Purpose: The aim of this work is to develop an automated method to objectively score the severity of image artifacts in four-dimensional (4D) computed tomography (CT).

Methods: We developed a metric based on the difference of the two-dimensional normalized correlation coefficients (NCC) between the edge slices at couch transitions and the NCC between edge slices and their neighbors within their respective couch positions. We applied our method to the 4D-CT images of ten patients that were initially retrospectively sorted using the breathing trace with miscalculated phase values, and then re-sorted using the same breathing trace with recalculated phase values after manually correcting the peaks of inhalation. The metric was calculated for both sets of 4D-CT images and a score was determined to assess the severity of the image artifacts in both sets. The accuracy of our method to identify the 4D-CT image set with fewer or lesser artifacts was validated by two human observers who evaluated three coronal and two sagittal cross-sections from the same locations in both image sets. The two sets were displayed side by side and each observer independently scrolled through ten respiratory phases of both sets simultaneously (blinded to the selection method of each set), and marked the image set that appeared to have fewer or lesser artifacts.

Results: Our method determined that the 4D-CT sets using the breathing trace with recalculated phase values after manually correcting the peaks of inhalation to result in images with fewer or lesser artifacts. This is in good agreement with the findings of both observers. The observers agreed forty times and disagreed one time among total fifty selections.

Conclusions: In this study we have demonstrated proof of principle that our method is able to replicate the findings of two human observers in determining 4D-CT images with fewer or lesser artifacts.

Funding Support, Disclosures, and Conflict of Interest:

The authors greatly acknowledge the support from Mr. and Mrs. T. Archer Morgan Fellowship in Radiation Oncology at Stanford University.