A two dimensional decision making model after comparing portal and reference images

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Portal images acquired using radiographic film or electronic portal imaging devices (EPIDs) are used routinely to verify the correct position of the treatment field in radiotherapy. While lots of efforts are directed at improving the quality of the images acquired using megavoltage radiation there are only few papers dealing with the decision making process after a deviation between portal image and reference image has been detected. We propose a model based on confidence ellipses defined by the two dimensional Hotelling's T^2 statistics. The model does not rely on assumptions or historical data but requires five portal images to be taken of an individual patient. Then it allows for a correlation between shifts in both image dimensions as may be the case in patient movement. In a mathematical analysis it can be shown that the proposed decision making model is particularly advantageous in cases where it is difficult to predict the random variation of field position from day to day and if there is a strong correlation between the two directions of movement identified by the image. As EPIDs become widely available the proposed model offers an alternative decision making algorithm which is easily implemented and may help to account for patient variability and movement not confined to the axis of the conventional coordinate system.