# Color storage and image processing through Young's fringes modulated speckle

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Young's fringes modulated speckle (YFMS) can be used for storing several pictures in a single photographic plate.[1] In this Letter we present a simple application of this technique for color storage on black and white film, which allows information processing in different colors in an independent way.

Fig. 1. Positive reproduction of unfiltered image; the object consisted of a green letter *A* and two red letters *E* and *P*.

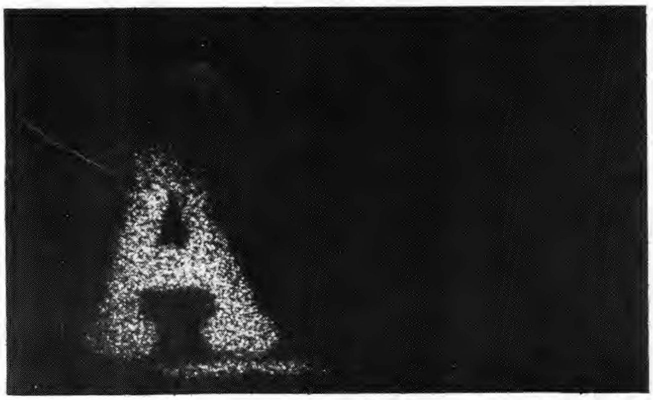

Fig. 2. Filtered green image registered with argon laser illumination ($\lambda = 514.5$ nm).

Fig. 3. Filtered red image registered with He–Ne laser illumination ($\lambda = 632.8$ nm); the letter *E* has been subtracted.

As is well known, when a diffusing object is illuminated by a laser, and its image is formed by a lens whose pupil consists of two identical holes, the speckles in the image are modulated by Young's fringes.[2] If a photographic record of the image is Fourier transformed in a conventional way,[3] Young's fringes will act as a carrier frequency, and two diffracted orders will appear in the Fourier plane symmetrically located to the zero order. When a spatial filter is placed in this plane to observe only one diffracted order, and this one is again Fourier transformed, an image of the object will be observed.

Now if more than one recording is made in the photographic plate, but the orientation of the Young's fringes is changed by in-plane rotating the pupil with the two identical apertures, several pictures (up to five) can be stored in a single photographic plate. Then, after processing, the pictures of the different objects can be reobtained by properly locating the spatial filter to select in each operation the corresponding diffracted order. This is the technique proposed by Kopf in Ref. 1.

What we propose is that the different pictures stored in the photographic plate can actually be the different color images of a single object. This can be done by recording the images of the object in a sequential way by changing the wavelength and pupil orientation between exposures.

After processing, the color images can be obtained in the following ways. If the recording wavelengths are very different, reconstruction can be done with all of them at the same time. In this case, to avoid crosstalk between wavelengths, i.e., to avoid an image constructed with one wavelength being reconstructed with another wavelength, adequate color or interferential filters should be placed behind the spatial filters in the Fourier plane. On the other hand, monochromatic images of each color image stored in this way can be sequentially reconstructed by illuminating the photographic plate with the corresponding wavelength and placing the spatial filter in the adequate diffracted order.

Because color is reconstructed by using well-known laser lines, this method seems to be promising for long-term storage of color pictures.

As the images are YFMS coded, some information processing operations can be separately performed on each of them, namely, subtraction, spatial derivatives, contrast-enhancement and reversal, as we proposed in Ref. 4.

Figures 1–3 show two color images of an object having only two colors, each one obtained by illuminating the recording plate with only one color. In addition a subtraction has been done in one of the object colors.[4]

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## References

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