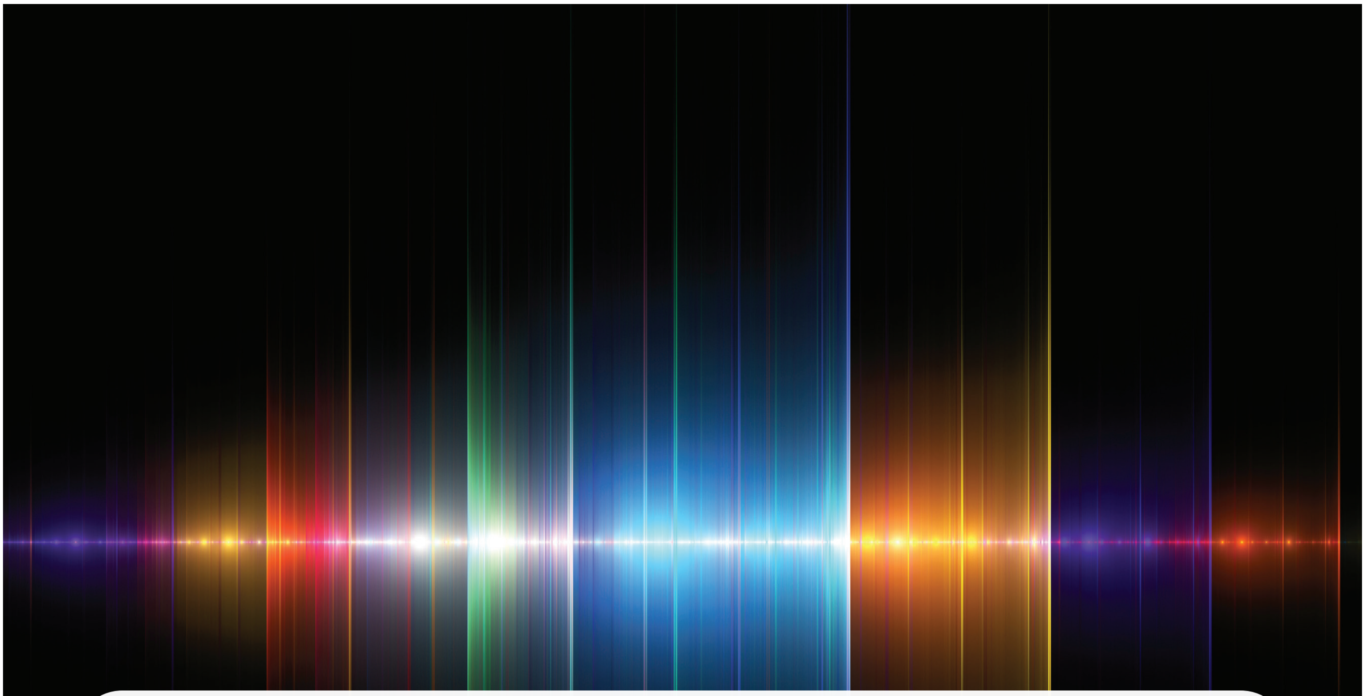

Ensuring High-Quality Viewing Experiences and the Preservation of Creative Intent

BY CATHERINE MEININGER

With every year that passes, brilliant minds continue to push the boundaries of imaging technology that empowers content creators to explore their creativity, bring their visions to life, and foster unforgettable experiences for audiences around the globe. These advancements lead to a desire to ensure those visions are accurately represented, whether in the cinema, at home, or on mobile devices. That final image the audience sees is the culmination of all the hard work of every media professional who played a role in creating that image, from technical teams, creatives, and administrators who brought everything together. Our society cares so deeply about promoting high-quality images, and maintaining "creative intent" is a recurring theme across our industry's publications and presentations.

This issue of the *Journal* focuses on two key aspects of image quality that directly relate to the viewing experience: how content is rendered for presentation and how the audience visually perceives that rendering. Between these two topics is the intersection of objectivity and subjectivity: was the image

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accurately rendered according to the creative intent, and did the audience think the image "looked good"? The field of color science and psychophysics connects these two by providing objective methods to approximate, measure, and describe human visual perception, including its more subjective attributes. The ability to quantify human perception and its phenomena allows us to develop processes and metrics that help to maintain creative intent not just from the objective perspective but also to ensure high-quality experiences from the subjective viewpoint of the audience.

The paper "Gamut Excursion Measurements (GEM)—Improving CIE Usage" by Lakshmanan Gopishankar provides a great color science primer by introducing common mathematical descriptions of color, such as the origination of the CIE-1931 XYZ color space and its derived chromaticity diagrams. This paper presents a method of using these diagrams in a color-grading workflow to improve the identification and evaluation of colors outside a desired color gamut boundary, allowing colorists to more efficiently address image regions that may be difficult to reproduce faithfully across various devices.

We dive deeper into color science with two papers that conducted psychophysical experiments regarding the impacts of wide color gamut technology on human color perception models. In the paper "Using Categorical Observers to Minimize Metameric Failures on Wide Color Gamut Displays," Meininger et al. investigate a phenomenon where, despite industry standard color difference metrics predicting that two calibrated devices should have no perceived differences, some observers still report seeing significant color differences. The experiment tests the hypothesis that these perceived differences could be reduced by identifying an appropriate observer model for select groups of the human population rather than using a single observer model for all humans.

Where observer models attempt to quantify absolute measurements of color, color appearance models are used to quantify the subjective attributes of color perception due to the unique ways in which the brain processes color. The paper "The Impact of Background Luminance on the Perception of Chromatic Lightness" by Martinez, Zuena, and Pytlarz examines a perceptual phenomenon known as the Helmholtz-Kohlrausch (H-K) effect, where chromatic colors (such as red, green, blue, etc.) appear brighter than an achromatic color despite having the same absolute luminance. This study collected perceptual data for highly saturated colors seen on wide color gamut technology and compared the results against predictions from current standard color appearance models, highlighting areas of improvement based on the experimental findings.

Collecting reliable participant feedback is paramount to conducting a valid subjective study. These types of investigations were challenged by the restrictions imposed by the COVID-19 pandemic, which inspired the authors of the paper "Testing 4K HDR-WCG Professional Video Content for Subjective Quality Using a Remote Testing Approach" to create an experimental design that allowed for remote participation. Choudhury et al. provide a meticulous description and evaluation of the reliability of this experimental approach, which demonstrates that accurate subjective data can be collected even outside of a controlled lab environment.

The remaining papers in this issue focus more specifically on how content is accurately rendered for viewing. The paper "Reducing Cinema Projectors Power Consumption Using Global Dimming and Image Statistics" by Mehajabin et al. examines the relationship between power savings using global dimming techniques for cinema projection and its resulting impacts on faithful image reproduction. The authors describe the limitations of the approach and offer solutions that balance maximizing power savings without sacrificing the creative intent of the rendered image.

"Using GPU-accelerated Pixel Format Conversions for Efficient Real-time Video Streaming" by Aguerre, Sena, and Stolarz presents an open-source C++ library that can be used to improve the rendering performance and image quality of real-time streaming applications by re-allocating computing resources onto a GPU. The paper describes the design and implementation of the library. It provides an analysis of the library's computational performance and impacts on image quality to demonstrate its improvements over currently available solutions.

The final paper in this issue is "What Electronic Image Noise Signatures Can Tell Us About Image Linearity and Camera Encoding" by Ricardo Figueroa, which details an approach to characterize the encoding transfer function of a digital camera based on detected noise signatures within captured images. This approach is an alternative to other processes that require specialty test equipment, which may be impractical for production workflows. The result of this approach helps to create input device more quickly transforms (IDT) commonly used in color-managed workflows and allows for more accurate color transforms throughout the production process.

The papers in this issue are excellent reflections of the amount of time, dedication, and detail media professionals put into creating tools and processes that help create beautiful images for people to enjoy. Imaging technology will continue evolving as we seek to enhance our media experiences, and so will the science and methodologies used to assess the objective and subjective attributes of the human viewing experience. We hope you enjoy reading!

About the Author

Catherine Meininger is the Sr. Director of Color Science at Portrait Displays, where she leads the design and development of color calibration algorithms.

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