International Journal of Population Data Science

Journal Website: www.ijpds.org

Accelerating AI-Driven Neuroimaging Research in Dementia

Lewis Hotchkiss[1], Chloe Tulip[1], Emma Squires[1], and Simon Thompson[1]

[1]Swansea University, Swansea, United Kingdom; Dementias Platform UK Data Portal, Swansea, United Kingdom

Artificial intelligence (AI) is rapidly advancing neuroimaging research for earlier and more accurate detection of dementia, yet the complexity, size, and heterogeneity of neuroimaging data create substantial barriers to scalable analysis within secure environments. Neuroimaging datasets require specialised processing, harmonisation across cohorts, and significant computational capacity - challenges that exceed those associated with typical structured health data. To address these issues, the Dementias Platform UK (DPUK) has developed a comprehensive neuroimaging infrastructure within its Trusted Research Environment (TRE), enabling secure, efficient, and standardised access to large-scale imaging resources for AI-driven research. We implemented automated pipelines to convert raw scans into research-ready datasets, adopting the Brain Imaging Data Structure (BIDS) standard across more than 20 cohort and clinical datasets. Harmonised imaging-derived features were produced to support cross-study comparability, and a curated clinical imaging collection focused on dementia was created to facilitate targeted AI model development. All datasets and workflows are available through the DPUK Data Portal, which provides researchers with high-performance compute, scalable storage, and established neuroimaging and AI tools within a secure environment. The resulting harmonised imaging resource offers a rich platform for investigating neurodegenerative disease trajectories and developing generalisable AI models. In collaboration with Dementias Platform Australia, we are extending this work internationally by federating TREs and aligning imaging collections using shared harmonisation methods, enhancing data diversity while preserving governance and privacy standards. By integrating processing pipelines, standardisation tools, and advanced infrastructure, DPUK has enabled scalable, responsible, and high-quality AI research using population-scale neuroimaging data.

https://doi.org/10.23889/ijpds.v11i5.3568