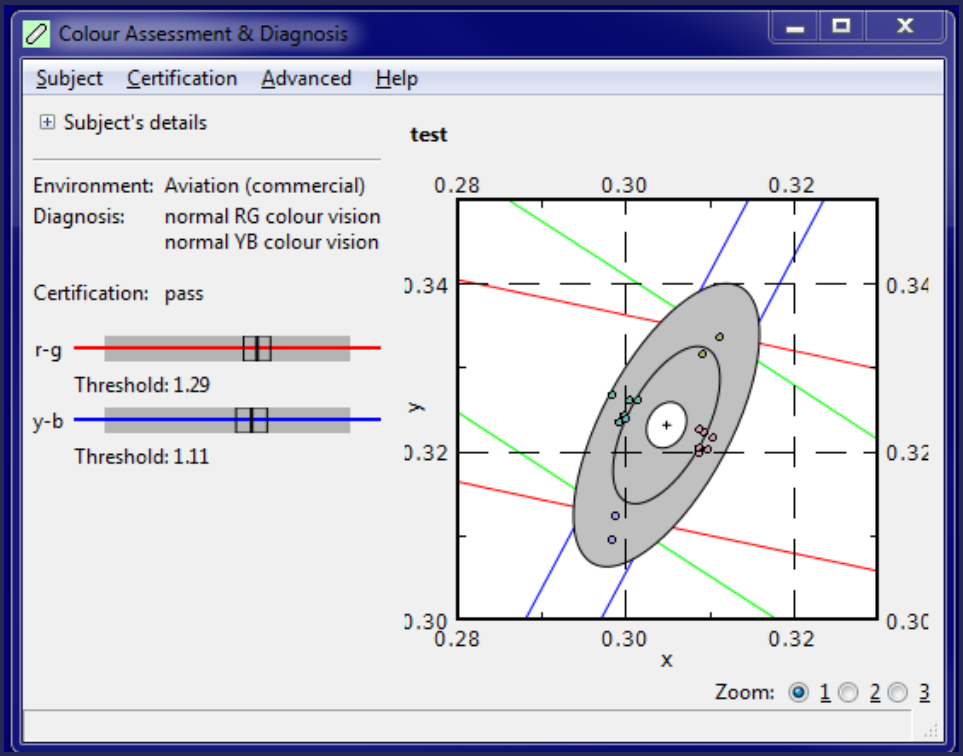
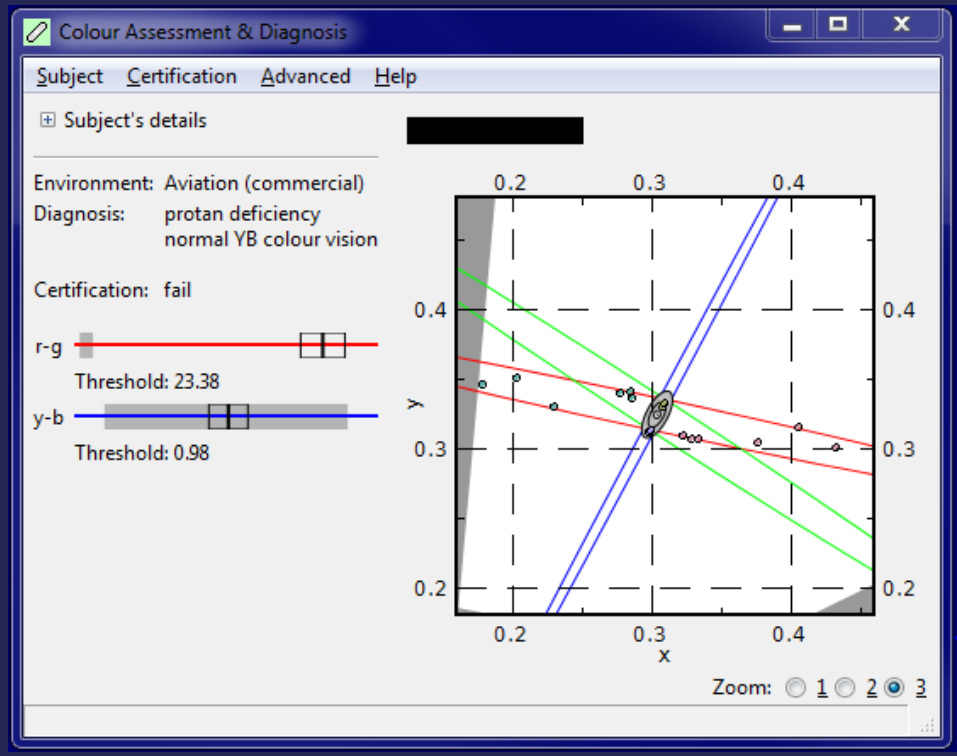
- Test distance 1.4m with applicant holding keypad
- Mesopic conditions
- Demo test to ensure test instructions understood
- Full threshold test 10-15 minutes
- 3 repeat (R-G only) tests where threshold borderline (up to certain levels of protan or deutan deficiency are acceptable for pilot certification)
- Applicant controls speed of test through speed of response on keypad
- Result print-out given to applicant
- Any further CAD thresholds are averaged with existing scores

Output of test





Practical Pros & Cons of the CAD

- Advantages:
  - Ability to diagnose and quantify level of colour vision deficiency
  - Repeatable and reliable
  - Subject can undertake CAD multiple times – all threshold results are averaged
  - Less examiner dependent
  - Less protocol dependent
  - Can be used as a screening test

- Disadvantages:
  - Time consuming if borderline result
  - Expense of hardware
  - Challenge for regulators determining ‘safe’ limit