New concept of color management system based on recognized visual space of illumination

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Getting consistent color reproduction among several color imaging devices is a classical requirement in various fields dealing with colors. And this has been served throughout decades by the color measurement systems established by the *CIE (Commission Internationale de I'Eclairage).* However, consistent colors based on the colorimetry, such as *CIE XYZ,* do not assure consistent appearances because an appearance of a stimulus depend significantly on context of its viewing environment. Much effort, therefore, has been made to improve toward prediction a color appearance of a stimulus under various environments. This resulted in, for instance, the *CIELAB*, or the *sRGB* color space which have been adopted as a profile connection space in modern digital color management system. In addition, more recently, *CIECAM97* and, later, *CIECAM02* color appearance model, which include several environmental factors, have been releasing. However, these improvements come out with restriction and standard which, in other words, means limitations. This is because the unclear understanding about how the visual system processes context of a viewing environment and how an appearance of a stimulus is affected by this process. From this inspiration, it was proposed a new concept of color management system based on the recognized visual space of illumination *(RVSI).* It was hypothesized that, by its nature, the visual system always attempt to solve the signal from two-dimensional retinal image to understand an illumination state of an outside three-dimensional world. The solution is recognized as an *RVSI* and then appearances of any object in the environment are perceived in relation to this constructed *RVSI.* In particular, this study focuses on two questions; first, how the visual system adapt to a viewing environment and, second, how an appearance of a stimulus is perceived in relation to that adaptation state. The center-surround simple configuration of a simultaneous color contrast representing a simple model of a stimulus within a viewing environment was employed in this study. Experiment I and II were conducted for the first objective. It was found that the visual system was able to recognize a surface color as an illumination color by means of introduction a three-dimensional structure surround. This suggested that the visual system attempts to recognize the state of an ambient illumination as an adaptation state or *RVSI.* Then an appearance of a stimulus within the environment is perceived in relation to this adaptation state, which resulted in simultaneous color contrast effect. Experiment III and IV was conducted to explore the relationship an appearance of a stimulus and the *RVSI.* It was found in the experiment III that an appearance of a stimulus would depend on the *RVSI* only if it appears in illuminated surface mode within its viewing environment. In light source mode, on the other hand, an appearance of a stimulus would refer to the fundamental adaptation state or independent of the *RVSI.* In addition, the experiment IV showed that, in illuminated surface mode, the maximal strength of the relationship between an appearance of a stimulus and the *RVSI* occurs at the object border where an appearance mode of a stimulus are about to change from a natural object to an unnatural object mode. In conclusion, these results suggest that, in an environment, the conceptual process for the color management system should be as followings. First, color of a stimulus produced from a color imaging device is transferred into profile connection space, based on the spectroradiometric device characterization. Second, an *RVSI* of the viewing environment should be subjectively measured, in terms of spectroradiometry, as a reference state of an adaptation. Third, both of information must be bound together as a profile of the color when it is reproduced by another color imaging device or in another viewing environment.