AbstractID: 12636 Title: Development of the Preliminary Quality Assurance Software for GafChromic EBT2 Film Dosimetry

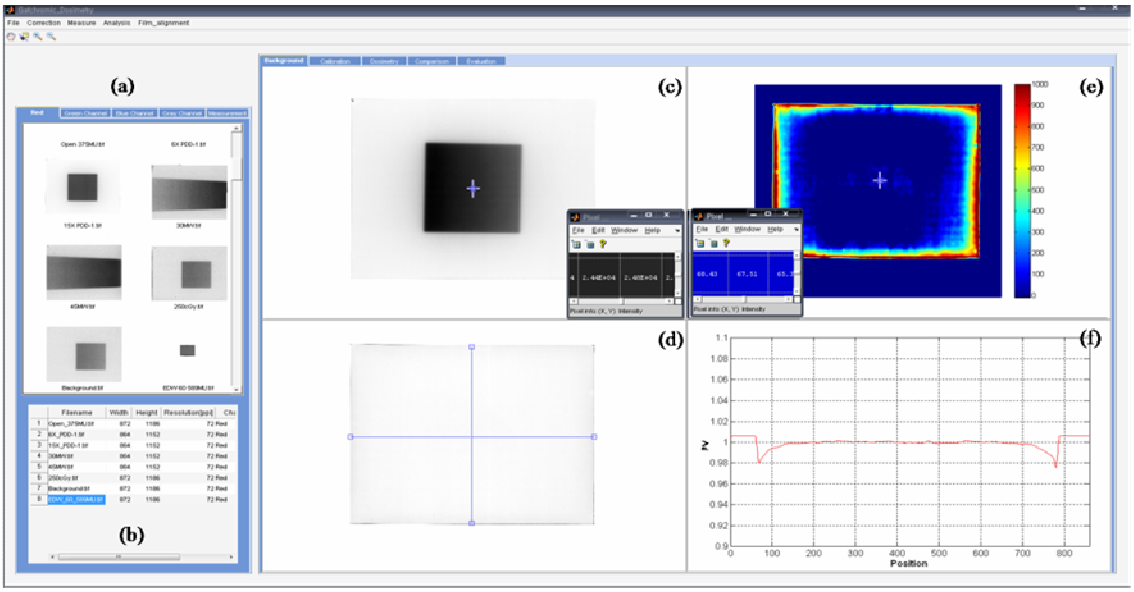

Figure 1: The tab for background correction and analysis of scattering effect in the developed software. (a) The frame displaying the imported images based on color channels, red, green, blue and gray. (b) The table showing the image information and providing sub–items to select images for each process. (c) The selective EBT2 film to evaluate measured dose. (d) Determination of the average pixel values in central region of un–exposed film for relative background correction. (e) The matrix representing standard deviations from the average pixel values of central region for absolute background correction. (f) Variation of the pixel values along horizontal direction in landscape orientation.

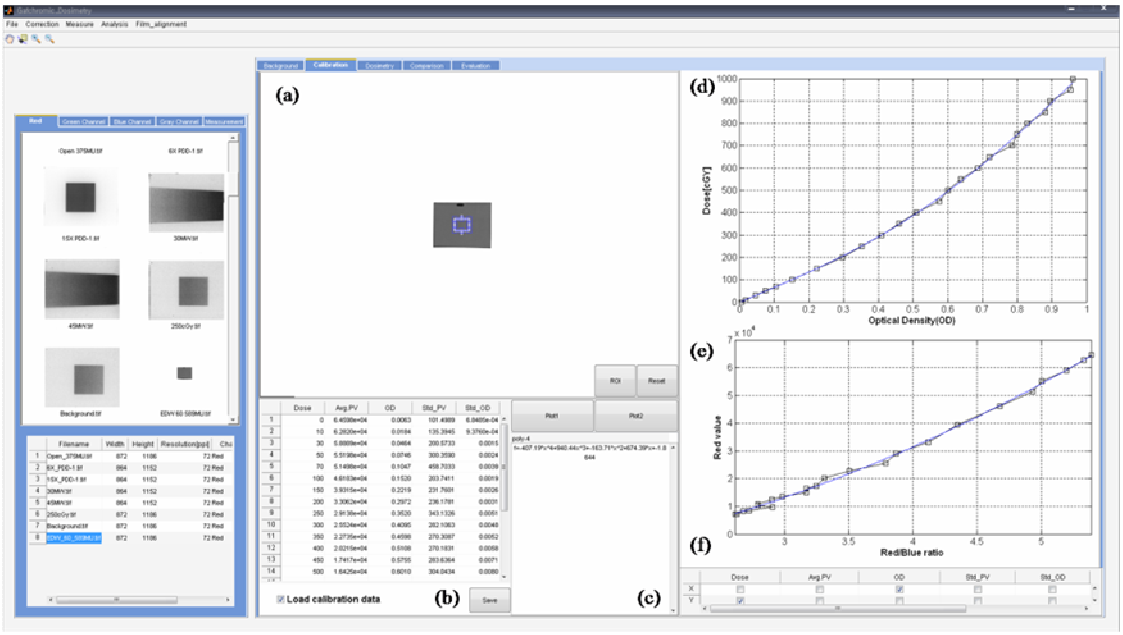

Figure 2: The tab for film calibration and active layer correction in the developed software. (a) Calculating average pixel values in the calibration film. (b) Calibration data of EBT2 film based on red channel. (c) Fitting equation of densitometry curve. (d) The densitometry curve and the fitting result based on 4th polynomial function. (e) The fitting curve for active layer correction. (f) Optional items to plot the relations between selective parameters for x and y axis.

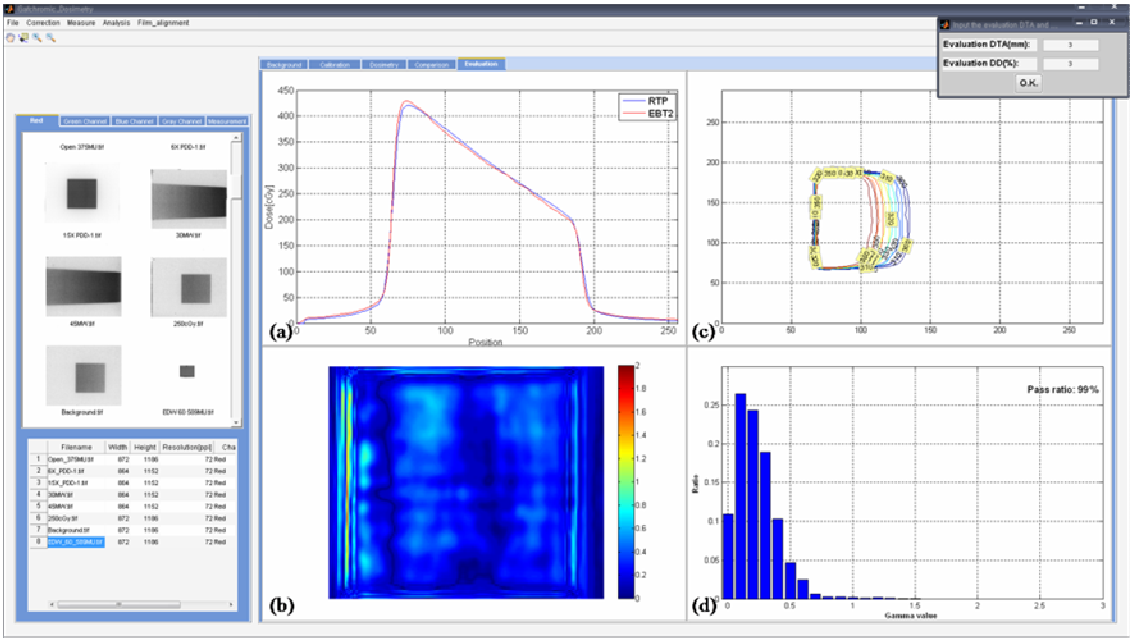

Figure 3: Dose evaluation between measured value using GafChromic® EBT2 films and ECLIPSE data in 60° enhanced dynamic wedged field. (a) Absolute x-axis profile in horizontal direction at the center of the field. (b) Comparison of isodose curves written the dose levels in yellow box for EBT2 films and without yellow box for planning system. (c) Gamma index applied the 3 mm distance–to–agreement and 3% dose difference. (d) Analysis of gamma histogram according to the gamma criteria.

For film calibration, EBT2 film in size of 8 inches×10 inches is cut into 25 rectangular pieces of 5 cm wide and 4 cm long. In source-to-axis distance (SAD) 100cm and in field of 10×10cm^2, the film pieces placed on the slab phantom (SP33, Scanditronix-Wellhofer, Schwarzenbruck, Germany) were exposed by the 6MV photons. Doses of 10, 30, 50, 70, 100 monitor units (MUs) were delivered to films for calibration in lower dose range. Treatment beam imparted doses at 50 MU intervals in the dose range over 100 MU up to 1000MU.

To reduce the scanner noise, the Wiener filter is applied for all imported images. In addition, the relative or absolute background correction is selectively applied to compensate intensity variation influenced by light scattering based on pixel–by–pixel. The relative background correction uses the matrixes representing the ratio of the each PV to the average pixel value of central region (avg. cPV) of the unirradiated films. On the other hand, the standard deviations (SDs) from avg. cPV are used as the absolute background correction. These matrixes of the PV ratio and SDs are divided or subtracted to correct scattering effect using eq. (1), $PV_{irradiate}^{Corr,\ relative}(i, j) = \frac{PV_{irradiated}(i, j)}{k(i, j)}$, and eq. (2), $PV_{irradiated}^{Corr,absolute}(i, j) = PV_{irradiated}(i, j) - SD(i, j)$, respectively. The correction for active layer thickness is appended to lessen the response differences between films in the same batch as in eq. (3), $f(PV)^{corrected} = \frac{PV_{red}}{PV_{red}/PV_{blue}}$.

By applying the characteristic curves based on the red and blue channel, the relation of eq. (4) was applied to correct difference of active layer thickness in irradiated EBT2 film. After several corrections and noise filtering, corrected PVs of EBT2 films were converted to dose using the eq. (5) of sensitometric curve.

$$y(x) = 2295x^2 + 2127x - 13808 \quad (4)$$

$$y(x) = -407.19x^4 + 940.44x^3 - 163.71x^2 + 674.39x - 1.8644 \quad (5)$$

The maximum value of measured dose in 60° EDW field (429.4 cGy) is higher than that of TPS (421cGy). The dose difference between 352.7 cGy and 360.2 cGy of EBT2 film and ECLIPSE, respectively, is lower than 3% error at the position where greater discrepancy is shown than around points. This result is reflected to the analysis using gamma index applied the distance–to–agreement of 3 mm and dose difference of 3 %, as can be seen Fig. 3 (b). Except for the edges showing the steep dose gradient, the regions within irradiated field represent lower gamma value than 1. It is also verified in the gamma histogram as in Fig .3 (d) with 99 % pass ratio.