RIT offers Ph.D. in color science —
the only program of its kind in the US

Color science provides standards of measurement and quality control to make sure one batch of red iPods is the same shade as the next, that a can of kiwi-colored paint is as brilliant as the sample chip in the paint store, and that the print in your hand matches the digital image on your computer screen.

This fall, Rochester Institute of Technology will offer a new doctoral degree in color science, the only one of its kind in the United States. This specialized field blends physics, chemistry and visual perception, among other sciences, to quantify how the human eye perceives color—to translate color into scientific data.

“You look around and you see a chromatic world,” says Roy Berns, program coordinator and the Richard S. Hunter Professor of Color Science, Appearance and Technology at RIT. “We put numbers on those perceptions important for commerce as well as for using color as scientific data. We study how changes in the building blocks of color—such as lighting, materials and the observer—change those perceptions and change those numbers.”

A variety of industries depend on color science research, especially those that center around manufacturing colored products, printing, digital photography and cinema, computer graphics and animation, art conservation, and medical data visualization and diagnoses. Advances in technology that give us plasma displays, for instance, rely upon consistent color control to translate reds, greens and blues from a signal to the screen and from one program, movie or commercial to the next. Color science provides a way to measure those interpretations to consistently produce the desired colors.

The doctorate in color science is an extension of the existing graduate program offered by RIT’s Chester F. Carlson Center for Imaging Science. It is designed for students with undergraduate majors in physics, chemistry, mathematics, computer science, engineering, experimental psychology, and imaging, as well as textiles, graphic arts, animation, material science and polymer science.

Students will learn how to address problems in the measurement, production, formulation, reproduction and perception of color. The curriculum combines required courses in color science, elective courses, a research project during the second year of study and a dissertation.

“The main thing is that it will allow us to have a wider variety of students from more diverse educational backgrounds because it expands the range of research we can do with students,” says Mark Fairchild, director of the Munsell Color Science Laboratory at RIT, a leading academic laboratory dedicated to color science education and research.

Berns adds: “The way we teach color science here has always been interdisciplinary. We’re trying to foster that into the color science Ph.D. both from a student and a departmental perspective.”

Applicants to the doctoral program in color science are being accepted for fall 2007. For more information, contact Roy Berns at berns@cis.rit.edu or 585-475-2230.

Written by: Susan Gawlowicz, University News Services
This year two articles will appear in the May/June issue of Color Research and Application. The focus of these articles, coauthored by Dave Wyble and Danny Rich of Sun Chemical, is to examine methods of instrument evaluation. The work is based on a large measurement study conducted in the summer of 2004 by two high school interns, David Borrelli and Carolyn Rudak. They designed a four-week testing schedule and made daily measurements on a suite of 12 commercial spectrophotometers. Instruments were evaluated for short-, medium-, and long-term repeatability, inter-instrument reproducibility, and accuracy. The mathematical basis was from ASTM E2214, a specification providing guidelines for all aspects of color-measuring instrument evaluation.

The focus of E2214 is on statistical techniques using multivariate descriptions of instrument performance. These descriptions are ellipsoidal tolerances as opposed to the spherical tolerance defined by the traditional color difference $\Delta E_{ab}^*$. Color difference equations based on ellipsoids are known to better match human observers, but there is no reason why instrument-derived ellipsoids should align with color difference ellipsoids. It is tempting to consider using these more advanced color difference formulae to describe instrument performance, but the results are not likely to improve upon the already-flawed application of $\Delta E_{ab}^*$. Simply put: instruments do not behave like human observers.

The results of the repeatability analysis showed that instruments performed very well. Traditional metrics, such as the various color difference equations and spectral RMS difference, all correlated well with some of the multivariate methods. When attempting to compare performance between instruments, the techniques in E2214 were found to be overly strict. The recommended analysis asks the question: “Is the difference between the performance of two instruments statistically different from zero?” Ideally, the answer is “no” for two instruments essentially that behave identically. However, in nearly all cases, the analyses showed a statistical difference, even when the statistical tolerance · was increased past the usually accepted levels. Further work is required to determine the best course of action. At this point the main conclusion is that E2214 requires some mathematical improvements.

There are several opportunities for further research beyond improving E2214. The accuracy analyses are still in progress; a paper describing that work is expected in the next year. Also, the testing results provide the data required to perform noise propagation studies in any analyses that begins with color measurement. For example, color device profiles are based on color measurements for the derivation and evaluation of the models.

These papers were the final portions of research contributing to a doctoral dissertation I presented to Chiba University in January. I am happy to report that the faculty committee accepted the dissertation. The picture above shows some of my weekend touring with former MCLS Visiting scientist Shohei Tsutsumi, of Canon. This was one of many examples of the hospitality shown to me by our Japanese friends and colleagues. I am already looking forward to my next opportunity to visit Japan.

~ Dave Wyble, MCSL Color Scientist