Enhancing Radiology Assessments with Human-Centric AI- A pilot Project in CT Scan Analysis

NHS George Eliot Hospital

The manual process for analysis of lesions on serial CT scans is time-consuming, lacks precise alignment due to anatomical positioning variations and automatic 3D alignment is imperfect. Small or developing lesions are prone to being missed.

INTRODUCTION

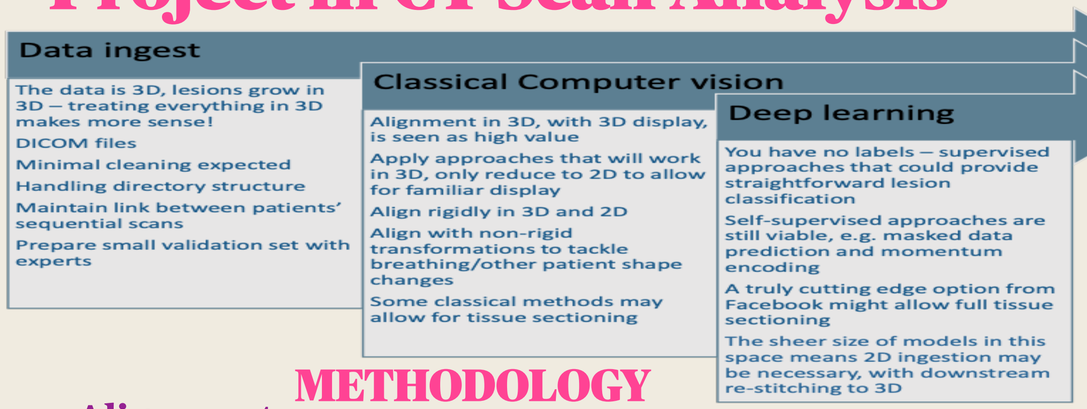
This AI algorithm was conceived with the intention to transform diagnostic imaging interpretation by enabling automated image overlap, precise alignment,3D lesion size assessment, accurate volume change documentation, and improved detection of new and resolved lesions.
This project aimed to take a human-centric approach to speed up the analysis of CT scans.

OBJECTIVE

Enhance radiology assessments by improving the current manual process.
Develop a human-centric AI model to expedite CT scan analysis by Radiologists.

APPROACH

12-week Agile project funded by the NHS AI Skunkworks and delivered in partnership with George Eliot Hospital (GEH) through the Accelerated Capability Environment framework by Roke Manor Research Ltd.



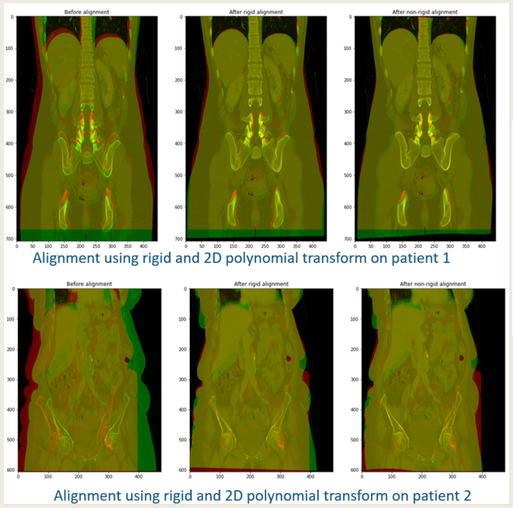
METHODOLOGY

(1) Alignment:

a. Phase Correlation - excellent local alignment, and typically takes a few seconds to run from the GUI, esp by a radiologist on demand. Achieving global alignment, either in 2D or 3D was a challenge with this method.

b. Keypoint Methods - (SIFT/ORB) predominantly used to perform alignment of 2D slices from scans. Initial results were inferior to those from the phase correlation.

c. Coherent point drift: Maxima of 50k target points and 5k source points were allowed in our use of the CPD algorithm.



CPD rigid and non-rigid methods, compared to no alignment for two patients

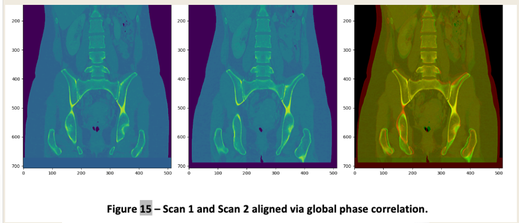


Figure 15 – Scan 1 and Scan 2 aligned via global phase correlation.

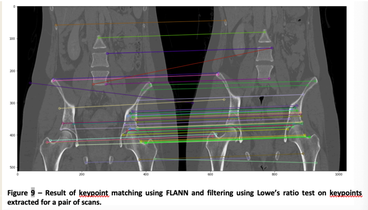


Figure 9 – Result of keypoint matching using FLANN and filtering using Lowe's ratio test on keypoints extracted for a pair of scans.

(2) Tissue Sectioning:

a. Textons method
b. Dino method – as released by Facebook
c. Machine learning and Deep Learning for tissue sectioning.
d. Unsupervised learning techniques for lesion detection.

(3) Anomaly Detection:

a. Ellipsoid Detection method
b. Masked Data Deep Learning

RESULTS

1. Coherent point drift was the most promising out of the three techniques.
2. Tissue sectioning and texton-based tissue sectioning appeared to perform well.
3. Anomaly detection alternate training objective for a masked data DL model could be trialled.
4. The project had various effective factors of human-centricity, including the incorporation of requirements of senior clinical radiology staff and the consideration of the target end users.
5. Limitations were the lack of inclusion of robust prior clinical documentation, lack of human factors in interpretability and the low numbers for validation.

CONCLUSION

Significant progress was made in alignment, sectioning, and anomaly detection methods. A proof-of-concept desktop application was developed using At5 with Paython binding (PySide2) and HMS clusterer processing via the Texton technique for tissue sectioning. Further work is required to provide a much needed 'support tool' for the Radiologists

REFERENCES:

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