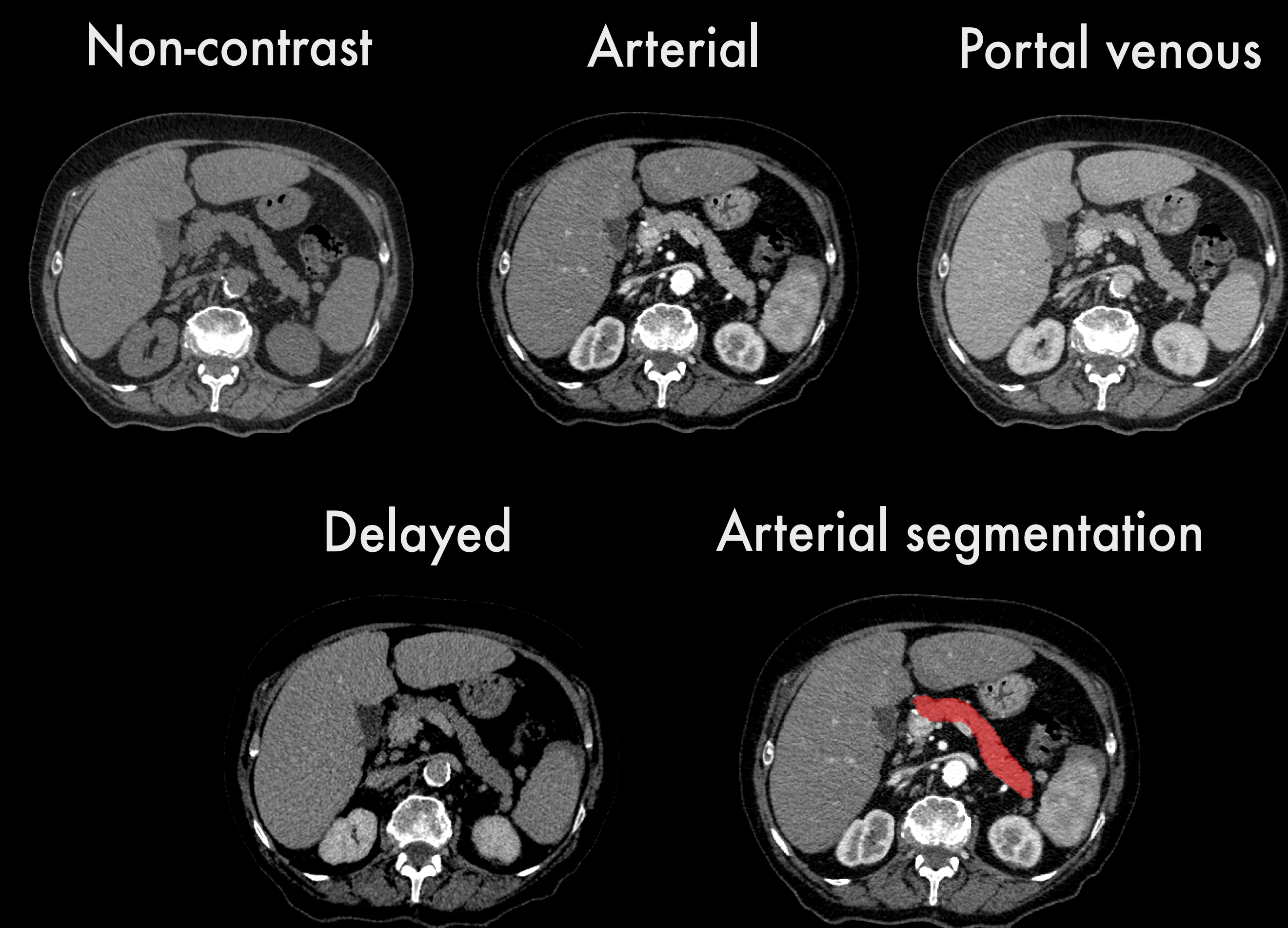


# The influence of CT contrast phase in early detection of pancreatic cancer when using radiomic features and machine learning

Susanna E. Kallioinen<sup>1,3</sup>, Abhir Bhalerao<sup>1</sup>, Charles E. Hutchinson<sup>1,3</sup>, Caron S. Parsons<sup>1,3</sup>

Affiliations: 1 University of Warwick, Medical School, 2 University of Warwick, Department of Computer Science, 3 University Hospitals Coventry and Warwickshire NHS Trust (UHCW)

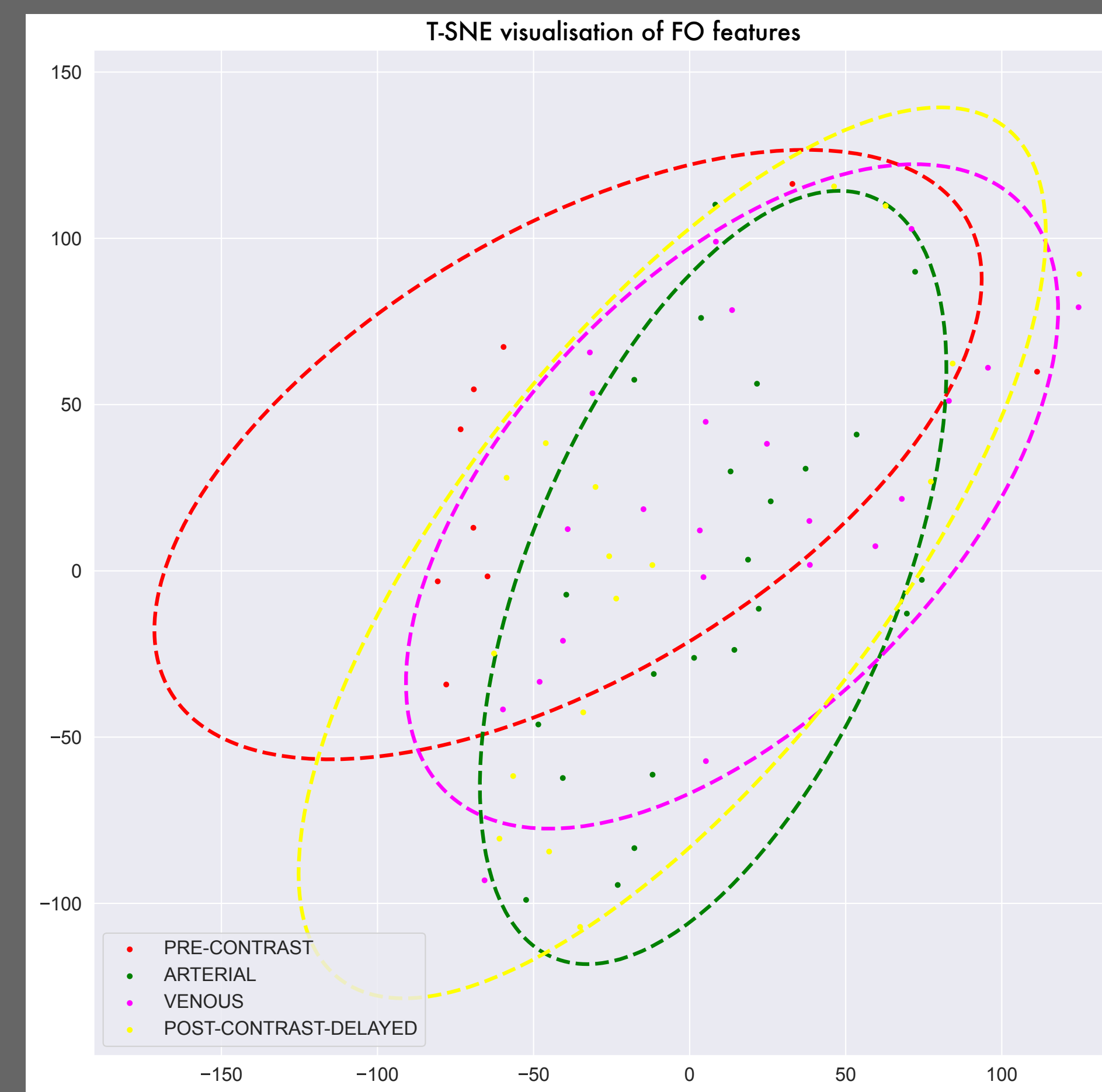
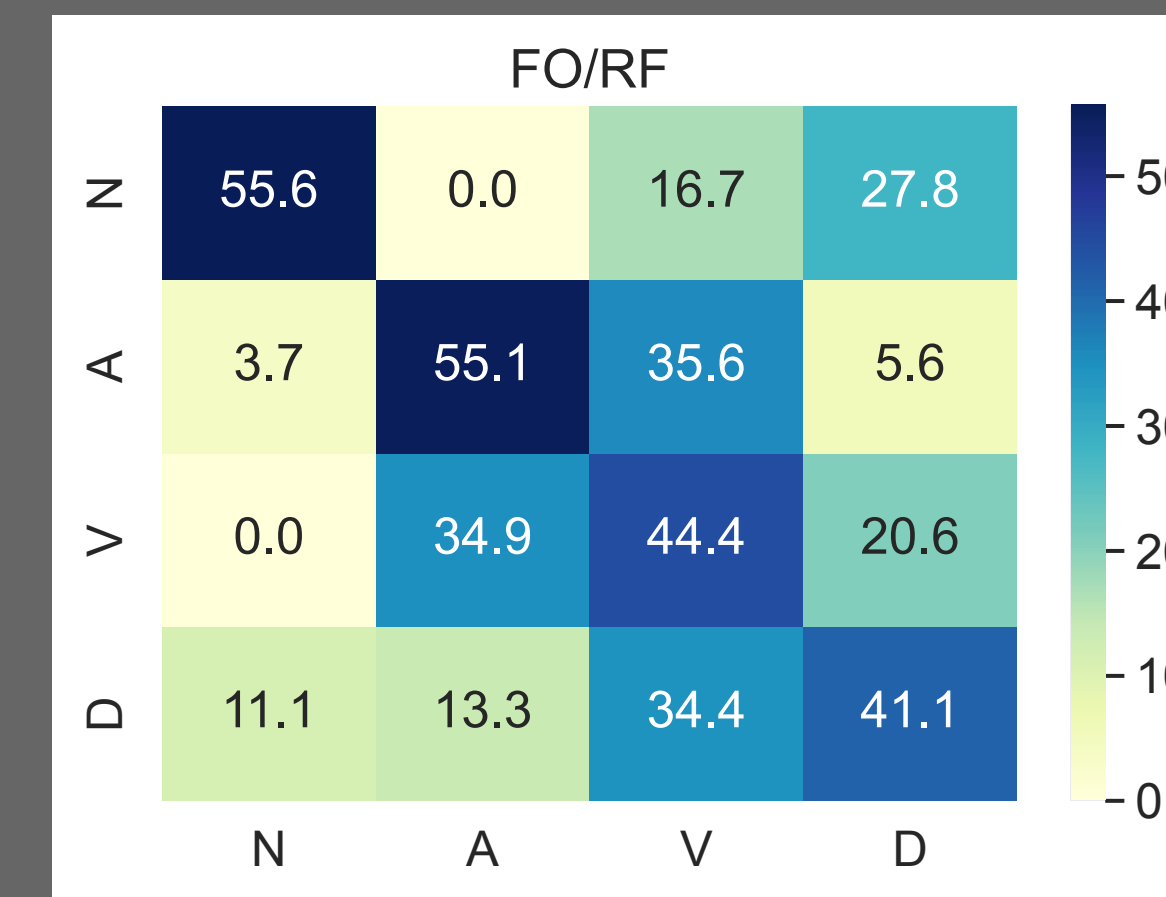


**Background:** Detecting pancreatic cancer early is essential for effective surgical treatment. We want to predict early pancreatic cancer from CT scans using texture analysis. To do this we compared non-contrast scans with the following contrast scans: arterial (35s) portal venous (70s) and delayed (3 minutes).

## Question: Does presence of contrast make a difference?

**Answer:** Yes. Gray-level co-occurrence matrix (GLCM) could distinguish between contrast and non-contrast scans, although the delayed phase behaves in a similar way to non-contrast scan.

Figures: First-order features correlate with the contrast phase; expected as they extract features of the histogram of the ROI voxels. The extracted features are closer together for the non-contrast, delayed, arterial and venous phases.

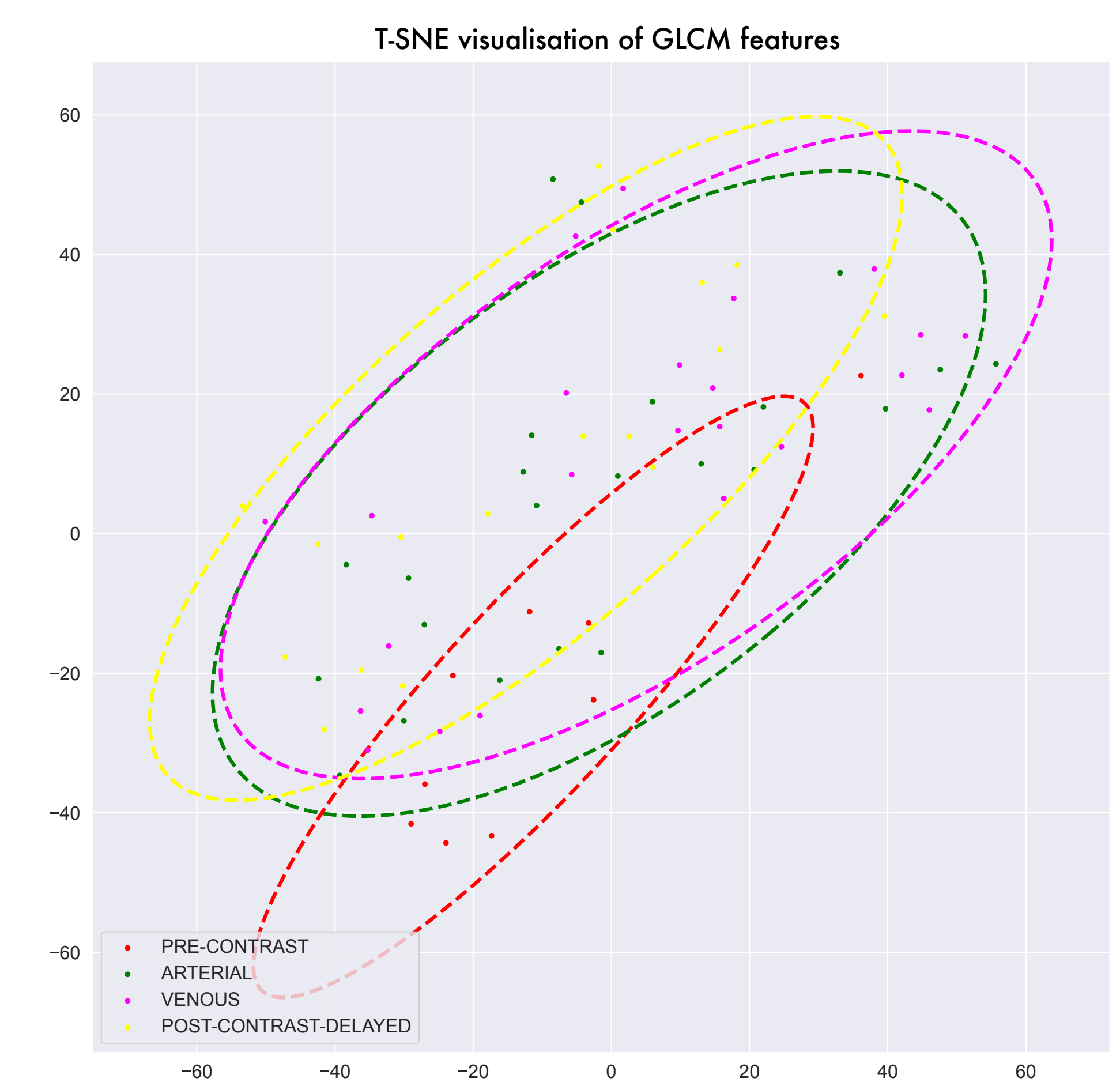
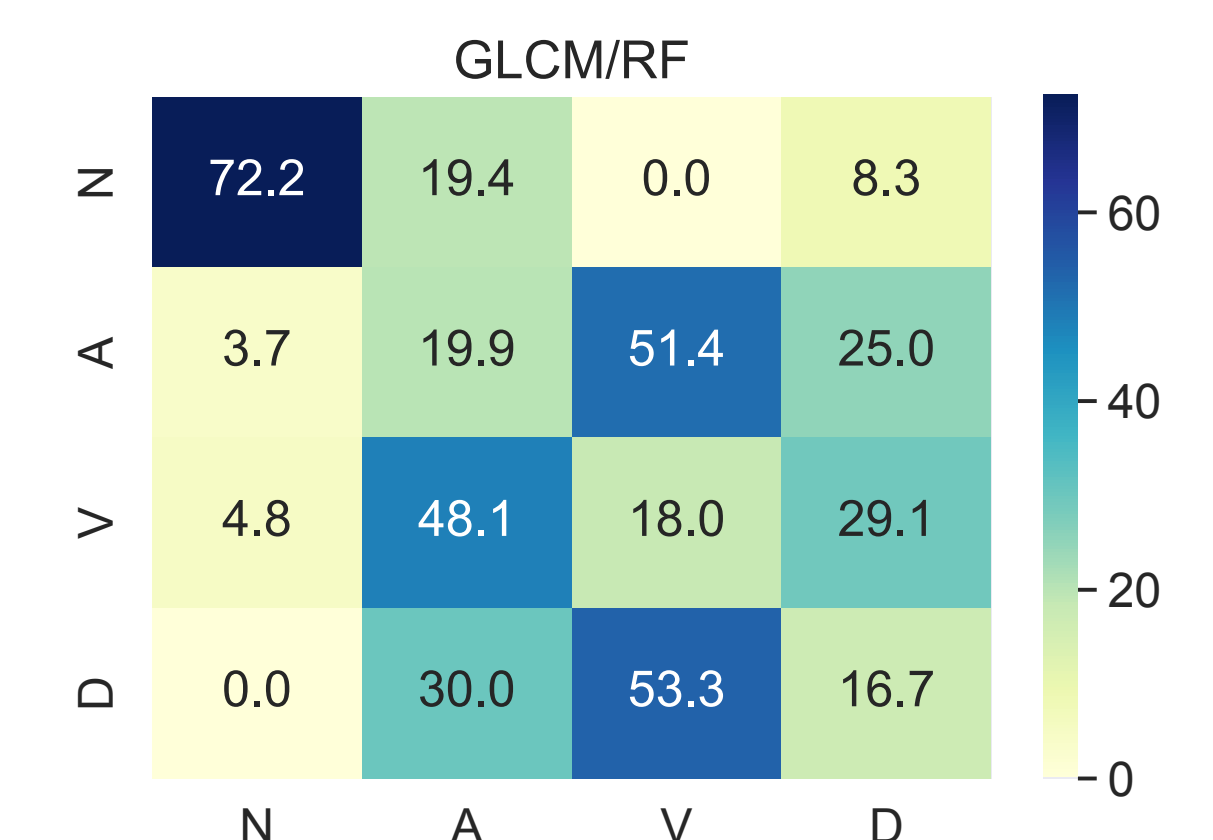


**Methods:** 72 liver CT scans at different phases were used to analyse the texture of the pancreas, obtained at the University Hospitals (UHCW). An automatic segmentation model of the pancreas, developed on publicly available databases of CT images of patients with normal pancreas (1) as well as pancreatic cancer patients (2, 3) was used to delineate the area of interest. The segmentations were manually checked for accuracy. Radiomic features, first-order histogram (FO) (4) and gray-level co-occurrence matrix (GLCM) (5) for texture, were extracted, after quantizing CT numbers [-1000,500] to 256 levels, and visualised using T-SNE low-dimensional plots (6, 7). A Random Forest classifier was trained to compare the expressive power of the feature sets across the contrast phases: non-contrast, arterial, portal venous, and delayed.

## Question: Does the phase of contrast make a difference?

**Answer:** No. Arterial, venous and delayed phases cannot be distinguished based on the GLCM textural features extracted.

Figures: GLCM textural features appear to be affected by the presence of contrast. Non-contrast scan can be distinguished from the other phases. Arterial, venous and delayed phases cannot be distinguished based on the GLCM textural features extracted.



**Conclusion:** A detection model built using GLCM texture features should work on any contrast phase if intravenous contrast has been given. A separate model might be built if using non-contrast scans. First-order, histogram based radiomic features are potentially confounding to classifying pancreatic voxels in different phase contrast images and should be used with care.

- References:
- Holger R. Roth, Amal Farag, Evrim B. Turkbey, Le Lu, Jiamin Liu, and Ronald M. Summers. (2016). Data From Pancreas-CT. The Cancer Imaging Archive. <https://doi.org/10.7937/K9/TCIA.2016.tN81kgBU>
  - Antonelli, M., et al., The Medical Segmentation Decathlon. Nat Commun, 2022. 13(1): p. 4128.
  - Hong, J., Reyngold, M., Crane, C., Cuaron, J., Haij, C., Mann, J., Zinovy, M., Yorke, E., LoCasta, E., Apte, A. P., & Mageras, G. (2021). Breath-hold CT and cone-beam CT images with expert manual organ-at-risk segmentations from radiation treatments of locally advanced pancreatic cancer [Data set]. The Cancer Imaging Archive. <https://doi.org/10.7937/TCIA.ESHQ-4D90>
  - pyradiomics: first order features <https://pyradiomics.readthedocs.io/en/latest/features.html#module-radiomics.firstorder>
  - pyradiomics: GLCM, texture features: <https://pyradiomics.readthedocs.io/en/latest/features.html#module-radiomics.glcm>
  - T-SNE Plots: L.J.P. van der Maaten and G.E. Hinton. Visualizing High-Dimensional Data Using t-SNE. Journal of Machine Learning Research 9(Nov):2579–2605, 2008.
  - T-SNE introduction: <https://towardsdatascience.com/an-introduction-to-t-sne-with-python-example-5a3a293108d1>