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A new approach to radiochromic film dosimetry based on non-local means

Introduction: Radiochromic films in conjunction with a flatbed document scanner are frequently employed as dosimeters for advanced techniques in radiotherapy. Their main advantages are: light element composition, low energy dependence, near biological tissue equivalence and high spatial resolution. However, they have some weaknesses as well: non-uniformities, read out noise and scanning artifacts. Several processing protocols have been proposed in order to overcome those weaknesses. The more recent ones are those derived from the work of Micke et al. in which a multichannel approach is introduced. These protocols assume a common perturbation map for the three color channels and usually employ additional corrections. This fact, to some extent, makes the radiochromic film use more complicated. The aim of this paper is to present a new protocol based on a non-local (NL) mean denoising algorithm.
Methods: The NL-means algorithm, as it is described by Buades et al., replaces the color of a pixel with the average of the colors of other pixels that resemble its color, except fluctuations due to noise. These other pixels do not have reason to be close to the first one. The main advantage of using these pixels is that it is possible to mitigate noise without r
elying on multiple images. Radiochromic film provides a different response in each of the three color channels, so in principle, it would be possible to mitigate electronic noise and other lack of uniformity, applying the NL-means algorithm to the images. In this work an implementation of the Buades algorithm has been used. The steps of the processing protocol we propose are: read out the film as a 48-bit color image with just one scan, apply the NL-means algorithm to the image, split the denoised image into its color channels and apply the corresponding color response vs dose response curve to each splitted denoised image. To validate the protocol, three open square fields absorbed dose distributions were measured with an ionization chamber and with radiochromic film. One percentage depth dose and three off-axis ratio profiles at different depths for each field have been compared using the gamma index. No independent renormalization was allowed for different curves belonging to the same field.

Results: Using the same raw data coming from just one scan it has been found that the proposed protocol improves the standard multichannel protocol according to the gamma index results.

Conclusions: The new protocol based in the NL-means algorithm could help radiochromic films become a handy dosimeter for quality control purpose, avoiding cumbersome and time consuming corrections.
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