NeuroSculpt: Forecasting Brain Structure 9 Years Ahead Using Structural MRI

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INTRODUCTION

As people age, brain tissue loss affects cognition, making early detection of abnormal changes in healthy individuals 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 different machine learning alternatives to predict nine years ahead brain changes in T1w MR images.

METHODOLOGY

Data – 703 individuals with T1w MR scans from HUNT study

Preprocessing – FreeSurfer / FastSurfer

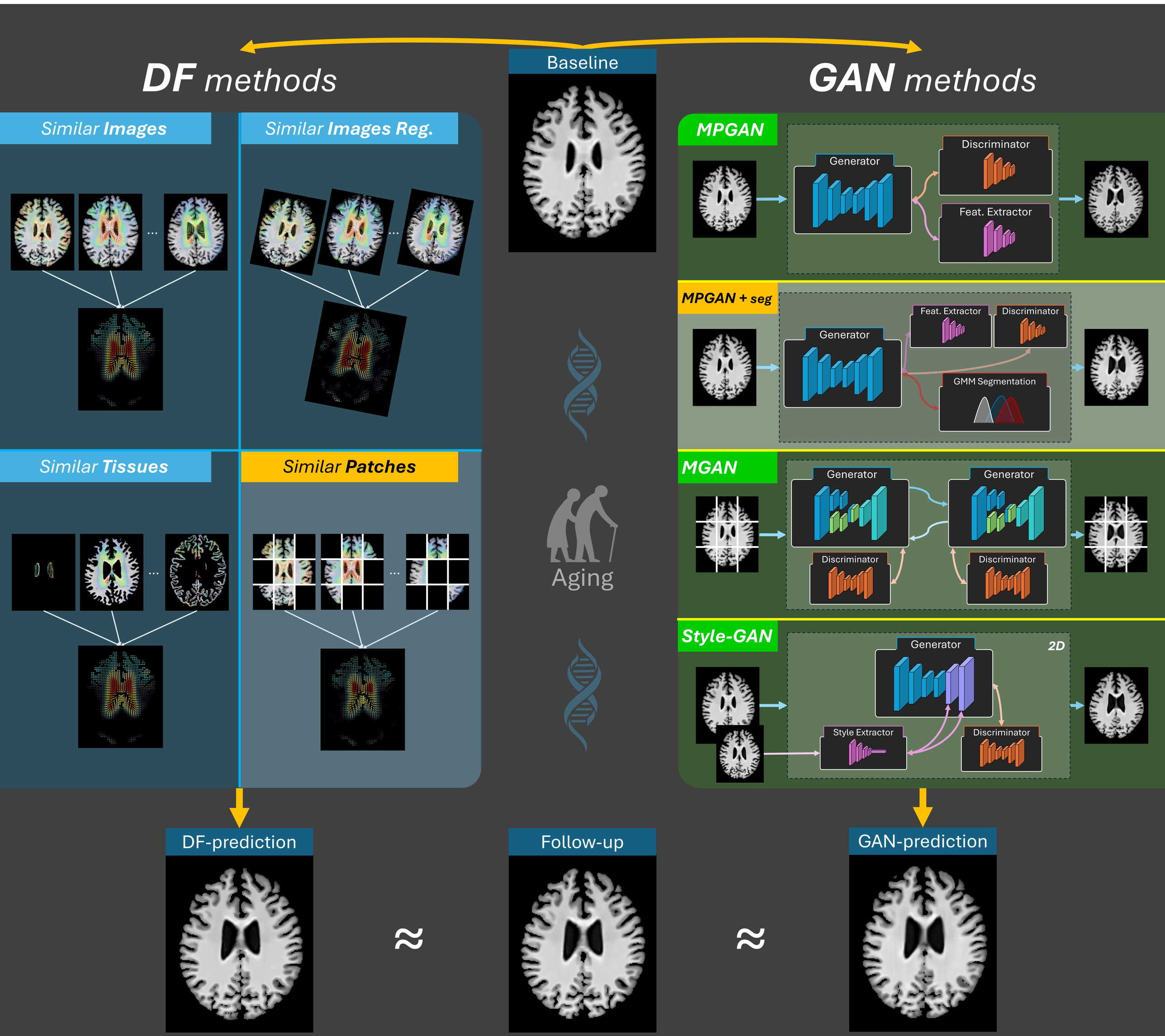
Methods – 8 methods with 2 different approaches based on:

- Deformation Fields (DFs)
- Generative adversarial Networks (GANs)

Evaluation – Dice coefficient, tissue volume differences, Brain Parenchymal Fraction (BPF) and image similarity.

DISCUSSION

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



STATISTICS

Comp.	Ventricles	Cortex	Thalamus	Hipoc.
	Dice coefficient ↑			
Baseline	82.6 ± 5.4	79.2 ± 2.6	89.5 ± 3.5	90.9 ± 2.7
DF-pred.	91.3 ± 3.2	83.0 ± 2.5	93.4 ± 1.9	91.1 ± 2.3
GAN-pred.	89.7 ± 3.8	80.1 ± 2.2	91.7 ± 1.6	89.5 ± 2.6
	ASPVC ↓			
Baseline	29.5 ± 12	2.41 ± 1.1	3.60 ± 2.8	2.68 ± 2.4
DF-pred.	10.2 ± 7.9	1.99 ± 1.1	3.12 ± 2.5	3.28 ± 2.8
GAN-pred.	13.6 ± 9.9	5.21 ± 1.5	5.94 ± 3.5	3.29 ± 2.2

Table 1: Dice coefficient and absolute tissue difference (ASPVC) with respect to the follow-up. ↑ Higher is better, ↓ Lower is better

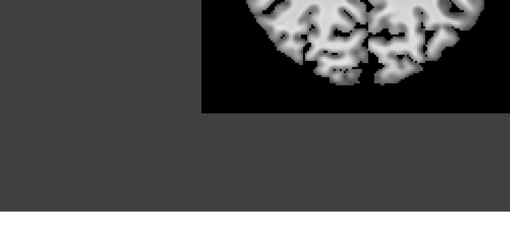


Fig. 2: BPF comparison, Baseline, Follow-up and predictions

VISUAL RESULTS

Fig. 1: Initial image, expected image, and best predictions with both methods.

PREPROESSING

REFERENCES