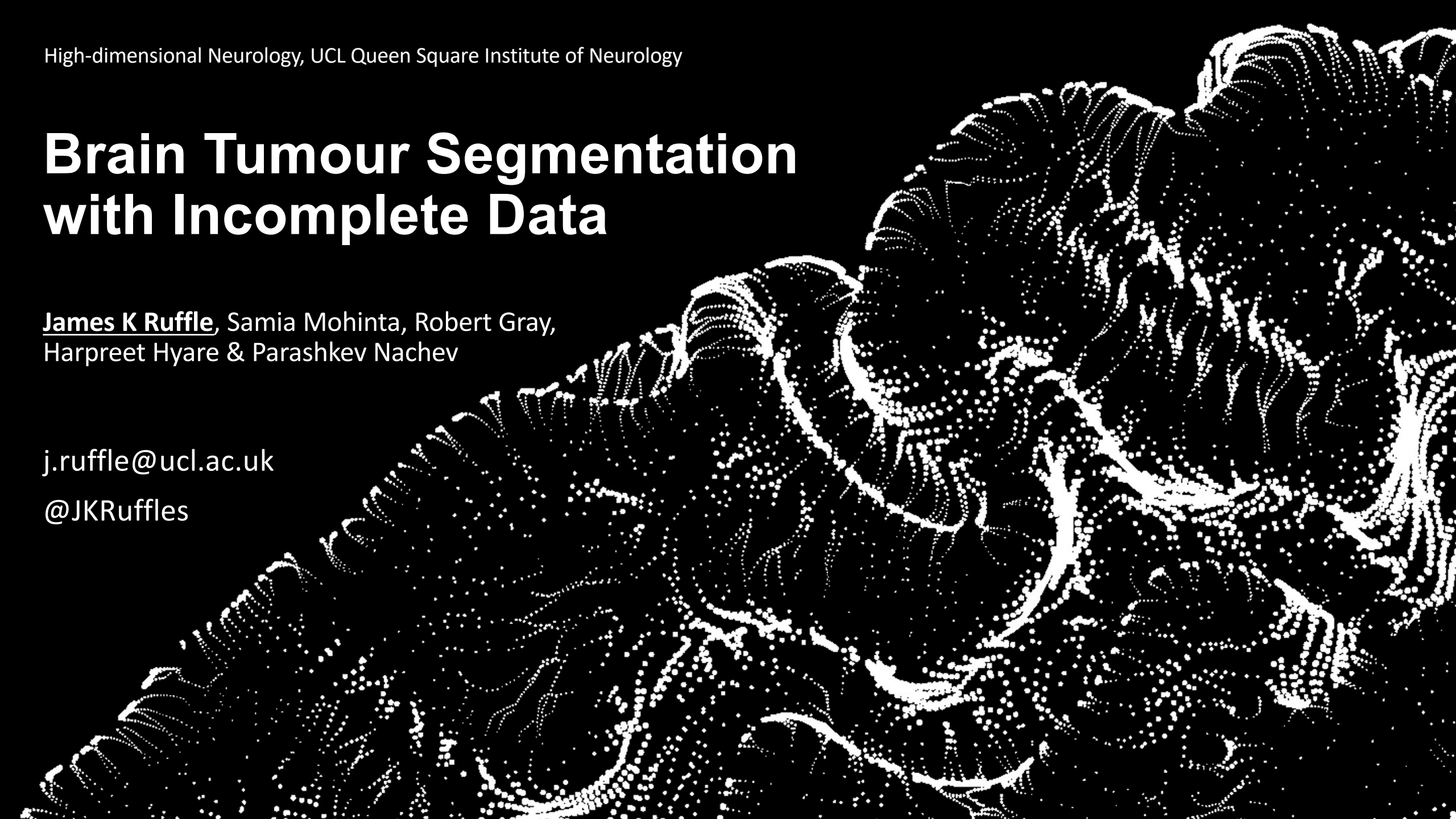
High-dimensional Neurology, UCL Queen Square Institute of Neurology

Brain Tumour Segmentation with Incomplete Data

James K Ruffle, Samia Mohinta, Robert Gray,
Harpreet Hyare & Parashkev Nachev

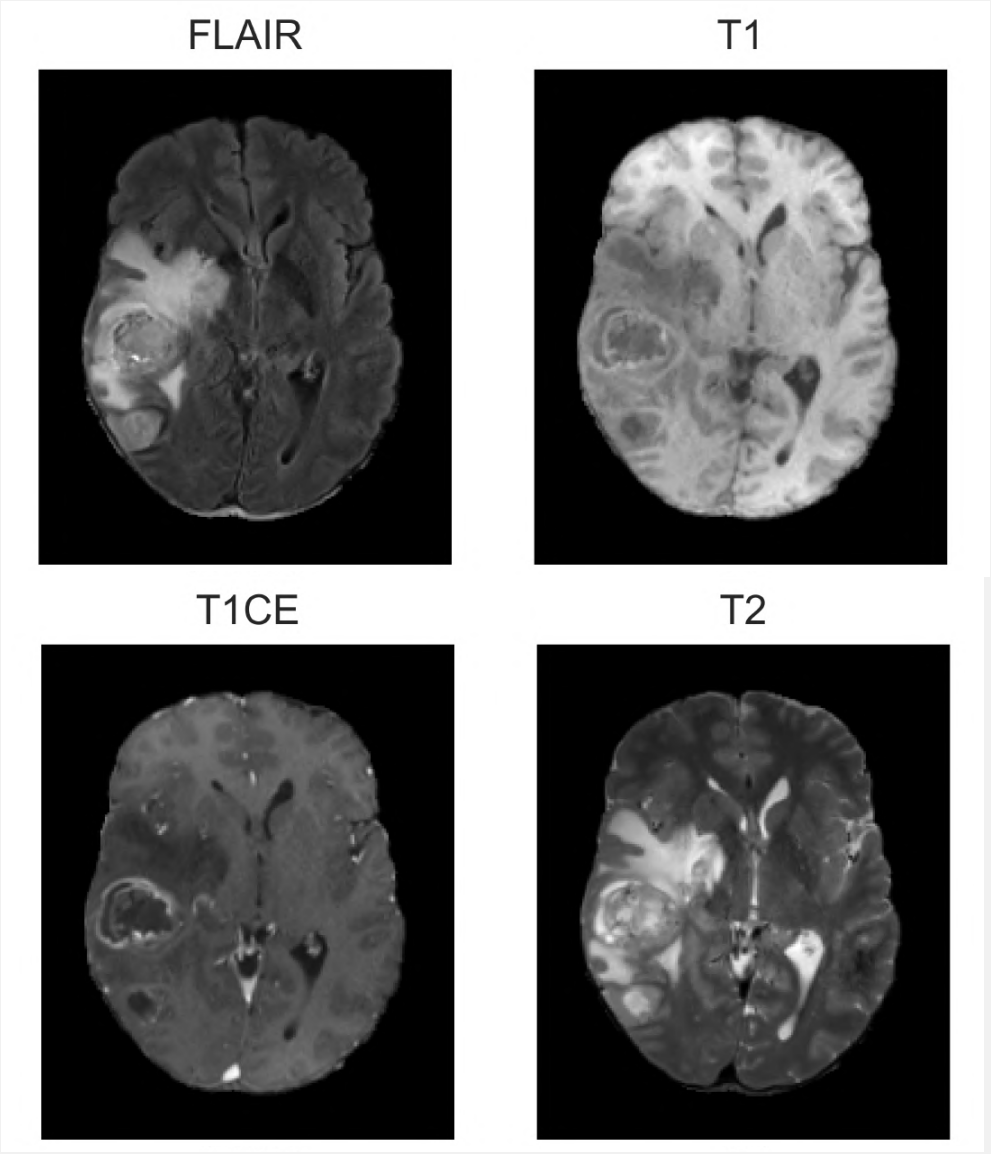
j.ruffle@ucl.ac.uk

@JKRuffles



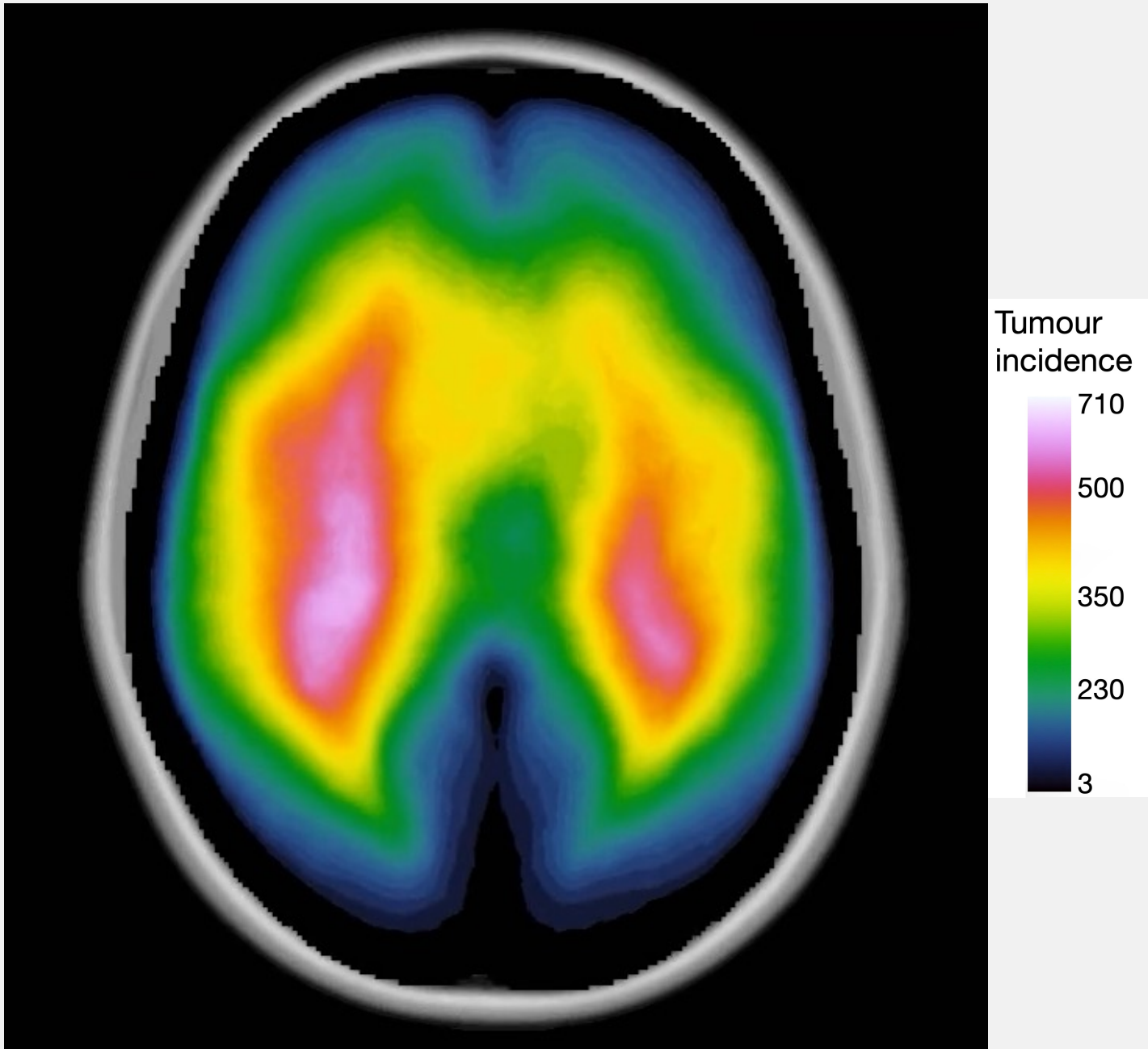
Background & Aim

- Brain tumour segmentation is ***difficult***
  - **Imaging is very heterogenous**
- **Best imaged with MRI**
  - 4 main structural sequences: FLAIR, T1-weighted, T2-weighted, and contrast-enhanced T1-weighted sequences (T1CE).
- Current brain tumour segmentation research focuses solely on **using deep learning models to automatically segment lesions** when ***all four sequences are available.***
  - **But this 'perfect' and complete data is often rare in clinical practice**.
  - For example, what about patients allergic to contrast, or those in renal failure who cannot receive it?
- **Aim:** How well do segmentation models perform **with incomplete data**?



Method

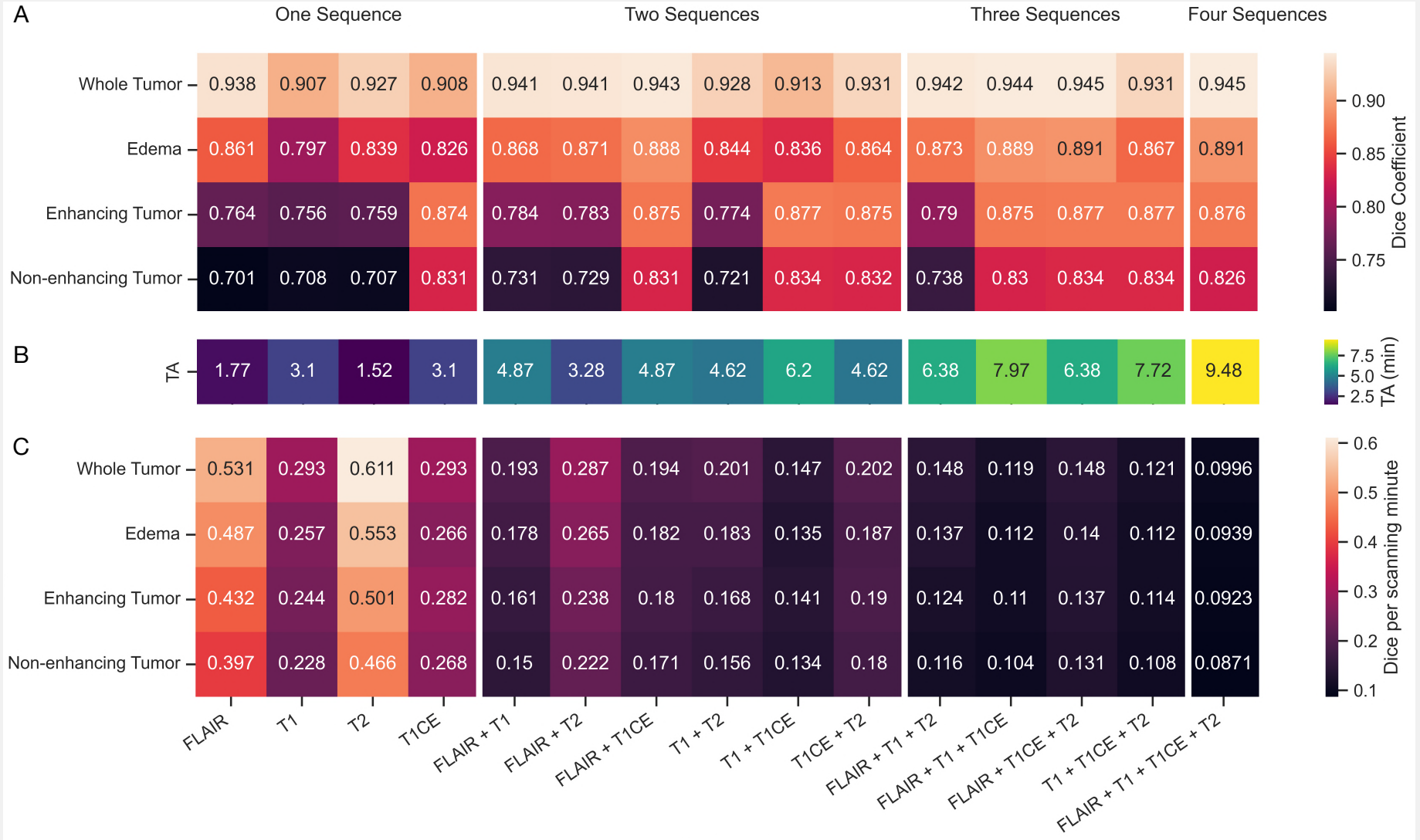
- State-of-the-art tumour segmentation modelling based on nnU-Net[1]
- Glioma population of **1251 patients**
- **All possible combinations of imaging modalities**
  - Trained, and tested with five-fold cross-validation on the 2021 BraTS-RSNA dataset
  - 30 separate models



1. Isensee et al, Nature Methods, 2020

Results

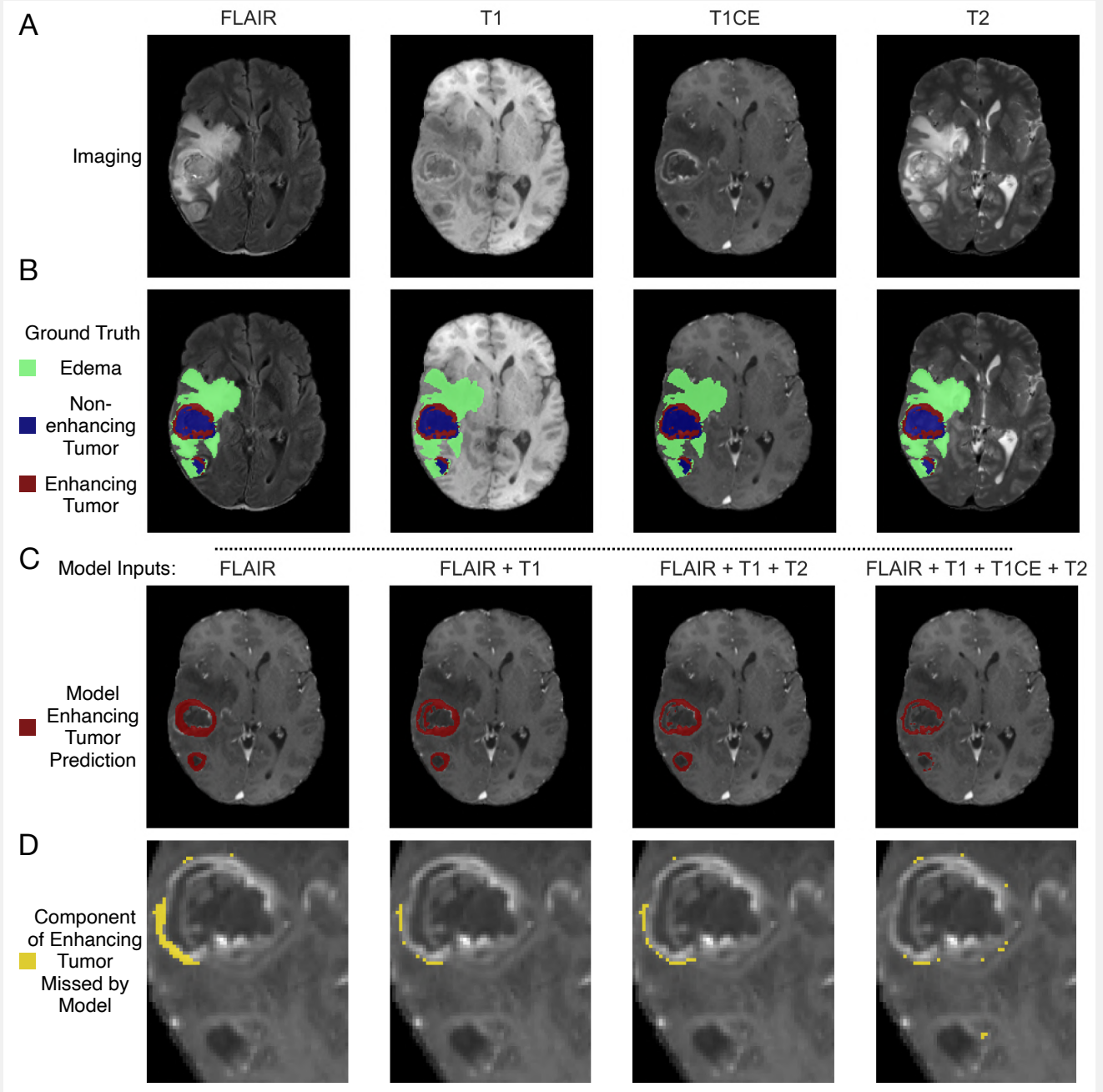
- A) **All models perform well**
  - Close to current state-of-the-art
- B) Incremental gain with scanning time (TA) for additional sequences ***is small***



Results

- Deep learning models ***without*** **contrast-enhanced imaging (T1CE)** available **still accurately identify the enhancing tumour**

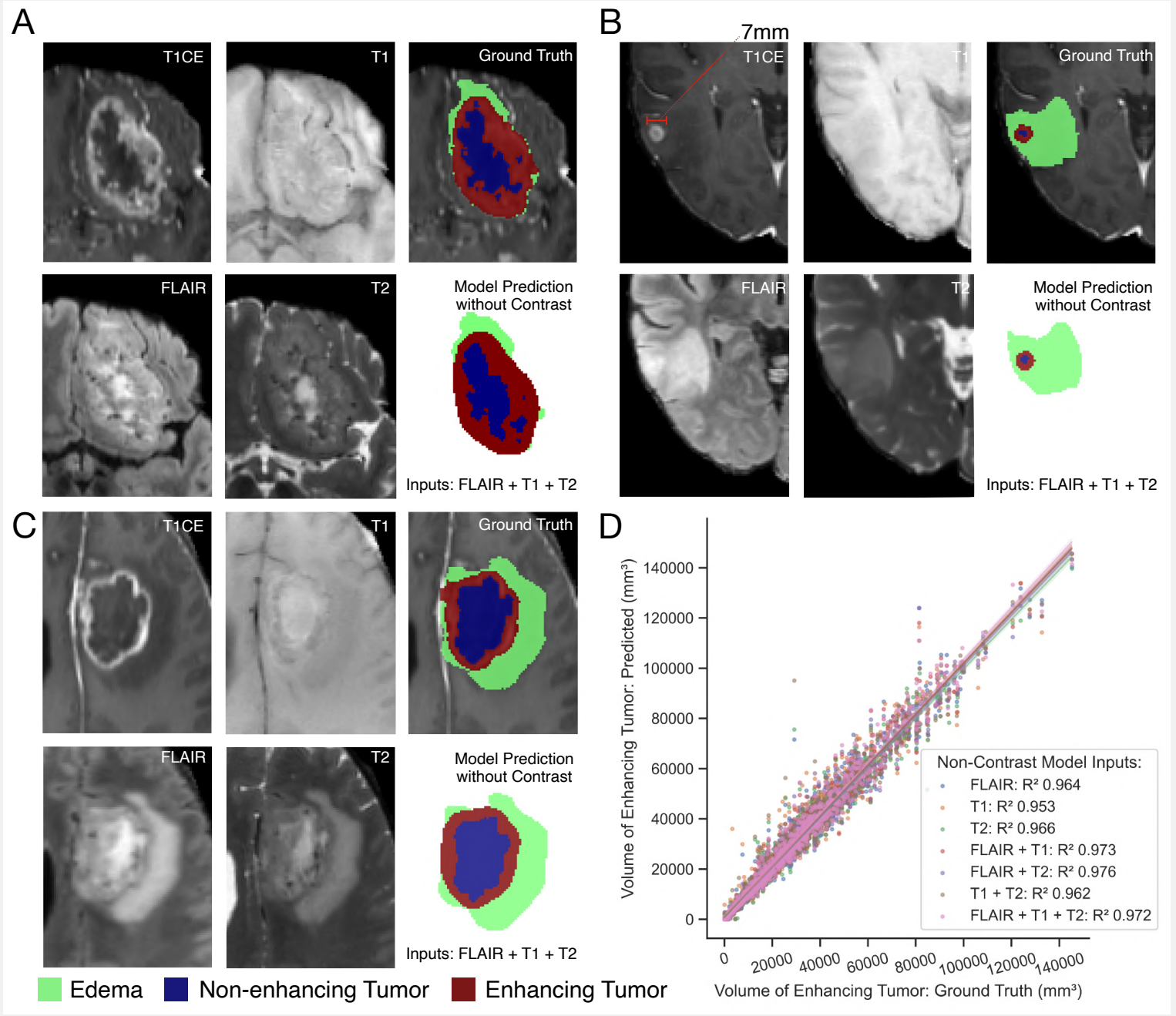
- **Moreover, their performance in doing so is close to models that do have it available.**



Results

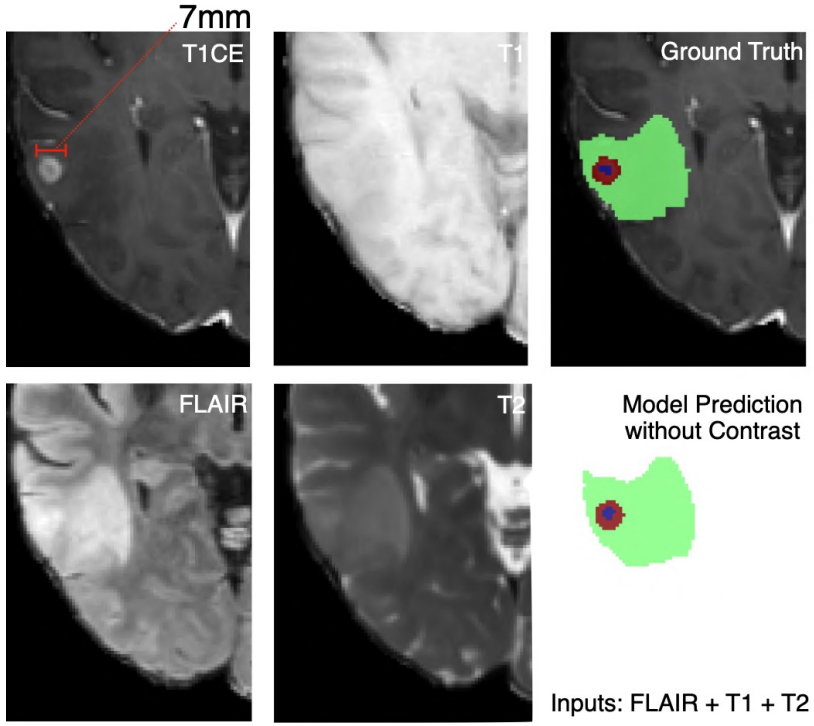
- Deep learning models ***without*** **contrast-enhanced imaging (T1CE)** available **still accurately identify the enhancing tumour**

- **Near perfect prediction of enhancing tumour volume, despite no contrast-enhanced imaging being provided to the model** (R^2 range 0.953-0.976)



Conclusions

- **Segmentation models can identify tumours with missing data**
- **Can be used in clinical situations where partial data is common.**



Acknowledgements

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j.ruffle@ucl.ac.uk

@JKRuffles