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Letter to the Editor of the Journal SDC

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Improvements in colour difference calculation

Kuehni (1) analysed the Davidson-Friede, Robinson, Kuehni and Metropolitan Section AATCC colour difference acceptability data. He calculated total and average group correlation coefficients for optimal ellipses and several colour differences formulae. He suggested a modified cube root formula for further consideration.

In my paper (2) for the Helmholtz Symposium I concentrated on the FMC formulae and concluded that FMC-2 (and therefore also the Simon-Goodwin system) is clearly in error in view of the Davidson-Friede data. Some parameter values in the FMC-1 formula should be adapted to get a better fit with these and other acceptability data. Especially the value $l = 0.279$ is too high and results in overrating of luminance differences as compared to chromaticness differences. I suggested the values $l = 0.08$ and $f = 1.0$ as an acceptable compromise. This adapted FMC formula is called FMC-F by me.

This suggestion has not got up to now the attention which it deserves, although I published already in 1965 (ref (3), color differences of commercial importance) and in 1971 (4) similar parameter values as the ones mentioned above. This should have been a warning against the use of $l = 0.279$ for tolerance data. Recently I calculated the correlation coefficients for the same set of data as used by Kuehni: 33 standards, 439 samples. FMC-F .63 (total) .77 (average)

The score is as good as that of the modified cube root formula (.64 resp. .77). In that case the adaptation of a well-known formula by changing only two parameter values is a better alternative than the introduction of a brand new formula. Those who are not familiar with the function of parameter f should consult the original publication by Chickering (5).

When the values ΔE (50%) for the Robinson, Kuehni and Metropolitan data are compared with those for the Davidson-Friede data in the same area of the chromaticity diagram, it turns out that the values for the former data are systematically lower than for the latter. The reduction factor is about 2/3 indicating that the observers in the former experiments were, as a mean, more strict than in the latter. There can be no objections against the correction of groups of data, when the tolerance limits are different. I therefore multiplied the calculated colour differences of the former groups by 1.5.

-2-

The total correlation coefficient FMC-F is then improved to .67. The average correlation coefficient stays of course unaltered.
Following the ideas presented in ref. (2) I developed a new colour difference formula based on the zone-fluctuation theory by Walraven and Vos. The parameter values were adapted to the same acceptability data. The correlation score is now .74 (total) .81 (average). None of the existing formulae can equal this score.
It is not intended to publish the new formula in the direct future, pending further analyses and parameter optimization.

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