AI in predicting structural brain changes

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INTRO

As people age, brain tissue loss affects cognition, making early detection of abnormal changes crucial to prepare for disease risk and interventions. However, predicting these changes is challenging due to costly continuous MRI studies. To address this, we propose two AI-based alternatives to predict 9-year brain changes in T1w MR images.

METHODOLOGY

Data – 703 individuals with T1w MR scans from HUNT study
Preprocessing – Using FreeSurfer
Methods – 2 different approaches using:

- Deformation Fields (DF)
- Generative adversarial Networks (GAN)

Evaluation – Using Dice coefficient, tissue volume differences, Brain parenchymal fraction and image similarity.

RESULTS

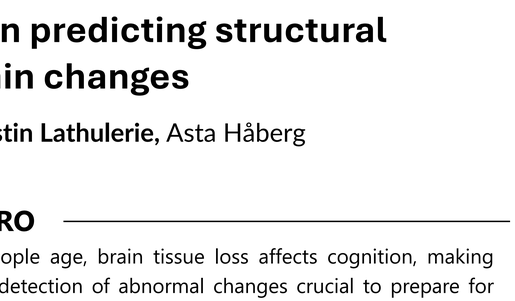
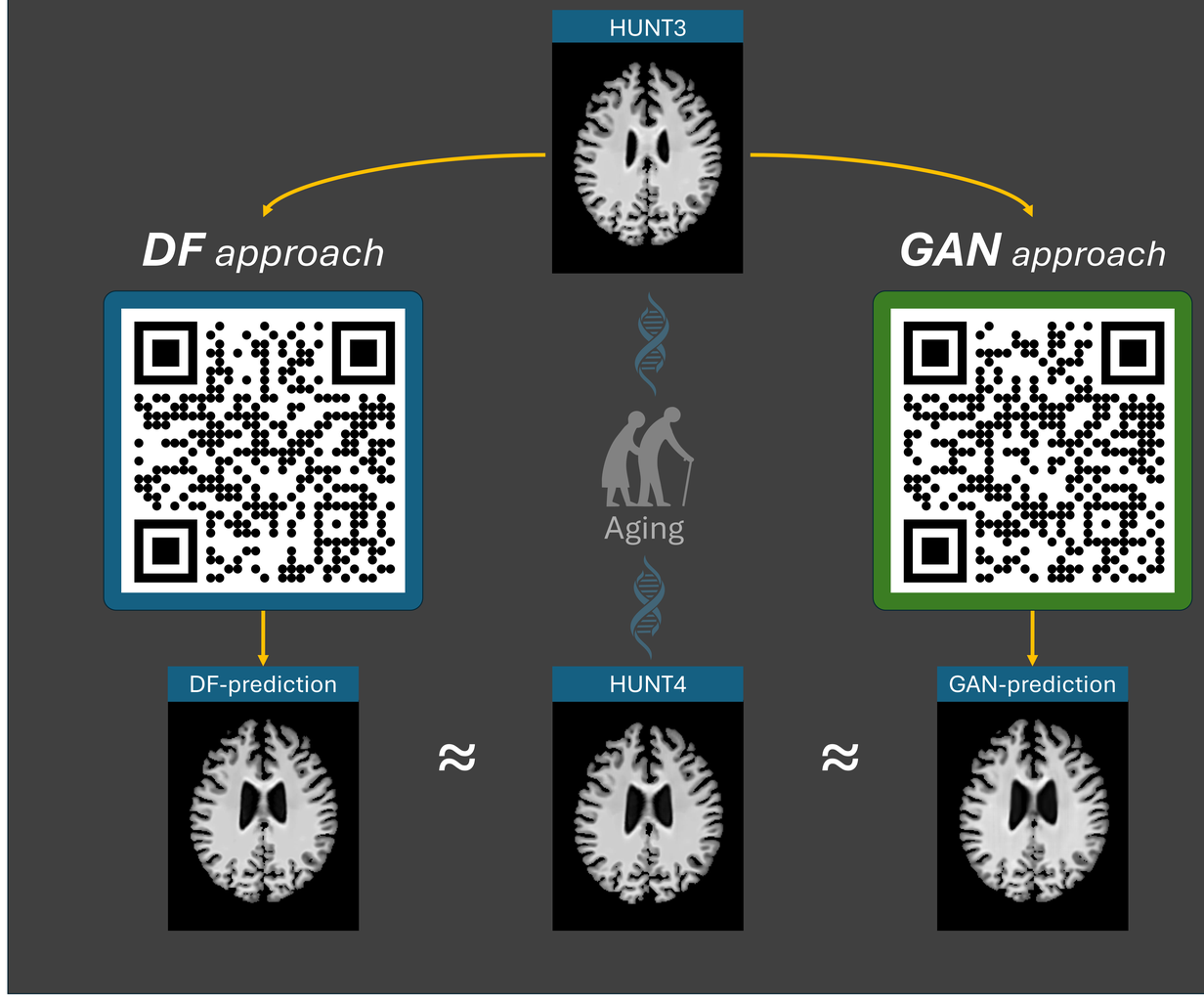


Fig. 1: Initial image, expected image, and predictions with both methods. The second row shows the differences from the expected image.

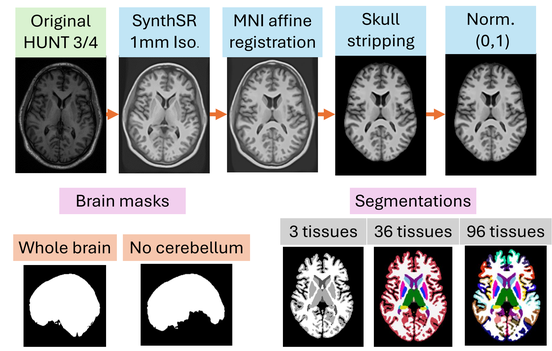
DISCUSSION

- Predicting structural brain changes is possible using AI.
- DF approaches capture more detailed information than GAN approaches.
- Better predictions were obtained for the ventricles, thalamus, and cortex compared to the hippocampus.

AI Predicts 9-Year Brain Changes Using T1w MR Images



PREPROCESSING



STATISTICAL RESULTS

Comp.	Ventricles	Cortex	Thalamus	Hipocamp.
		Dice coefficient ↑		
HUNT3	82.6 ± 0.6	79.2 ± 0.3	89.5 ± 0.4	90.8 ± 0.3
DF-Pred.	91.3 ± 0.3	82.9 ± 0.3	93.4 ± 0.2	92.0 ± 0.3
GAN-Pred.	89.7 ± 0.4	80.1 ± 0.3	91.7 ± 0.2	89.5 ± 0.3
		ASPVC ↓		
HUNT3	29.5 ± 12	2.41 ± 1.12	3.60 ± 2.8	2.68 ± 2.4
DF-Pred.	10.2 ± 7.9	1.99 ± 1.06	3.12 ± 2.5	3.28 ± 2.8
GAN-Pred.	13.6 ± 9.9	5.21 ± 1.45	5.94 ± 3.5	3.29 ± 2.2

Table 1: Dice coefficient and absolute tissue differences (ASPVC) between HUNT3, DF-prediction, GAN-predictions and HUNT4.

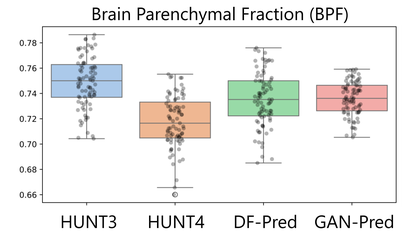


Fig. 2: Comparison of BPF. Initial (HUNT3), expected (HUNT4), and predicted (DF-pred and GAN-pred).

REFERENCES