A Supplementary Materials

A.1 Model Parameters and Hyperparameters

Table A.1: Model parameters and hyperparameters used in PASTA.

	Parameter	Value
Model	Diffusion steps T	1000
	Noise scheduler β	Cosine
	Base channels	64
	Depth	4
	Channel multipliers	[1, 2, 3, 4]
	Attention resolution	[16, 8, 4]
	Attention heads	4
	Model size (# parameters)	89M
Training	Batch size	6
	Optimizer	AdamW
	Learning rate	5×10^{-4}
	Weight Decay	1×10^{-6}
	Dropout	0.0
	Training Iterations	72K (96 hours)
	EMA	0.999
	Diffusion loss	MAE
	Predefined task loss	MAE
	Hardware	one NVIDIA A100 GPU
Classification	Batch size	32
	Optimizer	AdamW
	Learning rate	0.005
	Weight Decay	1×10^{-6}
	Dropout	0.2
	Training Iterations	5K

A.2 Data Preprocessing

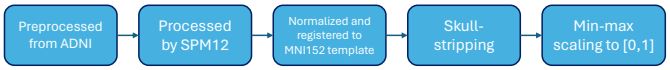


Fig. A.1: Data preprocessing steps for MRI and PET. Both scans have been preprocessed from the Alzheimer's disease neuroimaging initiative (ADNI)[1].

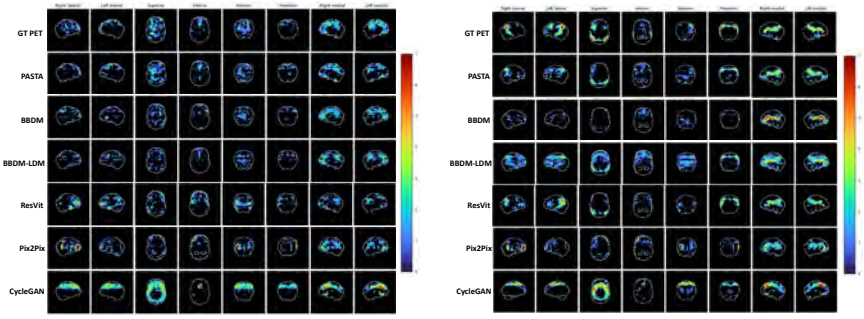
A.3 Additional Ablation Studies

Table A.2: Additional ablation studies on designs in PASTA, including alternative multi-modal fusion (direct feature concatenation (ConcatFeats)), positions to integrate conditions (conditioner arm (CondCond), both arms (CondBoth)).

Ablation	MAE(%) ↓	MSE(%) ↓	PSNR ↑	SSIM(%) ↑
ConcatFeats	3.61	0.48	24.04	85.00
PASTA (CondCond)	3.55	0.45	24.32	86.11
PASTA (CondBoth)	3.61	0.46	24.29	86.09
PASTA ($\lambda_{task} = 0.01$)	3.65	0.49	24.01	85.49
PASTA	**3.45**	**0.43**	**24.59**	**86.29**

[1] http://adni.loni.usc.edu/methods

A.4 Neurostat 3D-SSP Maps for PET Scans



(a) Healthy subject (b) Alzheimer's patient

Fig. A.2: Neurostat[2] 3D-SSP, a statistical brain mapping technology, helps brain disorders diagnosis through PET by comparing cortical metabolic activity between patients and healthy controls, visualized as Z-score maps on the brain surface. We employ 3D-SSP to assess the accuracy of synthesized PET, including those from PASTA and baseline methods. Results reveal PASTA aligns closely with GT metabolic patterns in both healthy (left) and AD (right) subjects, showcasing its superior pathology preservation. Other models fail to recover the pathology evidence correctly and sometimes introduce non-existent abnormality.

A.5 Fairness Evaluation

Table A.3: We demonstrate the MAE of the synthesized PET from test samples compared to the real PET across demographics. The results indicate that the errors across different groups exhibit minimal variance and the differences are statistically insignificant (after comparing each group against the remaining samples, using the Wilcoxon rank-sum test, and applying a Bonferroni correction for multiple testing, all the p-values exceed the threshold of 0.05). Thus, it suggests that PASTA demonstrates a uniform performance, maintaining equitable accuracy across all examined demographic categories.

Demographics	Groups	MAE (%) ↓
Age	< 60	3.55 ± 0.55
	60 - 70	3.30 ± 0.36
	70 - 80	3.44 ± 0.50
	> 80	3.66 ± 0.67
Gender	Male	3.52 ± 0.57
	Female	3.35 ± 0.41
Diagnosis	CN	3.31 ± 0.44
	AD	3.59 ± 0.46
	MCI	3.47 ± 0.56
Total		3.45 ± 0.51

[2] https://neurostat.med.utah.edu/