Purpose:Fluoroscopic tumor tracking without implanted fiducial markers in image-guided lung cancer radiotherapy is an important yet challenging research topic nowadays. In this study, a novel strategy using clustering on low-rank fluoroscopic images is proposed for lung tumor tracking.

Methods:Precisely localizing lung tumor position in fluoroscopic images is difficult because of either the obscure boundary between the tumor region and its surrounded non-tumor tissues or concurrent movement of both tumor and non-tumor tissues. A fluoroscopic image is first decomposed into low-rank and sparse components based on a Robust-PCA model via a split Bregman method in this study. The purpose is to obtain low-rank fluoroscopic images with less movement of non-tumor tissues. Later, a k-means clustering algorithm is applied on low-rank fluoroscopic images to differentiate tumor from non-tumor tissues. A morphological process and a connected components analysis are also incorporated on clustering results to determine detected tumor regions for tracking.

Results:400 fluoroscopic images obtained from 3 patients with lung cancer are utilized to evaluate the performance of the proposed tumor tracking strategy. Another strategy, which conducts the same tracking steps via clustering but directly on fluoroscopic images, is implemented for comparison. Experimental results and statistical analysis demonstrate that clustering on low-rank fluoroscopic images performs significantly better than performing clustering directly on fluoroscopic images for lung tumor tracking. Also, tracking results obtained by the newly proposed strategy are more stable, and they are less likely to be influenced by non-tumor tissues around the tumor region in fluoroscopic images, which often happens when applying clustering directly on fluoroscopic images.

Conclusions:A novel markerless tumor tracking strategy via clustering on low-rank fluoroscopic images for image-guided lung cancer radiotherapy is proposed. Promising results are demonstrated by testing the proposed strategy on real patient data.

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