



Feasibility study of utilizing a portable spectrophotometer to assess the radiation dose delivered to the radiochromic films



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Motivation : Do we need PORTABLE?

- *In-situ* analysis required for emergent situation particularly possible for public as well as radiation workers.
- Color change due to radiation dose is straight-forward and intuitive → Radiation workers or public may know that the irradiation is occurred via color change of the dosimeter
- Comparing with other dosimeters such as TLD and OSLD, spectrophotometers are light and portable

Objectives

- This study aims to show the feasibility of portable spectrophotometers to assess the dose delivered to the radiochromic films.
- This study compares the net optical density read by portable spectrophotometers with that obtained by the flatbed scanner.

Methods

Color space

yellowish, greenish, reddish, bluish

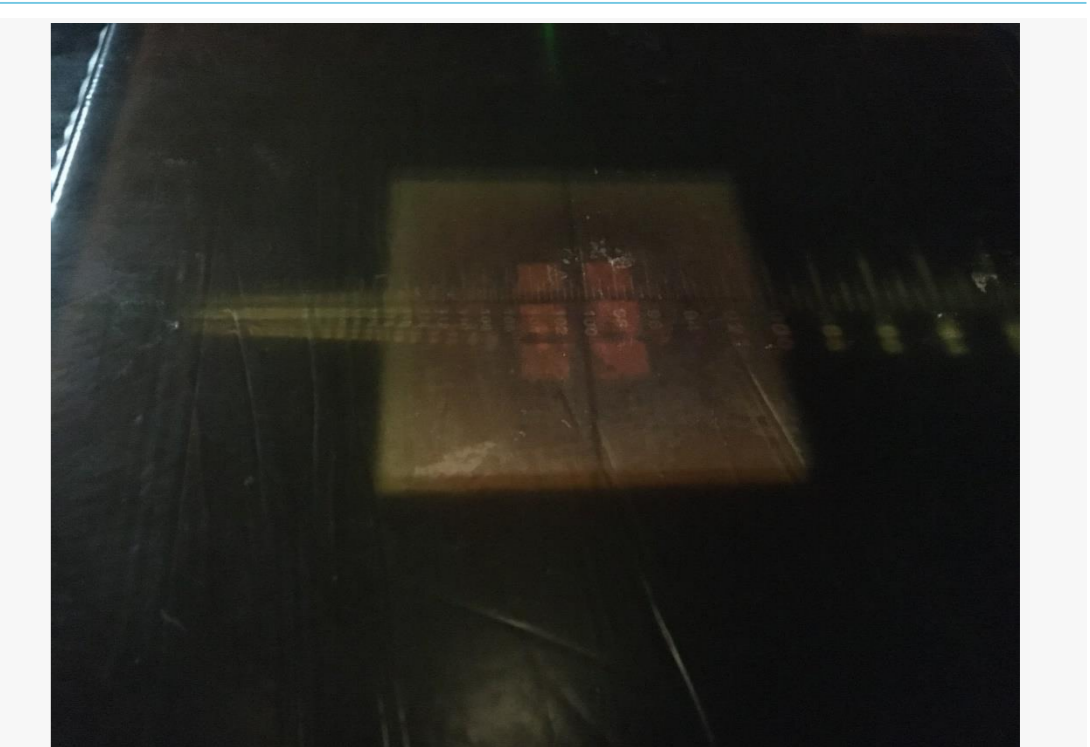
L^* (white), L^* (black)

CIE:Lab [1], CIE:XYZ (figures from Wikipedia.org/wiki/CIE_1931_color_space), RGB

- Portable spectrophotometers
 - ✓ eXact Advanced (X-Rite)
 - ✓ YS-3020 (3nh)
- Flatbed scanner
 - ✓ 10000XL (Epson)

YS-3020, YS-3020, Epson 10000XL

- EBT3 films
 - ✓ 24 hours after the irradiation
 - ✓ Three films for each dose
- Irradiation
 - ✓ 6 MV (TrueBeam STx, Varian)
 - ✓ 0 – 2000 cGy



6 MV photon irradiation

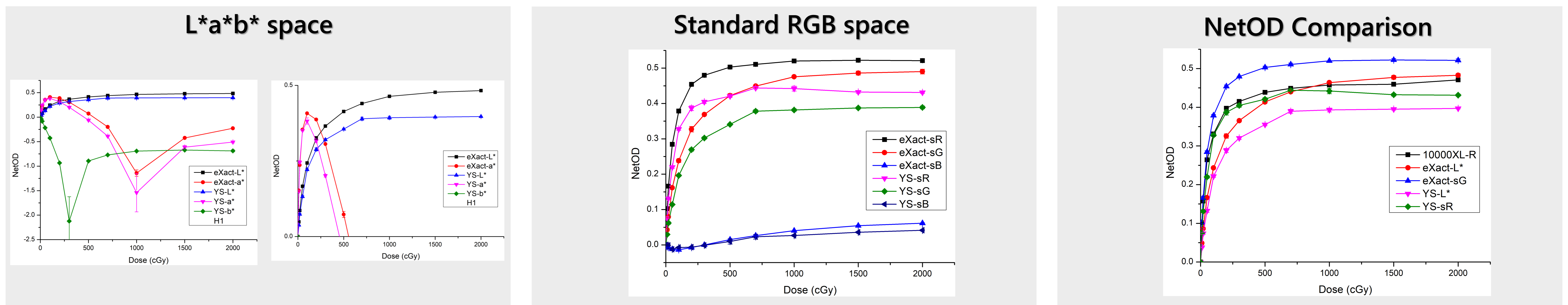
- Net optical density (NetOD)

$$NetOD = \log_{10} \left(\frac{I_{bkg} - I_{exp}}{I_{bkg} - I_0} \right)$$



Epson 10000XL

Results – NetODcurves



Results & Discussion

- The standard-red channel of eXact Advanced spectrophotometer showed the most sensitive curve in terms of netOD (i.e., 13.7% higher than 10000XL at 1000 cGy)
- The standard-red channel of YS-3020 device showed the similar levels of sensitivity with the Epson 10000XL flatbed scanner.
- However, Gafchromic did not recommend using standard color channels, since the raw data from the detector could be adjusted by color correction management [2].
- Further investigations are required to demonstrate the reproducibility and reliability of using standard color channels .

Conclusions

- The eXact Advanced showed higher sensitivity than that of the flatbed scanner, and YS-3020 showed similar levels of sensitivity with the flatbed scanner.
- Utilization of portable spectrometers to evaluate the dose of the radiochromic film is expected to be used especially for the fast and in situ analysis of irradiated film.

Reference

- [1] Anderson CK. Daytime color appearance of retroreflective traffic control sign materials. Publication No. FHWA-HRT-13-018, April 2013.
[2] Efficient protocols for accurate radiochromic film calibration and dosimetry.
<http://www.gafchromic.com/documents/Efficient%20Protocols%20for%20Calibration%20and%20Dosimetry.pdf>

Keywords

Portable spectrophotometer, radiochromic films, flatbed scanner, in situ analysis

Acknowledgement

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