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Appendix: Guided Stable Dynamic Projections

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1. PCD-tSNE parameters

Table 1 presents the PCD-tSNE parameters used for each dataset. This table compliments Sec. 3.2 of the main text.

dataset	λ	PC scaling
cartolastd	10^{-2}	10^{0}
cifar10cnn	10^{-5}	10^{0}
esc50	10^{-2}	10^{-1}
fashion	10^{-4}	10^{-1}
gaussians	10^{-3}	10^{1}
nnset	10^{-3}	10^{0}
qtables	10^{-3}	10^{-1}
quickdraw	10^{-3}	10^{0}
sorts	10^{-1}	10^{0}
walk	10^{-4}	10^{0}

Table 1: *The λ parameter modulates the amount of global influence applied to points in $P(\mathbf{D}^t)$; the* PC scaling *term scales W to increase/decrease the area of global influence, i.e., it scales the principal components of* $\mathbf{D}$.

2. LD-tSNE parameters

Table 2 presents the LD-tSNE parameters used for each dataset. This table compliments Sec. 3.1 and Sec. 5.5 of the main text.

dataset	λ	β	α	$\mathbf{I}^q$ projection (# landmarks)
cartolastd	.2	2	4	PCA(N)
cifar10cnn	.5	4	1	tSNE(N)
esc50	.3	5	1	PCA(N)
fashion	.1	4	2	tSNE(N)
gaussians	-	-	-	PCA(N)
nnset	.02	8	1	PCA(N)
qtables	-	-	-	PCA(N)
quickdraw	.1	2	1	tSNE(N)
sorts	.25	10	2	PCA(NT)
walk	-	-	-	PCA(N)

Table 2: *The λ, α, and β parameters control the amount of influence landmarks have on the the points being projected. In simple terms, α controls the tightness of clusters in $P(\mathbf{D}^t)$, β scales the strength of the "pull" of landmarks $\mathbf{L}$ on points in $P(\mathbf{D}^t)$, and λ balances the two factors. Values marked "-" were obtained using the interactive mode that was implemented and gave the user real-time control over parameters during the optimization. N is the number of points in $\mathbf{D}^t$ and T is the total number of timesteps in* $\mathbf{D}$.

3. Metric results

Table 3 shows unaggregated metric results. Each of the 10 subtables correspond to a dataset, columns correspond to the different quality metrics, and the rows represent the different methods. Methods are ordered according to their strategy: Per-timeframe, Global, Continuous, and Guided. The columns correspond, respectively, to distance preservation metrics ($S_{Pearson}, S_{Spearman}, S_{Kendall}, S_{Stress}$), neighborhood preservation metrics ($S_{NH}, S_{NP}, S_{Trust}, S_{Cont}$), and temporal stability metrics ()$T_{Pearson}, T_{Spearman}, T_{Kendall}, T_{Stress}$). The colormap is normalized independently for each metric and each dataset.

These tables compliment Sections 5.2 and 5.3 of the main text.

cartolastd

	$S_{Pearson}$	$S_{Spearman}$	$S_{Kendall}$	S_{Stress}	S_{NH}	S_{NP}	S_{Trust}	S_{Cont}	$T_{Pearson}$	$T_{Spearman}$	$T_{Kendall}$	T_{Stress}
TF-PCA	**0.931**	0.928	0.790	**0.137**	0.505	0.480	0.937	0.876	0.761	0.570	0.450	0.477
TF-tSNE	0.756	0.800	0.615	0.487	**0.597**	0.592	0.947	0.913	0.061	0.075	0.055	1.876
TF-UMAP	0.634	0.693	0.520	0.731	0.576	0.556	0.908	0.893	-0.00	-0.04	-0.03	2.003
G-AE	0.898	0.936	0.799	0.203	0.495	0.505	0.932	0.884	0.758	0.985	0.908	0.482
G-VAE	0.910	**0.949**	**0.822**	0.178	0.568	**0.618**	0.950	**0.934**	**0.864**	**0.987**	**0.917**	**0.270**
G-PCA	0.929	0.926	0.787	0.140	0.519	0.474	0.935	0.874	0.778	0.987	0.916	0.442
G-tSNE	0.685	0.733	0.547	0.628	0.550	0.455	0.847	0.806	0.514	0.788	0.655	0.970
G-UMAP	0.599	0.635	0.459	0.801	0.290	0.156	0.561	0.576	0.366	0.368	0.282	1.267
C-tSNE	0.602	0.678	0.495	0.794	0.527	0.503	0.849	0.846	0.307	0.175	0.132	1.384
C-UMAP	0.665	0.711	0.533	0.668	0.576	0.555	0.923	0.895	0.044	-0.11	-0.08	1.911
D-tSNE	0.768	0.822	0.638	0.462	0.538	0.558	0.932	0.905	0.141	-0.03	-0.02	1.716
PCD-tSNE	0.929	0.924	0.785	0.141	0.521	0.478	0.936	0.875	0.772	0.704	0.565	0.454
LD-tSNE	0.771	0.823	0.642	0.457	0.560	0.573	**0.957**	0.907	0.574	0.392	0.301	0.851

cifar10cnn

	$S_{Pearson}$	$S_{Spearman}$	$S_{Kendall}$	S_{Stress}	S_{NH}	S_{NP}	S_{Trust}	S_{Cont}	$T_{Pearson}$	$T_{Spearman}$	$T_{Kendall}$	T_{Stress}
TF-PCA	0.786	0.790	0.600	0.427	0.414	0.560	0.942	0.894	-0.11	-0.13	-0.08	2.229
TF-tSNE	0.786	0.783	0.597	0.427	**0.479**	**0.776**	0.963	**0.972**	-0.13	-0.15	-0.10	2.272
TF-UMAP	0.845	0.855	0.672	0.308	0.475	0.752	0.960	0.967	-0.04	-0.06	-0.04	2.096
G-AE	0.772	0.792	0.604	0.454	0.455	0.621	0.931	0.922	0.597	0.750	0.559	0.804
G-VAE	0.905	0.917	0.762	0.188	0.469	0.732	**0.969**	0.944	**0.816**	**0.889**	**0.720**	**0.367**
G-PCA	0.777	0.790	0.602	0.445	0.405	0.532	0.935	0.881	0.695	0.654	0.480	0.608
G-tSNE	0.886	0.884	0.713	0.226	0.455	0.603	0.903	0.851	0.521	0.641	0.460	0.957
G-UMAP	0.906	**0.922**	**0.766**	0.186	0.468	0.694	0.953	0.942	0.682	0.710	0.517	0.634
C-tSNE	0.888	0.916	0.752	0.223	0.455	0.623	0.897	0.887	0.378	0.367	0.251	1.243
C-UMAP	0.831	0.853	0.669	0.336	0.474	0.747	0.956	0.967	0.346	0.189	0.127	1.307
D-tSNE	0.842	0.845	0.662	0.315	0.476	0.721	0.952	0.950	0.317	0.283	0.191	1.365
PCD-tSNE	**0.908**	0.913	0.753	**0.182**	0.459	0.647	0.914	0.889	0.483	0.497	0.348	1.032
LD-tSNE	0.865	0.870	0.691	0.268	0.465	0.704	0.942	0.952	0.570	0.691	0.502	0.858

esc50

	$S_{Pearson}$	$S_{Spearman}$	$S_{Kendall}$	S_{Stress}	S_{NH}	S_{NP}	S_{Trust}	S_{Cont}	$T_{Pearson}$	$T_{Spearman}$	$T_{Kendall}$	T_{Stress}
TF-PCA	**0.993**	**0.990**	**0.927**	**0.012**	0.323	0.712	**0.989**	**0.974**	0.095	0.801	0.641	1.808
TF-tSNE	0.920	0.935	0.784	0.159	0.372	0.694	0.964	0.969	-0.04	-0.03	-0.02	2.096
TF-UMAP	0.926	0.935	0.786	0.146	0.360	0.676	0.967	0.968	-0.10	-0.05	-0.03	2.214
G-AE	0.937	0.965	0.842	0.124	0.323	0.604	0.961	0.959	0.981	0.898	0.738	0.037
G-VAE	0.977	0.968	0.859	0.045	0.210	0.458	0.939	0.896	0.985	0.866	0.697	0.029
G-PCA	0.993	0.990	0.926	0.012	0.323	0.711	0.989	0.974	**0.992**	**0.917**	**0.778**	**0.014**
G-tSNE	0.776	0.827	0.639	0.446	**0.393**	0.356	0.748	0.769	0.608	0.545	0.386	0.783
G-UMAP	0.778	0.812	0.616	0.443	0.300	0.320	0.754	0.769	0.568	0.550	0.392	0.862
C-tSNE	0.887	0.909	0.742	0.225	0.367	0.685	0.960	0.964	0.384	0.557	0.394	1.231
C-UMAP	0.928	0.936	0.787	0.142	0.359	0.668	0.967	0.967	0.034	0.029	0.019	1.930
D-tSNE	0.912	0.925	0.771	0.174	0.305	0.510	0.938	0.929	0.026	0.020	0.013	1.947
PCD-tSNE	0.993	0.990	0.926	0.012	0.323	**0.712**	0.989	0.974	0.748	0.875	0.705	0.503
LD-tSNE	0.886	0.952	0.841	0.227	0.341	0.636	0.949	0.939	0.619	0.570	0.404	0.761

	$S_{Pearson}$	$S_{Spearman}$	$S_{Kendall}$	S_{Stress}	S_{NH}	S_{NP}	S_{Trust}	S_{Cont}	$T_{Pearson}$	$T_{Spearman}$	$T_{Kendall}$	T_{Stress}	
TF-PCA	0.650	0.627	0.450	0.699	0.434	0.542	0.954	0.927	0.502	0.508	0.354	0.995	
TF-tSNE	0.664	0.660	0.475	0.670	0.651	0.632	0.951	**0.948**	-0.07	-0.07	-0.05	2.153	
TF-UMAP	0.659	0.658	0.470	0.680	0.624	0.613	0.944	0.943	0.343	0.372	0.225	1.312	
G-AE	0.712	0.725	0.531	0.574	0.614	0.573	0.933	0.936	0.328	0.469	0.324	1.342	
G-VAE	0.638	0.636	0.452	0.723	0.589	0.588	0.938	0.939	0.357	0.391	0.266	1.284	
G-PCA	0.648	0.626	0.448	0.702	0.434	0.542	0.954	0.927	0.447	0.429	0.295	1.105	
G-tSNE	**0.740**	**0.750**	**0.554**	**0.518**	0.660	0.610	0.940	0.938	0.208	**0.886**	**0.697**	1.582	
G-UMAP	0.710	0.713	0.518	0.579	**0.669**	0.585	0.913	0.931	0.078	0.248	0.168	1.843	
C-tSNE	0.457	0.417	0.286	1.085	0.589	0.561	0.873	0.889	0.368	0.425	0.297	1.263	
C-UMAP	0.641	0.637	0.452	0.716	0.623	0.610	0.943	0.943	**0.528**	0.556	0.392	**0.943**	
D-tSNE	0.721	0.734	0.535	0.557	0.636	**0.642**	0.938	0.944	0.286	0.346	0.236	1.427	
PCD-tSNE	0.702	0.700	0.508	0.595	0.594	0.621	**0.961**	0.945	0.513	0.631	0.446	0.972	
LD-tSNE	0.722	0.726	0.530	0.555	0.638	0.630	0.951	0.948	0.397	0.661	0.477	1.204	
TF-PCA	0.431	**0.500**	**0.364**	1.136	0.837	0.536	0.880	0.852	0.808	0.915	0.739	0.383	
TF-tSNE	-0.06	0.172	0.132	2.126	0.948	0.611	0.880	0.881	-0.08	-0.04	-0.03	2.163	
TF-UMAP	-0.24	0.117	0.103	2.494	0.957	0.589	0.878	0.883	0.553	0.406	0.268	0.892	
G-AE	0.226	0.361	0.264	1.546	0.964	0.581	0.882	0.889	0.679	0.880	0.699	0.640	
G-VAE	0.264	0.384	0.282	1.470	0.978	0.585	**0.882**	0.887	0.668	0.917	0.741	0.662	
G-PCA	**0.443**	0.491	0.362	**1.112**	0.847	0.539	0.880	0.852	0.841	0.945	0.790	0.317	
G-tSNE	0.218	0.396	0.293	1.563	0.995	0.567	0.880	0.874	-0.07	-0.17	-0.15	2.153	
G-UMAP	0.220	0.368	0.268	1.559	0.997	0.593	0.877	0.885	0.063	-0.35	-0.24	1.873	
C-tSNE	-0.14	-0.09	-0.06	2.285	0.672	0.422	0.760	0.750	-0.04	0.191	0.170	2.080	
C-UMAP	-0.30	-0.06	-0.05	2.604	0.953	0.583	0.879	0.881	0.737	0.420	0.293	0.524	
D-tSNE	0.152	0.279	0.199	1.695	**0.998**	**0.625**	0.878	**0.892**	0.811	0.868	0.694	0.376	
PCD-tSNE	0.442	0.490	0.361	1.114	0.856	0.549	0.882	0.856	**0.844**	**0.948**	**0.797**	**0.311**	
LD-tSNE	-0.09	0.082	0.063	2.199	0.969	0.611	0.880	0.884	0.652	0.535	0.366	0.694	
TF-PCA	0.697	**0.842**	0.674	0.605	0.230	0.453	0.935	0.860	0.151	0.312	0.223	1.696	
TF-tSNE	0.468	0.582	0.413	1.063	0.214	0.449	0.923	0.861	0.231	0.255	0.175	1.537	
TF-UMAP	0.494	0.666	0.499	1.010	0.185	0.434	0.908	0.818	0.009	0.007	0.005	1.981	
G-AE	0.630	0.795	0.630	0.738	0.239	0.454	0.929	0.854	0.579	0.524	0.362	0.841	
G-VAE	0.558	0.745	0.564	0.882	**0.245**	0.317	0.799	0.792	0.619	**0.582**	**0.408**	0.760	
G-PCA	0.629	0.794	0.628	0.741	0.233	0.452	0.929	0.853	0.565	0.501	0.344	0.869	
G-tSNE	**0.719**	0.724	0.549	**0.561**	0.216	0.436	0.898	0.837	0.474	0.565	0.403	1.050	
G-UMAP	0.509	0.634	0.465	0.981	0.218	0.385	0.869	0.812	0.279	0.392	0.266	1.440	
C-tSNE	0.524	0.738	0.586	0.951	0.235	**0.489**	**0.941**	**0.880**	0.535	0.390	0.269	0.928	
C-UMAP	0.475	0.648	0.482	1.048	0.186	0.421	0.902	0.810	-0.07	-0.03	-0.02	2.153	
D-tSNE	0.448	0.619	0.448	1.103	0.099	0.101	0.509	0.531	-0.05	-0.03	-0.02	2.109	
PCD-tSNE	0.627	0.802	0.640	0.744	0.229	0.480	0.939	0.867	0.532	0.462	0.316	0.935	
LD-tSNE	0.688	0.840	**0.676**	0.622	0.235	0.462	0.936	0.877	**0.628**	0.543	0.382	**0.742**	
TF-PCA	**0.998**	**0.980**	**0.917**	**0.002**	**0.729**	0.568	0.952	0.957	0.370	0.526	0.369	1.259	
TF-tSNE	0.286	0.688	0.508	1.426	0.703	**0.658**	0.977	**0.971**	0.220	-0.04	-0.03	1.559	
TF-UMAP	0.668	0.764	0.560	0.663	0.685	0.563	0.949	0.941	0.174	0.058	0.037	1.650	
G-AE	0.987	0.977	0.893	0.024	0.709	0.567	0.955	0.954	0.832	0.971	0.870	0.335	
G-VAE	0.968	0.967	0.864	0.063	0.716	0.557	0.957	0.953	**0.861**	**0.975**	**0.878**	**0.277**	
G-PCA	0.998	0.977	0.909	0.002	0.720	0.563	0.951	0.954	0.855	0.965	0.864	0.288	
G-tSNE	0.556	0.594	0.431	0.887	0.496	0.406	0.782	0.822	0.547	0.528	0.435	0.905	
G-UMAP	0.472	0.484	0.349	1.054	0.436	0.344	0.648	0.779	0.262	0.645	0.467	1.475	
C-tSNE	0.723	0.796	0.606	0.553	0.713	0.651	**0.977**	0.970	0.276	0.289	0.198	1.447	
C-UMAP	0.740	0.802	0.604	0.519	0.686	0.555	0.951	0.947	0.223	0.227	0.155	1.552	
D-tSNE	0.588	0.684	0.494	0.822	0.187	0.180	0.670	0.657	-0.03	-0.05	-0.03	2.064	
PCD-tSNE	0.997	0.964	0.884	0.004	0.717	0.624	0.976	0.966	0.687	0.505	0.360	0.624	
LD-tSNE	0.825	0.842	0.655	0.349	0.706	0.607	0.969	0.962	0.242	0.699	0.492	1.515	
TF-PCA	0.608	0.685	0.500	0.783	0.479	0.250	0.774	0.704	0.376	0.739	0.589	1.247	
TF-tSNE	0.092	0.243	0.178	1.815	0.575	0.318	0.787	0.737	0.117	0.071	0.054	1.764	
TF-UMAP	0.116	0.344	0.246	1.767	0.539	0.295	0.743	0.708	0.334	0.331	0.253	1.330	
G-AE	0.560	**0.769**	**0.595**	0.879	**0.613**	0.259	0.754	0.715	0.277	0.938	0.827	1.445	
G-VAE	0.675	0.769	0.586	0.649	0.595	0.270	0.728	0.726	0.438	0.953	0.857	1.122	
G-PCA	0.655	0.738	0.544	0.689	0.482	0.213	0.671	0.672	**0.856**	**0.970**	**0.919**	**0.287**	
G-tSNE	0.602	0.622	0.443	0.795	0.276	0.128	0.533	0.550	0.304	0.906	0.829	1.390	
G-UMAP	**0.696**	0.759	0.566	**0.606**	0.203	0.119	0.539	0.538	0.277	0.647	0.511	1.444	
C-tSNE	0.592	0.713	0.521	0.815	0.537	0.287	0.753	0.705	0.434	0.547	0.422	1.131	
C-UMAP	0.089	0.341	0.245	1.821	0.541	0.291	0.744	0.705	0.404	0.459	0.349	1.190	
D-tSNE	0.363	0.499	0.375	1.272	0.575	**0.319**	**0.840**	**0.773**	0.436	0.625	0.490	1.127	
PCD-tSNE	0.642	0.740	0.541	0.714	0.507	0.242	0.742	0.688	0.763	0.762	0.625	0.472	
LD-tSNE	0.400	0.528	0.376	1.198	0.515	0.275	0.766	0.700	0.435	0.648	0.500	1.129	
TF-PCA	**0.762**	**0.798**	**0.616**	**0.475**	0.596	0.404	0.879	0.820	0.208	0.399	0.271	1.582	
TF-tSNE	0.022	0.005	0.010	1.954	0.505	0.512	0.890	0.873	0.034	0.085	0.057	1.930	
TF-UMAP	0.086	0.281	0.208	1.826	0.509	0.505	0.902	0.853	-0.06	-0.06	-0.04	2.135	
G-AE	0.692	0.764	0.585	0.614	0.577	0.384	0.870	0.804	0.485	0.667	0.496	1.028	
G-VAE	0.724	0.747	0.568	0.551	0.578	0.398	0.870	0.816	**0.529**	0.688	0.514	**0.941**	
G-PCA	0.729	0.764	0.595	0.540	0.603	0.398	0.868	0.809	0.494	**0.704**	**0.524**	1.011	
G-tSNE	0.654	0.654	0.473	0.690	0.538	0.421	0.818	0.799	0.167	0.372	0.267	1.664	
G-UMAP	0.638	0.656	0.471	0.722	0.590	0.380	0.808	0.777	0.087	0.240	0.163	1.825	
C-tSNE	0.556	0.576	0.412	0.887	0.571	**0.553**	**0.916**	**0.892**	0.393	0.452	0.307	1.213	
C-UMAP	-0.06	0.271	0.200	2.123	0.498	0.484	0.897	0.844	-0.12	-0.10	-0.07	2.243	
D-tSNE	0.432	0.468	0.323	1.134	0.106	0.099	0.532	0.528	0.026	0.047	0.032	1.946	
PCD-tSNE	0.714	0.736	0.563	0.571	**0.623**	0.421	0.888	0.823	0.462	0.570	0.393	1.075	
LD-tSNE	0.576	0.609	0.439	0.847	0.602	0.411	0.850	0.822	0.274	0.425	0.289	1.451	
TF-PCA	**0.980**	**0.961**	**0.849**	**0.038**	0.896	0.427	0.925	0.879	-0.03	-0.10	-0.00	2.063	
TF-tSNE	0.837	0.897	0.711	0.325	0.875	**0.492**	0.932	0.893	-0.12	-0.10	-0.07	2.245	
TF-UMAP	0.786	0.857	0.658	0.427	0.812	0.437	0.916	0.868	0.008	-0.03	-0.02	1.983	
G-AE	0.979	0.959	0.844	0.040	0.886	0.419	0.920	0.874	-0.65	-0.36	-0.14	3.305	
G-VAE	0.977	0.952	0.831	0.045	0.879	0.411	0.917	0.867	-0.64	-0.40	-0.19	3.288	
G-PCA	0.980	0.961	0.849	0.039	0.891	0.425	0.924	0.878	-0.66	-0.33	-0.11	3.329	
G-tSNE	0.761	0.850	0.667	0.476	0.913	0.336	0.811	0.833	0.024	-0.18	-0.11	1.950	
G-UMAP	0.569	0.733	0.546	0.860	0.913	0.296	0.788	0.777	-0.02	-0.28	-0.18	2.042	
C-tSNE	0.547	0.707	0.504	0.905	**0.933**	0.466	0.890	0.873	0.020	0.023	0.015	1.959	
C-UMAP	0.688	0.846	0.640	0.622	0.817	0.428	0.914	0.866	**0.026**	**0.047**	**0.032**	**1.946**	
D-tSNE	0.860	0.878	0.695	0.278	0.873	0.329	0.890	0.860	-0.11	-0.14	-0.09	2.234	
PCD-tSNE	0.920	0.896	0.720	0.158	0.905	0.479	**0.939**	**0.894**	-0.06	-0.04	-0.02	2.136	
LD-tSNE	0.956	0.933	0.787	0.087	0.827	0.414	0.917	0.869	-0.23	-0.30	-0.18	2.469	

fashion

gaussians

nnset

qtables

quickdraw

sorts

walk

low quality — high quality

Table 3: *Unaggregated metric results.*