Development and validation of an algorithm to detect and quantify CT motion artifacts

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Introduction

- Artifacts can significantly degrade the quantitative usefulness of CT images, which can lead to consequences for patient safety.
- Hence, it is essential to quantify the presence and severity of artifacts to make inferences about how the presence of artifacts relates to other acquisition settings.
- **Current gaps:** The need for a method to quantify the presence and severity of motion artifacts leads us to the development of this algorithm.

Methods

- **Data collection:** Curated a combination of publicly-available CT data (RSNA, SPIE/AAPM) and Duke clinical images known to contain motion artifacts.
- **Data preparation:** Segmented motion artifacts were using Seg3D software (Univ. of Utah) and created binary motion masks to be used as ground-truth data.
- **Model and training:** Trained a convolutional neural network with u-net architecture to identify pixels containing motion. The training dataset comprised 50 image series.
- **Model evaluation:** Calculated the percentages of ground truth and predicted voxels with motion and analyzed using a direct correlation plot. Computed ROC curves. Conducted visual examination to confirm the success of the model.

Methods

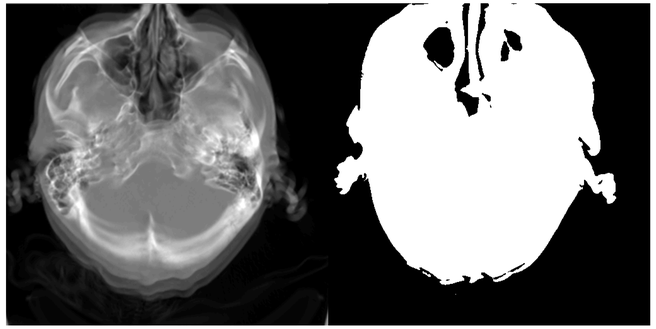

Fig. *Example of a CT image slice (left) and its corresponding binary motion mask (right).*

Results

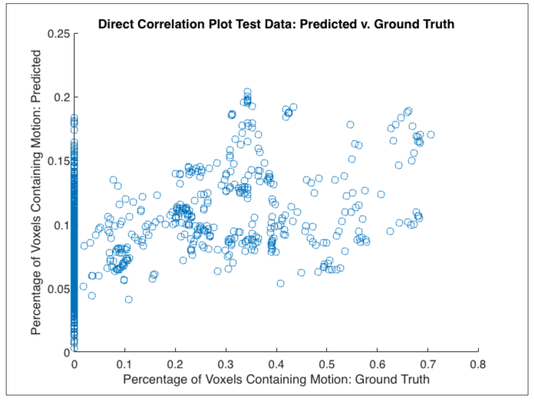

Fig. *Direct correlation plot between ground truth and predicted pixels with motion. The predictions are moderately positively correlated with the ground truth with a correlation coefficient of 0.4840, a promising preliminary result that will be revised as more training data are acquired.*

Results

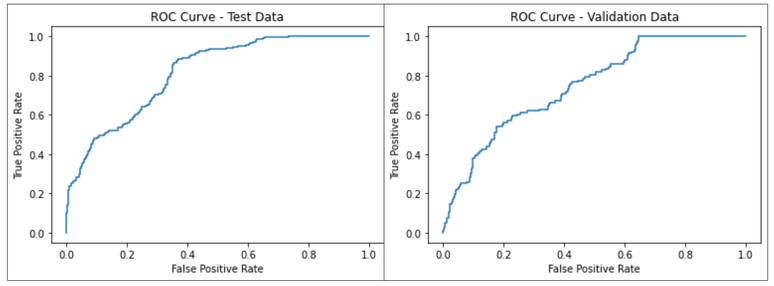

Fig. *ROC curves for test data (left) with AUC = 0.81 and validation data (right) with AUC = 0.75. These results suggest that the discrimination performance of the model is strong.*

Conclusion

- Demonstrated the capability of the model to identify characteristics of motion artifacts in CT images.
- The network has potential to be a useful tool in detecting and quantifying motion artifacts and comparing this metric to other CT acquisition parameters.

Acknowledgments

We would like to thank Dr. Yunfeng Cui, Dr. Don Frush, and Dr. Josh Wilson for their contributions to the data collection process.

Study supported by Imalogix.

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