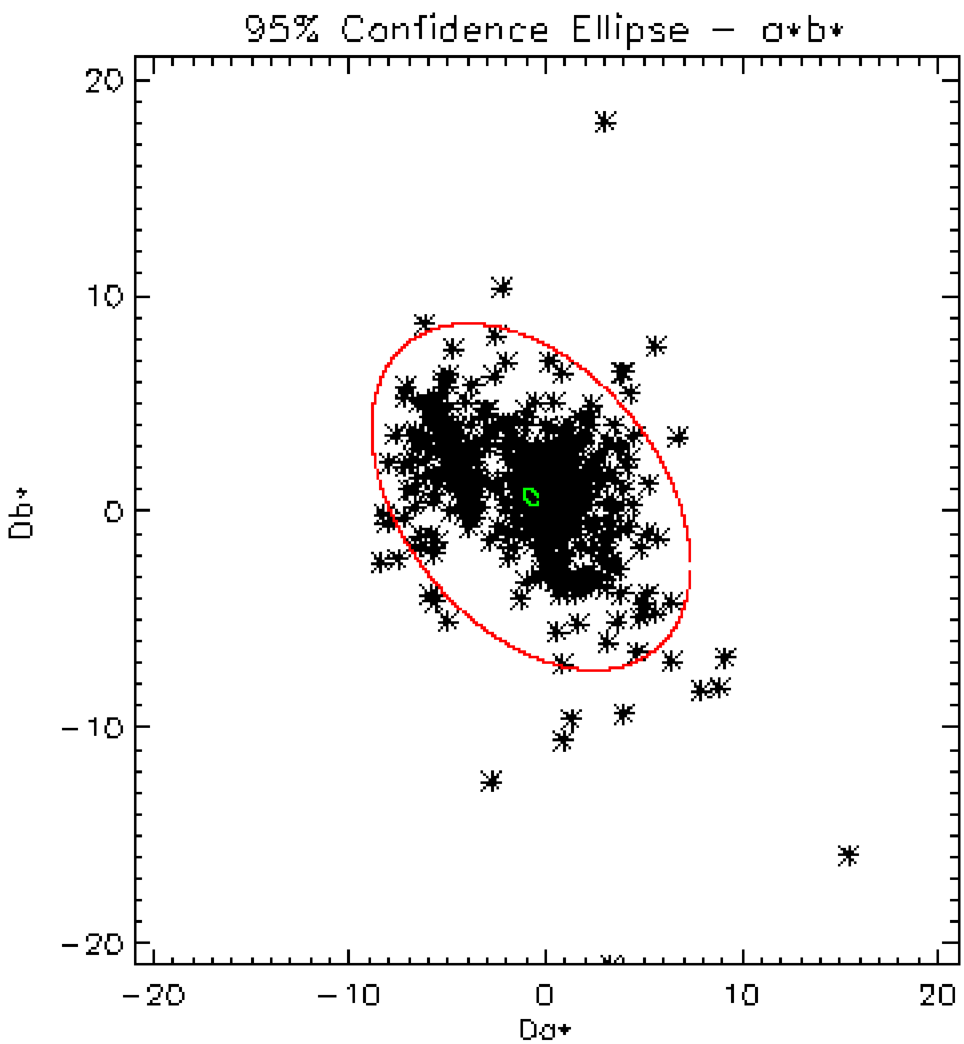
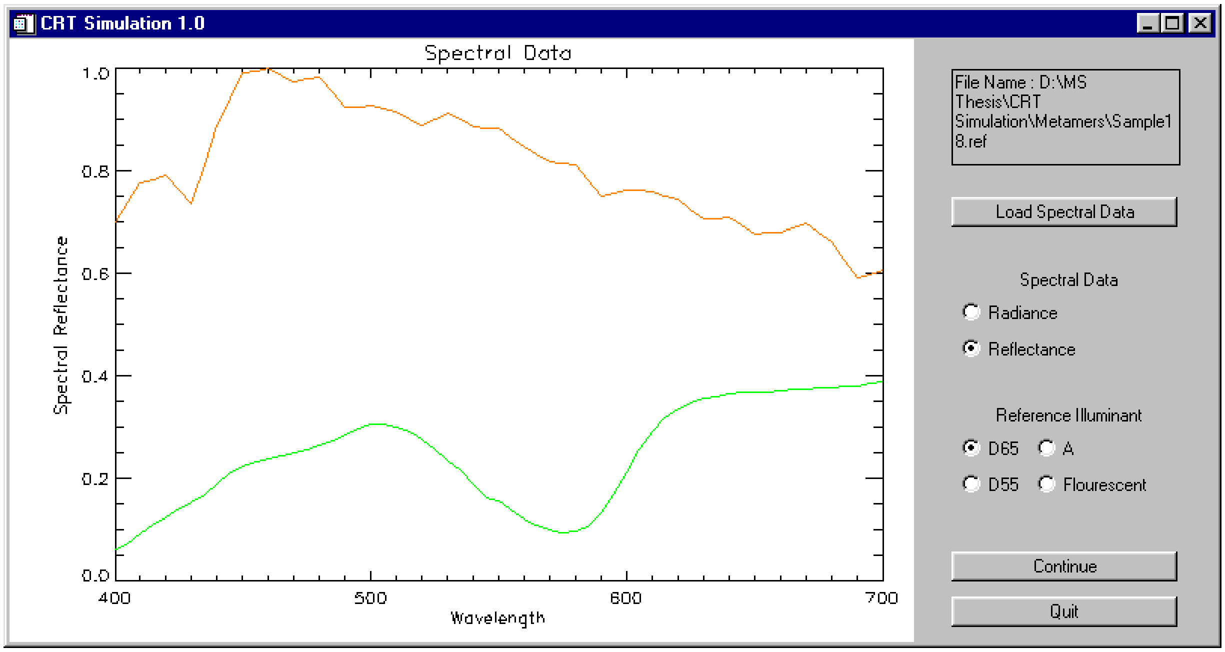
Evaluating Color Matching Functions

The use of colorimetry within industry has grown extensively in the last few decades. Central to many of today's instruments is the work of the CIE system, established in 1931. Many have questioned the validity of the assumptions made by Wright (1928-29) and Guild (1931), some suggesting that the 1931 color matching functions are not the best representation of the human visual systems' cone responses.



A computational analysis was performed to evaluate the 1931 color matching functions against other responsivity functions using metameric data. The underlying principle is that an optimal set of responsivity functions will yield minimal color difference errors between pairs of visually matched metamers. The difference of average color differences found in the six chosen sets of responsivity functions were small. The CIE 1931 2° color matching functions, on average, provided the largest color difference, 4.56 ΔE*ab. With the best performance coming from the CIE 1964 10° color matching functions, yielding an average color difference of 4.02 ΔE*ab.

An optimization was then performed on the CIE 1931 color matching functions. The concept was that color differences between metamers can be used to improve predictions of color matching functions. If one is to take all pairs, and perform an optimization that globally minimizes the average color difference, then one can hope to obtain an optimal set of responsivity functions. The optimum solution was to use a weighted combination of each of the different sets of responsivity functions. The optimized set, the 'Shaw and Fairchild' responsivity functions, were able to reduce the average color difference down to 3.92 ΔE*ab.



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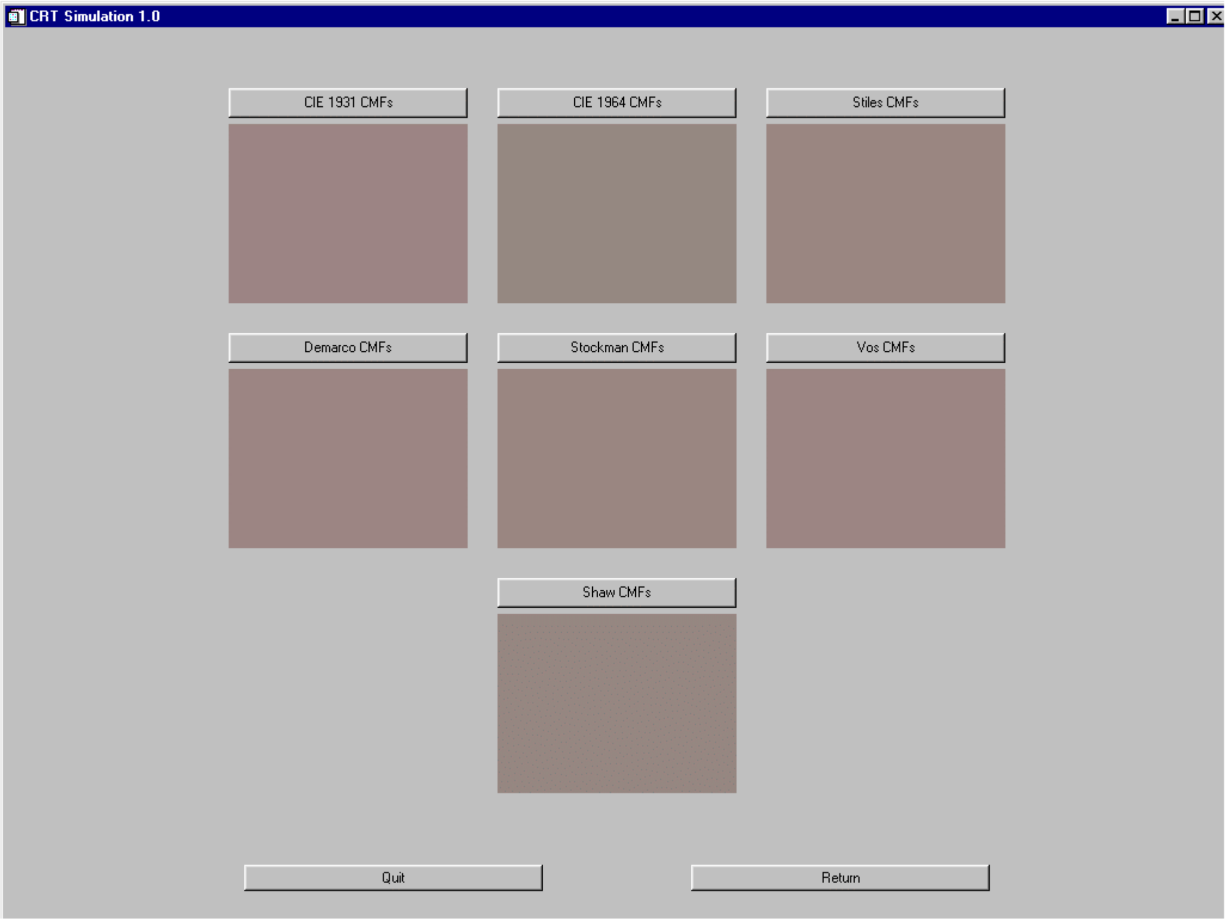
The final part of the work was to build a computer-based simulation of the color differences between the different sets of responsivity functions. This simulation allows a user to load a spectral radiance, or reflectance, data file and display the tristimulus match predicted by each of the seven sets of responsivity functions.



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