

BASIS :

Batch-Aligned Spectral-Embedding Space

Or Streicher, Ido Cohen, Guy Gilboa

CVPR Tag: WED-AM-207

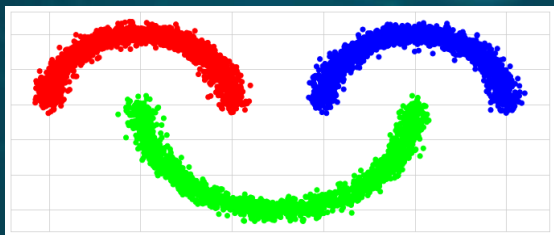


JUNE 18-22, 2023

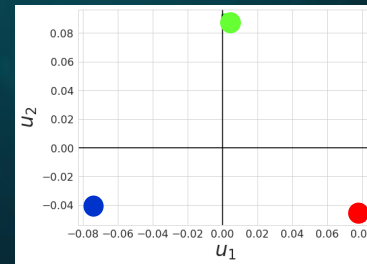
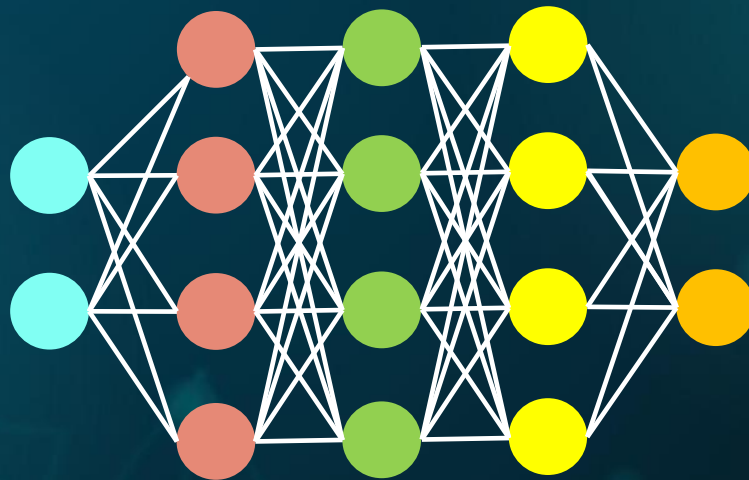
CVPR



Introduction

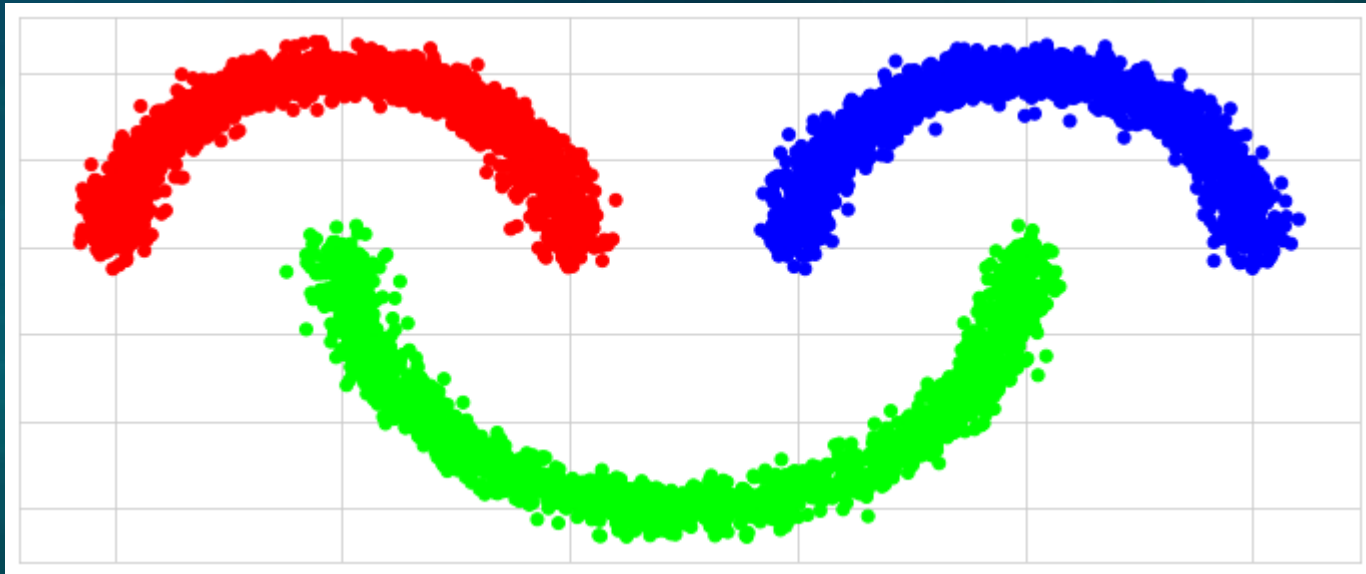


Graph

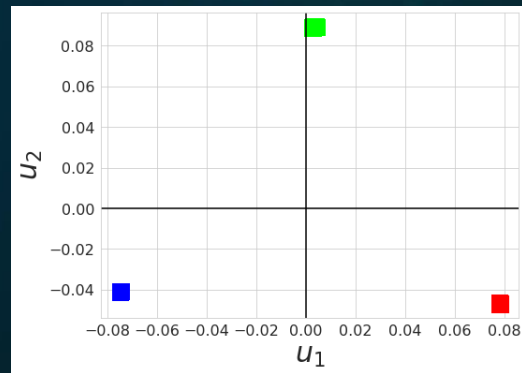
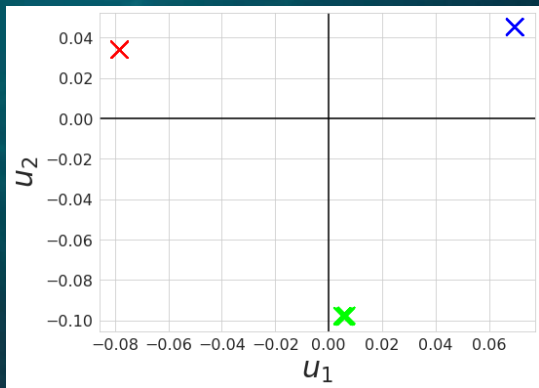
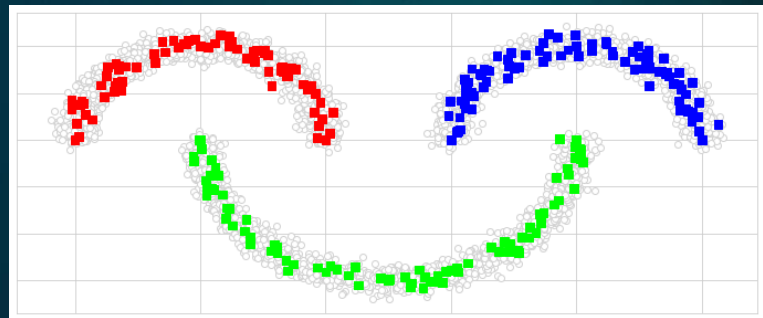
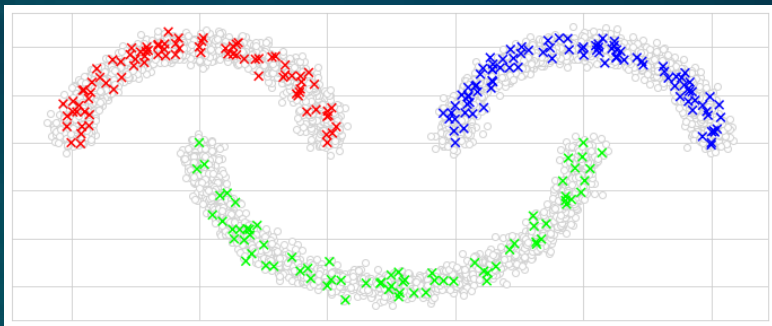


Spectral
Space

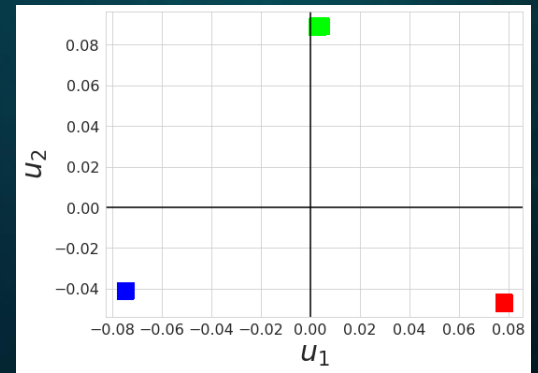
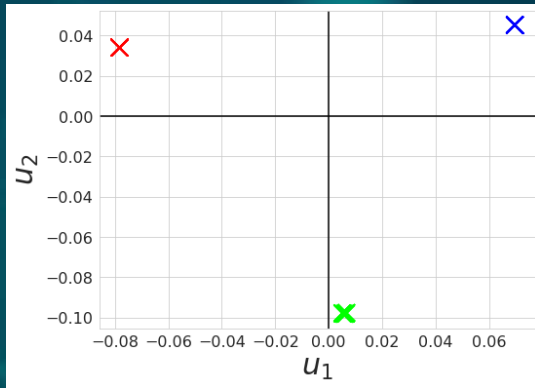
Proof of Concept



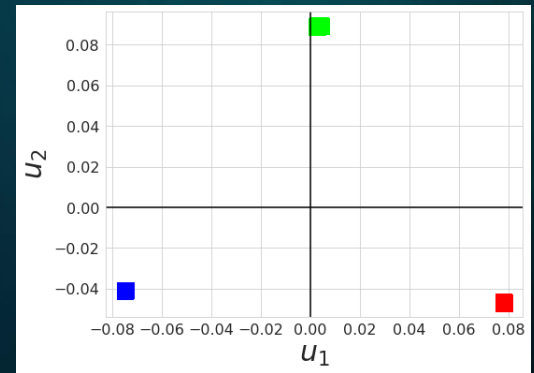
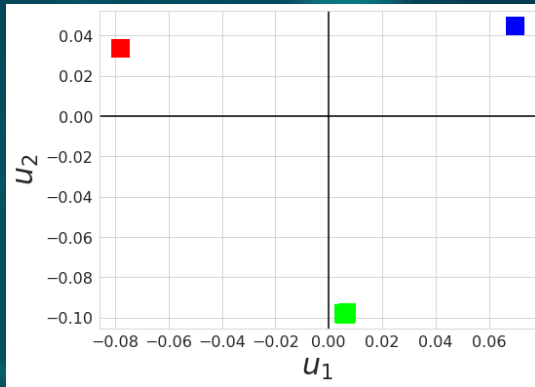
Proof of Concept



Proof of Concept



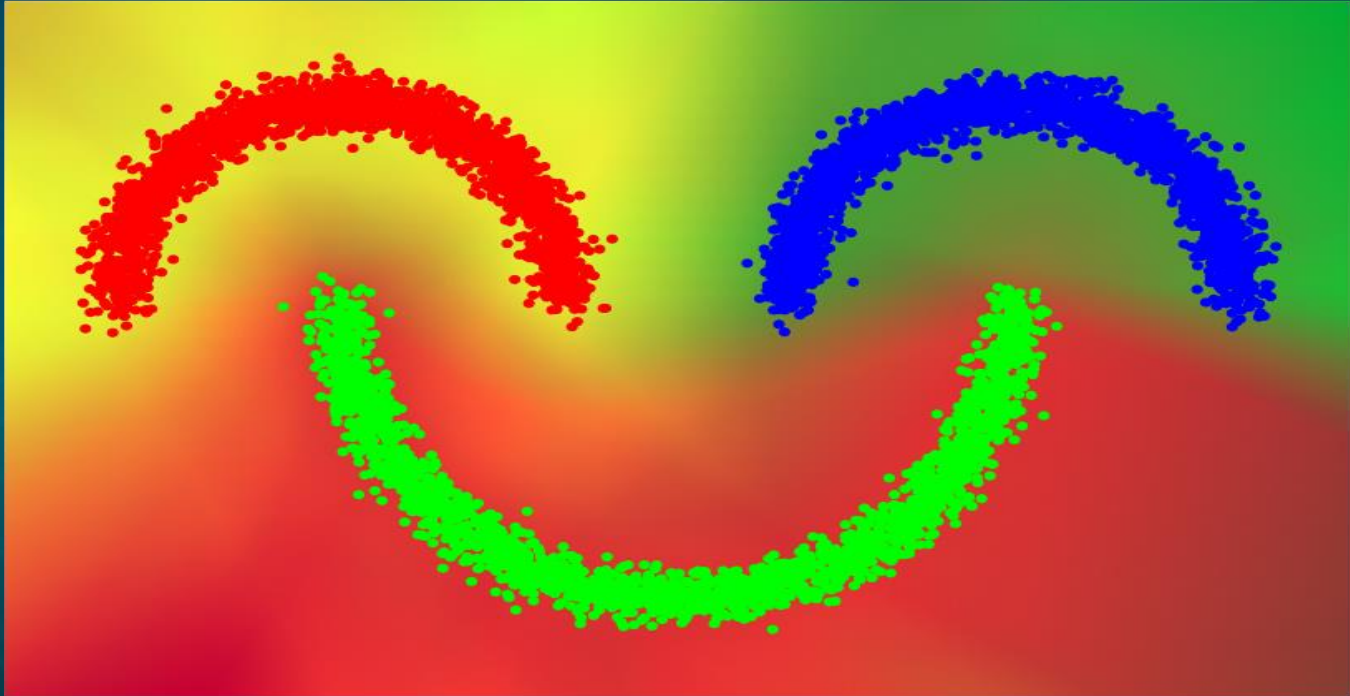
Proof of Concept



Proof of Concept



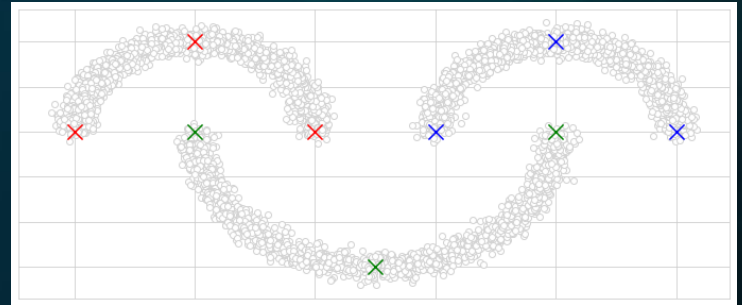
Proof of Concept



BASiS Algorithm

- Initialization:
 - Define an anchor set

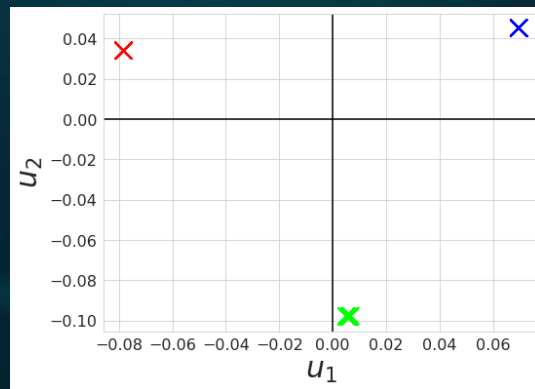
V^a



BASiS Algorithm

- Initialization:
 - Define an anchor set
 - Define the reference embedding space

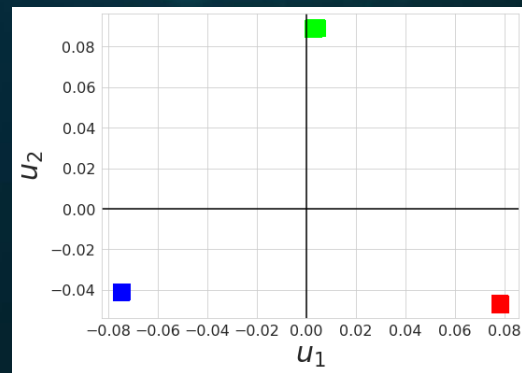
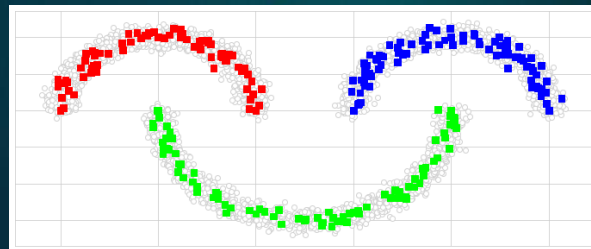
$$V^a \rightarrow \varphi^{a,ref}$$



BASiS Algorithm

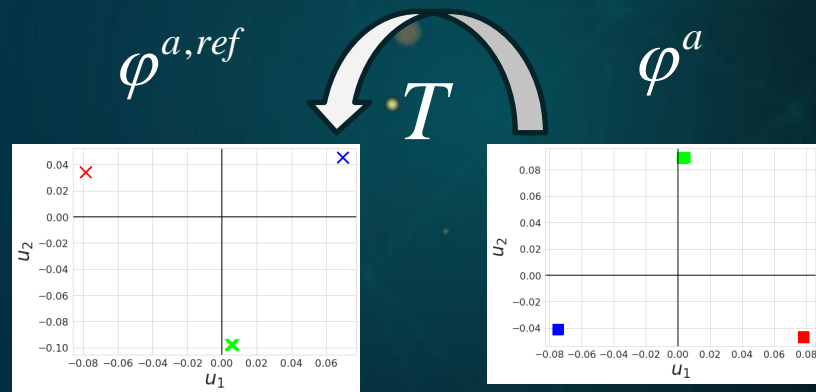
- Initialization:
 - Define an anchor set
 - Define the reference embedding space
- Training loop:
 - Calculate the embedding space over a new batch

$$V^b \rightarrow \varphi \quad V^a \rightarrow \varphi^a$$



BASIS Algorithm

- Initialization:
 - Define an anchor set
 - Define the reference embedding space
- Training loop:
 - Calculate the embedding space over a new batch
 - Calculate the alignment transformation

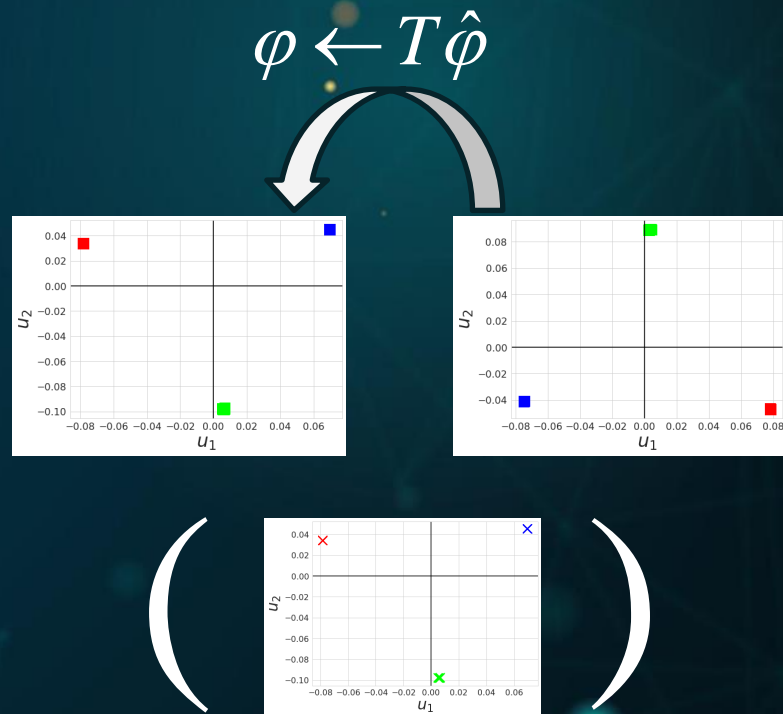


$$\min_T \sum_{i=1}^l \left\| \varphi_i^{a,ref} - T \hat{\varphi}_i^a \right\|^2$$

$$\hat{\varphi} = [\varphi, 1] \quad T \in \mathbb{R}^{K \times (K+1)}$$

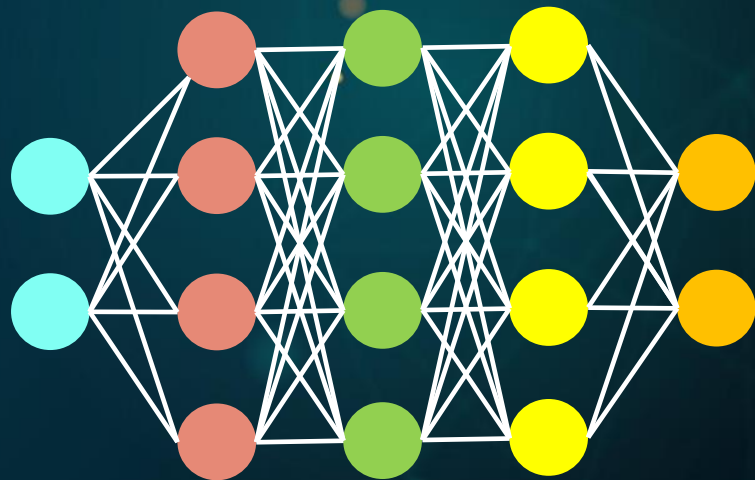
BASiS Algorithm

- Initialization:
 - Define an anchor set
 - Define the reference embedding space
- Training loop:
 - Calculate the embedding space over a new batch
 - Calculate the alignment transformation
 - **Batch Alignment**



BASiS Algorithm

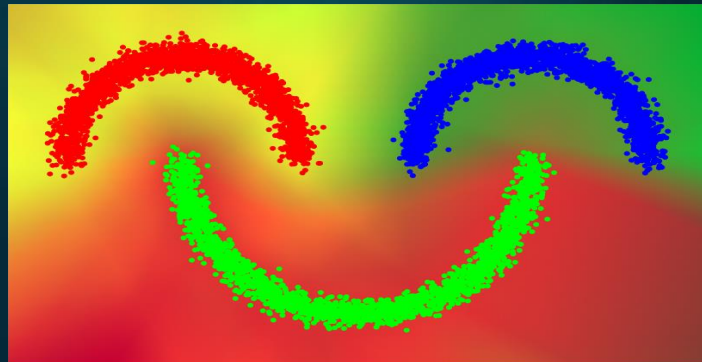
- Initialization:
 - Define an anchor set
 - Define the reference embedding space
- Training loop:
 - Calculate the embedding space over a new batch
 - Calculate the alignment transformation
 - Batch Alignment
 - Gradient Step



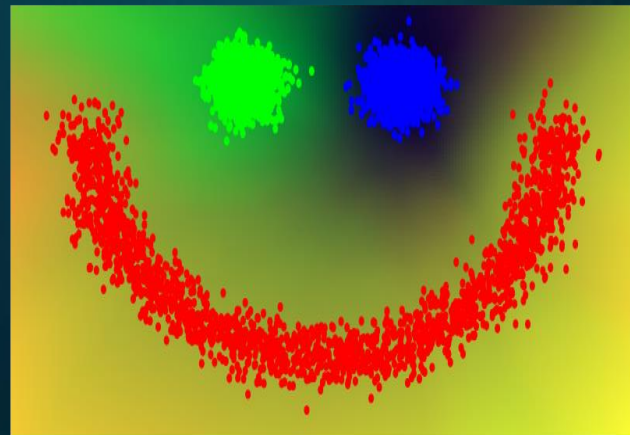
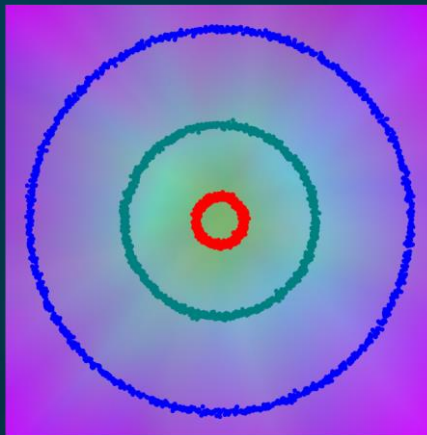
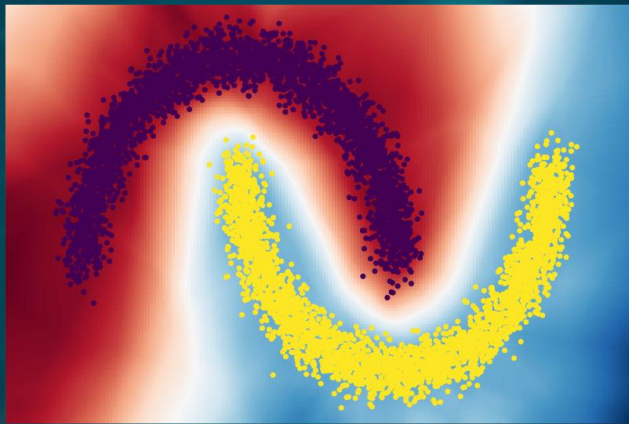
$$L_{BASiS}(\theta) = \frac{1}{m^2} \sum_{i=1}^m \|y_i - \varphi_i\|^2$$

BASiS Algorithm

- Initialization:
 - Define an anchor set
 - Define the reference embedding space
- Training loop:
 - Calculate the embedding space over a new batch
 - Calculate the alignment transformation
 - Batch Alignment
 - Gradient Step



Toy Examples



Spectral Clustering

Measures	Networks	MNIST	Fashion-MNIST	SVHN	CIFAR-10
$d_G \downarrow$	Diffusion-Net	0.204 ± 0.058	0.488 ± 0.238	1.909 ± 0.238	1.022 ± 0.250
	SpecNet1	0.386 ± 0.074	0.375 ± 0.132	3.526 ± 0.529	2.256 ± 0.471
	SpecNet2	1.388 ± 0.262	1.976 ± 0.210	1.903 ± 0.242	2.970 ± 0.682
	BASiS (Ours)	0.107 ± 0.038	0.284 ± 0.073	1.656 ± 0.170	0.803 ± 0.085
$d_{\perp} \downarrow$	Diffusion-Net	0.535 ± 0.365	0.823 ± 0.664	1.532 ± 0.354	2.957 ± 1.837
	SpecNet1	6.296 ± 0.922	6.384 ± 0.899	4.507 ± 0.821	5.169 ± 0.775
	SpecNet2	9.486 ± 0.001	8.561 ± 1.397	4.104 ± 0.269	4.922 ± 0.102
	BASiS (Ours)	0.247 ± 0.076	0.590 ± 0.144	0.488 ± 0.098	0.407 ± 0.095
NMI \uparrow	Diffusion-Net	0.944 ± 0.041	0.759 ± 0.085	0.645 ± 0.016	0.466 ± 0.034
	SpecNet1	0.911 ± 0.008	0.761 ± 0.011	0.665 ± 0.018	0.443 ± 0.012
	SpecNet2	0.925 ± 0.012	0.759 ± 0.010	0.701 ± 0.009	0.466 ± 0.013
	BASiS (Ours)	0.961 ± 0.001	0.798 ± 0.001	0.736 ± 0.001	0.501 ± 0.001
ACC \uparrow	Diffusion-Net	0.944 ± 0.030	0.781 ± 0.179	0.687 ± 0.303	0.620 ± 0.062
	SpecNet1	0.963 ± 0.005	0.815 ± 0.029	0.811 ± 0.039	0.637 ± 0.029
	SpecNet2	0.966 ± 0.007	0.801 ± 0.023	0.813 ± 0.015	0.606 ± 0.039
	BASiS (Ours)	0.986 ± 0.001	0.865 ± 0.003	0.880 ± 0.001	0.688 ± 0.001
Accuracy(%) \uparrow	Diffusion-Net	95.508 ± 1.449	86.207 ± 0.196	86.850 ± 1.386	67.316 ± 2.112
	SpecNet1	92.278 ± 4.776	84.123 ± 1.229	85.154 ± 0.377	65.336 ± 0.626
	SpecNet2	97.026 ± 0.546	85.953 ± 0.240	87.469 ± 0.130	67.093 ± 0.644
	BASiS (Ours)	98.522 ± 0.065	87.202 ± 0.187	88.021 ± 0.064	68.887 ± 0.128

Conclusions

- ✓ Scalability
- ✓ OOSE
- ✓ High-quality approximation of the eigenspace
- ✓ Invariance to the Laplacian definition
- ✓ BASiS building block

Thank you for listening!

Do you have any questions?

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 Or Streicher

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