Extensions to the Theory of Matrix R

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CORM-ISCC Annual Meeting

Troy, New York

July 31-August 2, 2017

$$Ax = b \tag{1}$$

$$A\begin{bmatrix} R \\ G \\ B \end{bmatrix} = b \tag{2}$$

$$A\begin{bmatrix} R \\ G \\ B \end{bmatrix} = N \tag{3}$$

$$AT\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = N \tag{4}$$

Are the units the same on both sides of

$$A\begin{bmatrix} R \\ G \\ B \end{bmatrix} = N \qquad ? \qquad (2)$$

$$AI\begin{bmatrix} R \\ G \\ B \end{bmatrix} I = N \qquad (5)$$

With these substitutions, used by colorists, what does eq.(2) look like?

$$AQ = N \qquad (2)$$

$$E = A'(A'A)^{-1} \qquad \text{(C7.12)(6)}$$

$$E' = (A'A)^{-1}A' \qquad (7)$$

$$(A'A)^{-1}\mathrm{A'AQ} = \mathrm{E'N} \qquad (8)$$

$$Q = E'N \qquad (9)$$

Cohen sought a vector *U* that weighted the fundamentals of the primaries to the fundamental of the color stimulus such that:

$$EU = N^* \qquad (10)$$

$$EA' = R \qquad \text{(C10.6)(11)}$$

$$EA'N = RN = N^* \qquad (12)$$

$$EU = EA'N \qquad (13)$$

$$U = A'N \qquad (14)$$

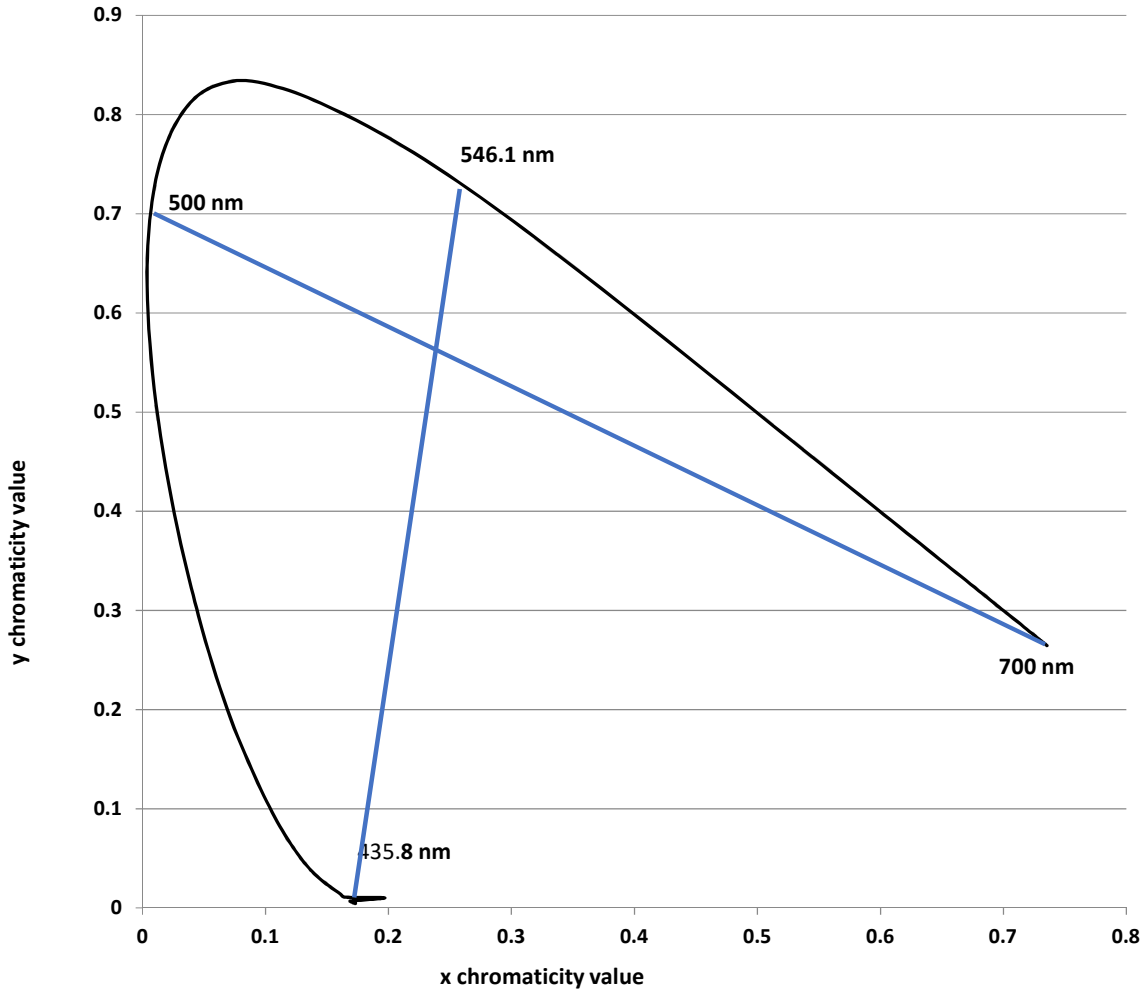
$$U = (E'E)^{-1}E'N \qquad \text{(C7.43)(15)}$$

We have derived two new relationships which differ from the colorists' paradigm:

$$Q = E'N \qquad \text{tristimulus values} \qquad (9)$$

$$U = A'N \qquad \text{tricolor values} \qquad (15)$$

What are the units of these two equations?


0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
y chromaticity value
x chromaticity value
546.1 nm
500 nm
700 nm
435.8 nm

What are the units of these two equations?

Wv Wr Wg Wb

NWv NWr NWg NWb

$NW_i = kW_i$ $k = 1000\ mw\ per\ unit\ sensation/Wv$

So the units of *A* are:

power per unit sensation

$$Q = E'N \qquad \text{tristimulus values} \qquad (9)$$

$$\frac{sensation}{power} * power = sensation$$

$$U = A'N \qquad \text{tricolor values} \qquad (15)$$

$$\frac{power}{sensation} * power = power^2 per\ unit\ sensation$$

$$EU = N^*$$ (C7.33)(10)

$$\frac{sensation}{power} * \frac{power^2}{sensation} = power$$

Other features of written paper mentioned:

- What if Q were to equal U?
- That the null space of A is invariant to transformation and inversion.
- That the process of tristimulus integration is a least-square best fit process.

Kuhn, Thomas. *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, 1997.