

A Perception-Driven Approach to Supervised Dimensionality Reduction for Visualization (Supplemental Material)

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ABSTRACT

This supplemental material file provides additional information for the TVCG paper “A Perception-Driven Approach to Supervised Dimensionality Reduction for Visualization.” Specifically, it provides

- 1) the dDSC, dKNNG, GONG and SC scores of the scatterplots generated by all ten DR methods including PD and PK, which are our perception-driven DR with the existing DSC measure (PD) and with the KNNG measure (PK);
- 2) the class ratings of the scatterplots generated by the eight DR methods specified by the experts;
- 3) an additional analysis of how our approaches PDK and PDD, as well as the existing LDA handle cases with randomly assigned class labels; and
- 4) the screenshots of all projections along with their GONG and SC values.

I. FULL LIST OF DDSC, DKNNG, GONG AND SC SCORES

To demonstrate the effectiveness of PDD and PDK, we compared them with eight existing DR techniques (see paper). To evaluate the scatter plots generated by ten DR techniques, we use four measures: GONG, SC, (as in the paper), as well as our introduced measures dDSC and dKNNG (not in the paper). Note that PDD and PDK definitely have advantages over other methods in terms of dDSC and dKNNG, since they are designed to maximize dDSC and dKNNG. Figure 1 presents the scores of dDSC, dKNNG, GONG and SC with heatmaps, where blue cells indicate large scores (well-separated) and white cells indicate small scores (not separated at all). The average score within each cell in both heatmaps in Figure 1 is encoded with a white-to-blue color ramp, where blue is better. White cells indicate classes that are not-well-separated, and blue cells indicate the classes are well-separated in this projection.

The columns of the heatmaps are ordered in the same way as the boxplots shown in Figure 8 in the paper. In terms of lines (rows), the three categories of the data sets are ordered from very realistic to highly artificial and we employ the same ordering consistently throughout the paper. For consistency with Figure 3, the rows within each category (real, entangled and gaussian) are ordered by the number of classes in each data.

We can see that PDK and PDD produce similarly higher GONG values than the others for most data, while PDD and LDA behave similarly on SC values. No matter GONG or SC measures, KDA, NCA and PCA all perform poorly. We assume the reason for KDA and NCA is that most data can be linearly separated, whereas the quadratic kernel and the softmax function used by KDA and NCA destroy the separability. This hypothesis is also confirmed by RAND, whose GONG values are similar to LDA. On the other hand, it is not surprising that PCA does not work well because it does not have any discriminative ability. Only the *entangled* datasets show a different pattern, where t-SNE produces much higher GONG and SC values than all the other methods. In all, we can see that PDD and PDK are better than the other methods for most data, while PD and PK are worse than PDD and PDK for most data. To facilitate the comparison between different DR methods, we summarize the scores with boxplots as shown in Figure 2, which clearly demonstrate the advantages of PDD and PDK.

II. FULL RESULTS OF USER STUDY RATINGS

Furthermore, we evaluate the results of human class ratings, collected from a carefully-designed user study. Since PD and PK are worse than PDD and PDK, we did not run the user study with their results. For the results of the other eight methods, the averaged class ratings are visualized with heatmaps by using a white-to-blue color ramp, with 1 in white (not separable), to 5 in dark blue (nicely separable). Figure 3 shows the results, where each row represents one dataset and the color of a cell indicates the average score of the three expert coders assigned for one specific class. To maintain legibility, we only show 92 datasets (out of 93) who have 15 or fewer number of classes, since the absent dataset has 28 classes, which are too many for humans to explore. We can see that PDD, PDK, LDA and t-SNE are the top four methods in terms of number of dark blue cells. To investigate how PDD and PDK outperform existing DR techniques, we summarize the results with boxplots as shown in Figure 11 in the paper.

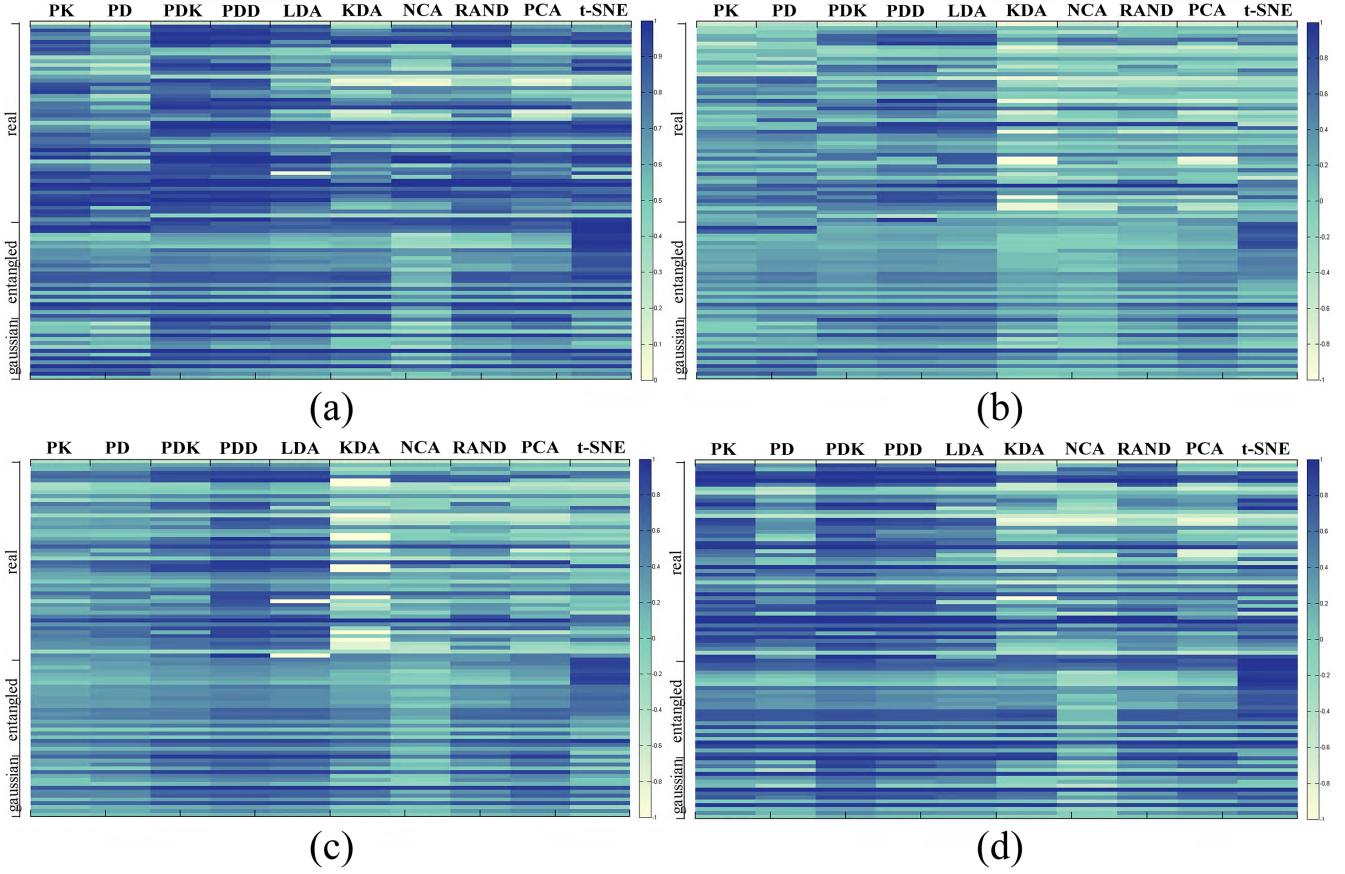


Fig. 1. The above heatmaps present the values of GONG (a), SC (b), dDSC (c), and dKNNG (d) of projections generated by ten different DR methods for each of the 93 datasets. Each row represents one dataset, and each column a DR method.

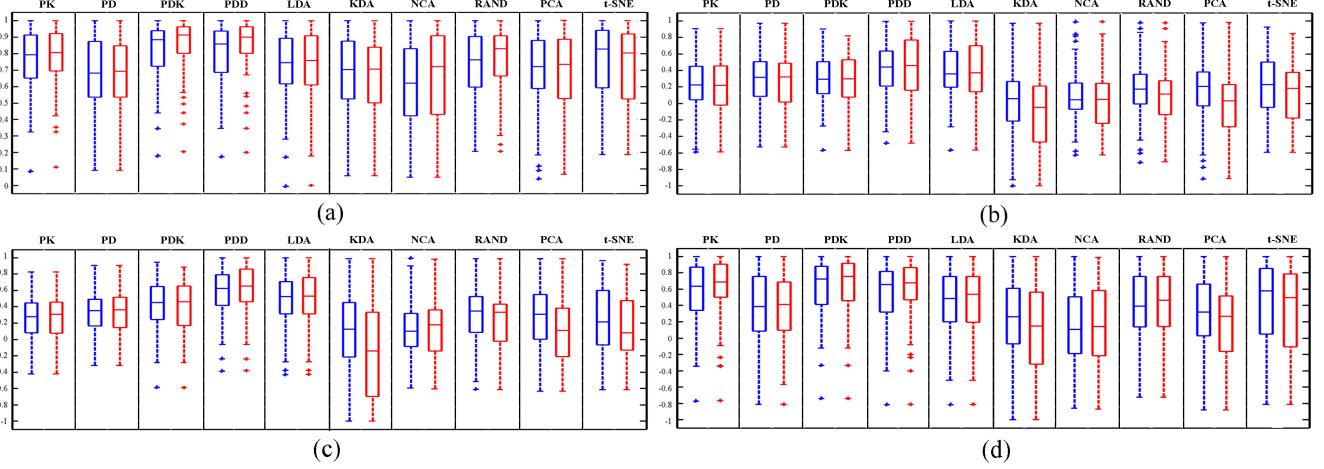


Fig. 2. The boxplots summarize the values of GONG (a), SC (b), dDSC (c), and dKNNG (d) shown in Figure 1 of the ten DR methods, where the blue boxplots show the score distributions over all 93 datasets and the red boxplots describe the score of the 53 real datasets.

III. ANALYSIS OF RANDOMLY ASSIGNED CLASS LABELS

We also test whether our approach can make bad clusterings to be better separated than LDA. It is achieved with the following procedure. Taking a real high-dimensional data set, we randomly assign imbalanced class labels to all data points and then perform different DR methods to them. Figure 4 shows the results of two examples, where the imbalance ratio of the data sets shown in the above and below rows are 4.4 and 13.1, respectively. We can see that neither LDA nor our PDD and PDK lead to perfect separable results. This is expected, as the data are also not separable in the original high-dimensional space, and hence should also not show up to be separable in low-dimensional space. The labels are randomly assigned, which cannot reflect the data inherent structure. Note, however, that although all methods fail to separate the classes, the GONG and SC scores produced by PDD and PDK are still better than the ones produced by LDA. This further supports our findings that

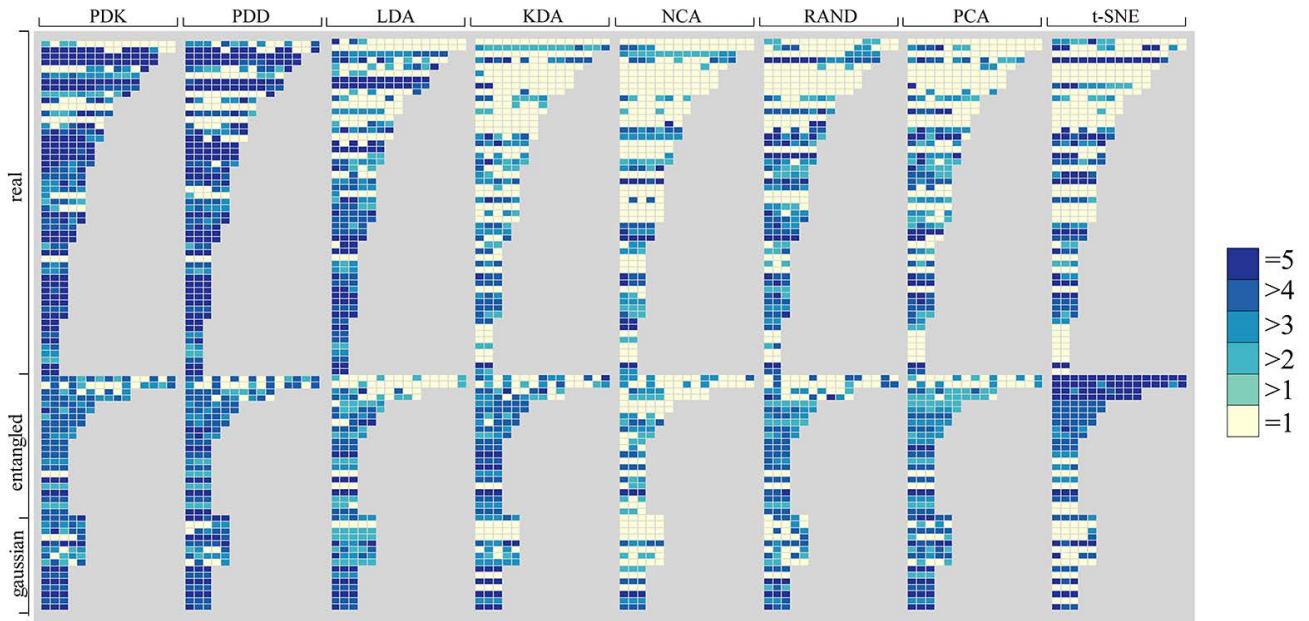


Fig. 3. The above heatmaps show the averaged class-wise ratings of three expert coders, where the ratings range from 1 (not separated at all) to 5 (well-separated).

our perception-driven approach can separate class structure more effectively in 2D space than previous methods. If the classes are not separable at all though, our methods and existing methods do not incorrectly separate them.

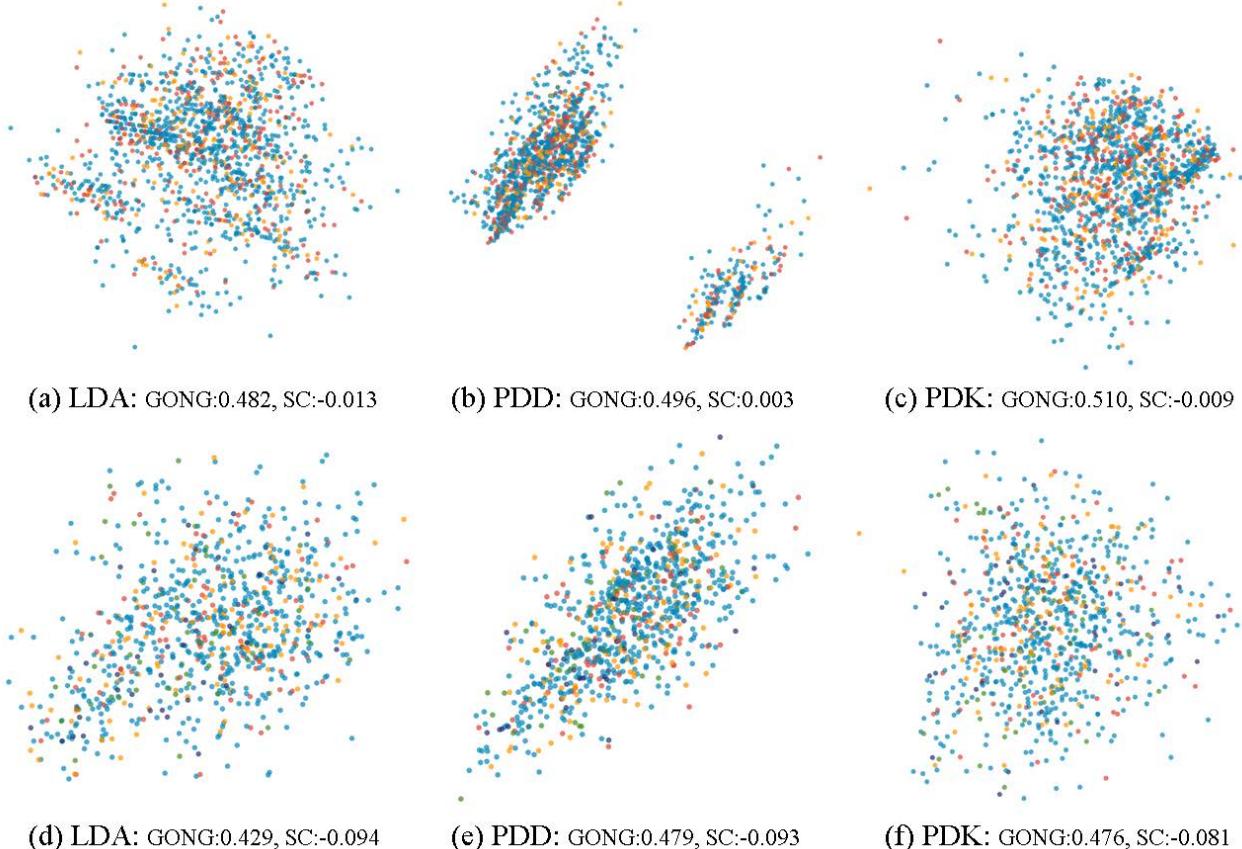
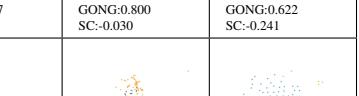
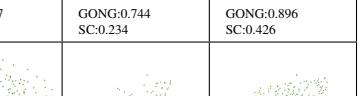
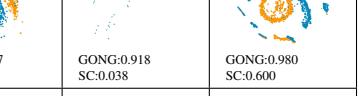
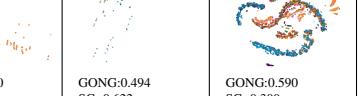


Fig. 4. Comparing the class separation quality of LDA, PDD, and PDK (left to right) on two datasets with randomly assigned class labels, where the resultant GONG and SC scores for each data are shown next to each subplot.

IV. SCREENSHOTS OF ALL PROJECTIONS

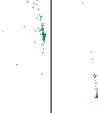
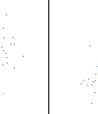
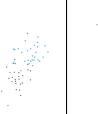
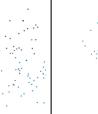
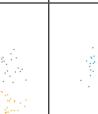
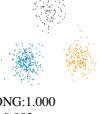
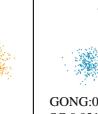
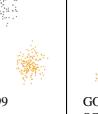
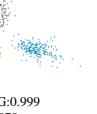
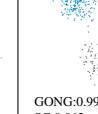
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abalone points:4154 dim:7 classes:28										
balance-sc points:625 dim:4 classes:3										
bddm13 points:200 dim:13 classes:5										
boston points:155 dim:13 classes:3										
breast-can points:454 dim:9 classes:2										
cars03Crop points:7404 dim:22 classes:2										
cars03Crop points:7404 dim:22 classes:12										
cereal points:77 dim:12 classes:7										
cmc points:1473 dim:9 classes:3										
combined-s points:1000 dim:100 classes:3										

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
Connection points:990 dim:13 classes:11										
	GONG:0.839 SC:-0.176	GONG:0.536 SC:-0.088	GONG:0.885 SC:0.045	GONG:0.683 SC:0.085	GONG:0.553 SC:0.086	GONG:0.777 SC:-0.100	GONG:0.466 SC:-0.052	GONG:0.714 SC:-0.112	GONG:0.645 SC:-0.023	GONG:0.946 SC:0.086
dermatolog points:259 dim:34 classes:6										
	GONG:0.960 SC:0.544	GONG:0.792 SC:0.462	GONG:0.964 SC:0.627	GONG:0.981 SC:0.788	GONG:0.820 SC:0.503	GONG:0.670 SC:-0.469	GONG:0.432 SC:-0.241	GONG:0.831 SC:0.447	GONG:0.805 SC:-0.198	GONG:0.824 SC:0.191
digits5-8 points:898 dim:64 classes:5										
	GONG:0.806 SC:0.290	GONG:0.709 SC:0.278	GONG:0.896 SC:0.577	GONG:0.936 SC:0.669	GONG:0.652 SC:-0.218	GONG:0.566 SC:0.017	GONG:0.299 SC:-0.058	GONG:0.635 SC:0.180	GONG:0.607 SC:0.057	GONG:0.992 SC:0.574
ecoliprote points:332 dim:7 classes:8										
	GONG:0.593 SC:0.239	GONG:0.560 SC:0.344	GONG:0.793 SC:0.291	GONG:0.782 SC:0.310	GONG:0.719 SC:0.332	GONG:0.706 SC:0.293	GONG:0.695 SC:0.186	GONG:0.729 SC:0.080	GONG:0.710 SC:0.193	GONG:0.775 SC:0.300
efashion points:3272 dim:4 classes:8										
	GONG:0.324 SC:-0.100	GONG:0.224 SC:-0.308	GONG:0.372 SC:-0.098	GONG:0.346 SC:-0.109	GONG:0.280 SC:-0.564	GONG:0.260 SC:-0.868	GONG:0.248 SC:-0.582	GONG:0.249 SC:-0.587	GONG:0.245 SC:-0.588	GONG:0.238 SC:-0.340
fisheries- points:121 dim:12 classes:11										
	GONG:0.920 SC:0.144	GONG:0.618 SC:0.106	GONG:0.967 SC:0.262	GONG:0.928 SC:0.772	GONG:0.635 SC:0.677	GONG:0.058 SC:-0.317	GONG:0.093 SC:-0.339	GONG:0.343 SC:0.359	GONG:0.065 SC:-0.286	GONG:0.309 SC:0.208
fisheries- points:121 dim:12 classes:11										
	GONG:0.834 SC:-0.108	GONG:0.665 SC:0.155	GONG:0.859 SC:-0.087	GONG:0.897 SC:0.550	GONG:0.419 SC:0.630	GONG:0.132 SC:-0.216	GONG:0.050 SC:-0.418	GONG:0.302 SC:-0.271	GONG:0.143 SC:-0.219	GONG:0.374 SC:0.235
Forest-Typ points:325 dim:27 classes:4										
	GONG:0.803 SC:0.261	GONG:0.705 SC:0.313	GONG:0.824 SC:0.352	GONG:0.855 SC:0.504	GONG:0.566 SC:0.488	GONG:0.720 SC:0.183	GONG:0.728 SC:0.299	GONG:0.730 SC:0.136	GONG:0.722 SC:0.223	GONG:0.784 SC:0.211
hayes-roth points:132 dim:5 classes:3										
	GONG:0.784 SC:0.076	GONG:0.674 SC:-0.001	GONG:0.803 SC:0.120	GONG:0.677 SC:0.176	GONG:0.715 SC:0.133	GONG:0.379 SC:-0.109	GONG:0.739 SC:-0.099	GONG:0.676 SC:0.108	GONG:0.407 SC:-0.079	GONG:0.381 SC:0.079
Hill-Valle points:606 dim:100 classes:2										
	GONG:0.841 SC:0.004	GONG:0.493 SC:-0.002	GONG:0.860 SC:0.003	GONG:0.728 SC:0.062	GONG:0.611 SC:0.184	GONG:0.522 SC:-0.004	GONG:0.000 SC:-0.002	GONG:0.573 SC:0.001	GONG:0.526 SC:-0.002	GONG:0.526 SC:-0.003

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
hiv points:78 dim:159 classes:6										
	GONG:0.656 SC:0.134	GONG:0.323 SC:0.027	GONG:0.907 SC:0.411	GONG:0.987 SC:0.996	GONG:0.987 SC:1.000	GONG:0.699 SC:0.879	GONG:0.687 SC:-0.583	GONG:0.749 SC:-0.563	GONG:0.665 SC:-0.683	GONG:0.446 SC:-0.370
interleave points:1490 dim:10 classes:10										
	GONG:0.662 SC:0.314	GONG:0.615 SC:0.223	GONG:0.678 SC:0.243	GONG:0.669 SC:0.326	GONG:0.626 SC:0.261	GONG:0.664 SC:0.002	GONG:0.313 SC:-0.103	GONG:0.501 SC:0.116	GONG:0.615 SC:0.258	GONG:0.960 SC:0.705
interleave points:1479 dim:10 classes:10										
	GONG:0.575 SC:0.131	GONG:0.531 SC:0.207	GONG:0.626 SC:0.252	GONG:0.622 SC:0.279	GONG:0.562 SC:0.213	GONG:0.538 SC:-0.066	GONG:0.408 SC:-0.001	GONG:0.482 SC:0.103	GONG:0.579 SC:0.221	GONG:0.973 SC:0.774
interleave points:2049 dim:15 classes:15										
	GONG:0.518 SC:0.115	GONG:0.450 SC:0.085	GONG:0.592 SC:0.189	GONG:0.590 SC:0.210	GONG:0.527 SC:0.139	GONG:0.574 SC:-0.023	GONG:0.392 SC:-0.049	GONG:0.429 SC:0.040	GONG:0.542 SC:0.150	GONG:0.997 SC:0.858
interleave points:2318 dim:15 classes:15										
	GONG:0.441 SC:0.002	GONG:0.463 SC:0.083	GONG:0.488 SC:0.109	GONG:0.498 SC:0.148	GONG:0.461 SC:0.033	GONG:0.523 SC:-0.039	GONG:0.352 SC:-0.038	GONG:0.348 SC:-0.066	GONG:0.431 SC:0.031	GONG:0.979 SC:0.792
interleave points:1254 dim:4 classes:4										
	GONG:0.820 SC:0.179	GONG:0.799 SC:0.353	GONG:0.833 SC:0.255	GONG:0.821 SC:0.391	GONG:0.803 SC:0.414	GONG:0.787 SC:-0.013	GONG:0.667 SC:0.275	GONG:0.800 SC:0.342	GONG:0.810 SC:0.404	GONG:0.950 SC:0.507
interleave points:538 dim:4 classes:4										
	GONG:0.694 SC:0.227	GONG:0.644 SC:0.320	GONG:0.705 SC:0.298	GONG:0.688 SC:0.337	GONG:0.663 SC:0.329	GONG:0.676 SC:0.100	GONG:0.662 SC:0.036	GONG:0.681 SC:0.293	GONG:0.673 SC:0.324	GONG:0.842 SC:0.394
interleave points:741 dim:5 classes:5										
	GONG:0.675 SC:0.222	GONG:0.710 SC:0.311	GONG:0.768 SC:0.266	GONG:0.734 SC:0.339	GONG:0.697 SC:0.297	GONG:0.704 SC:0.073	GONG:0.480 SC:0.052	GONG:0.678 SC:0.211	GONG:0.704 SC:0.289	GONG:0.894 SC:0.505
interleave points:696 dim:5 classes:5										
	GONG:0.745 SC:0.279	GONG:0.676 SC:0.368	GONG:0.783 SC:0.360	GONG:0.758 SC:0.389	GONG:0.752 SC:0.335	GONG:0.701 SC:0.056	GONG:0.563 SC:0.144	GONG:0.680 SC:0.244	GONG:0.723 SC:0.378	GONG:0.900 SC:0.554
interleave points:837 dim:6 classes:6										
	GONG:0.705 SC:0.291	GONG:0.655 SC:0.290	GONG:0.716 SC:0.295	GONG:0.700 SC:0.318	GONG:0.663 SC:0.316	GONG:0.651 SC:0.081	GONG:0.615 SC:0.043	GONG:0.580 SC:0.122	GONG:0.658 SC:0.300	GONG:0.901 SC:0.480

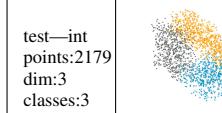
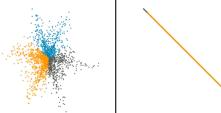
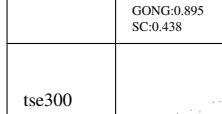
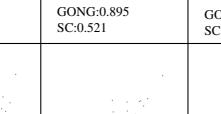
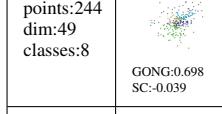
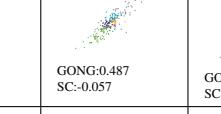
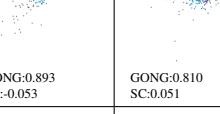
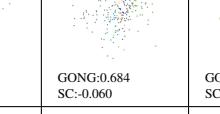
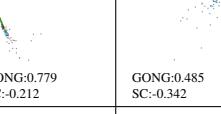
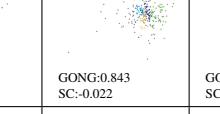
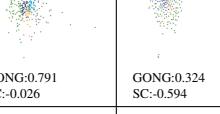
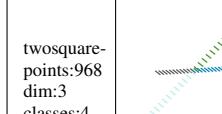
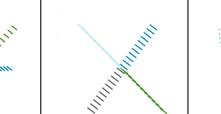
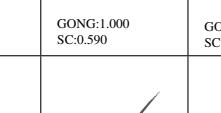
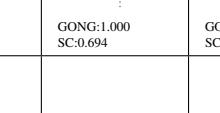
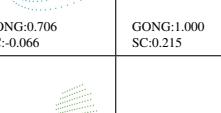
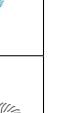
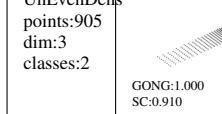
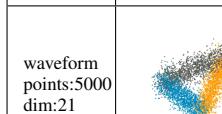
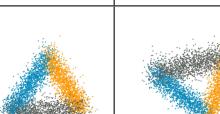
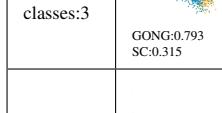
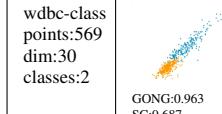
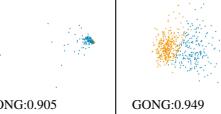
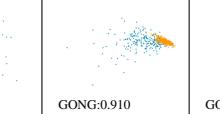
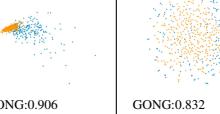
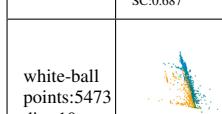
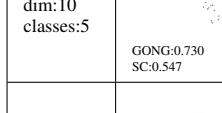
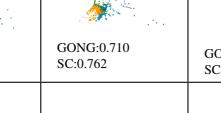
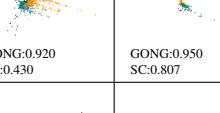
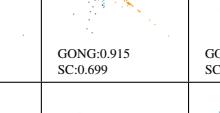
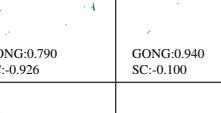
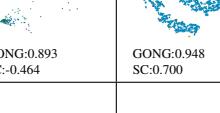
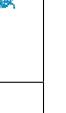
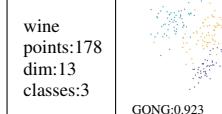
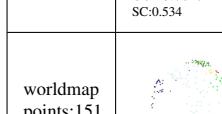
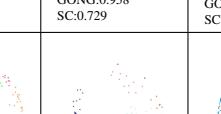
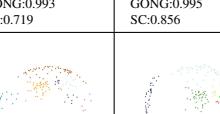
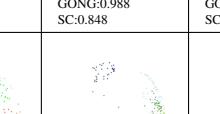
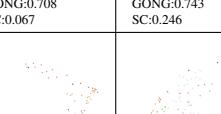
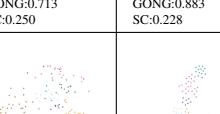
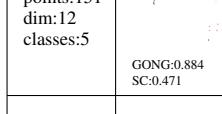
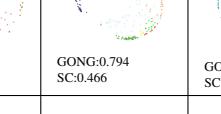
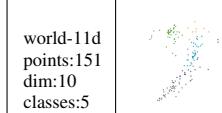
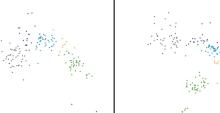
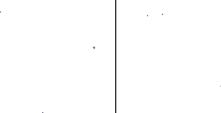
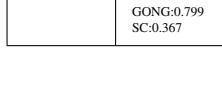
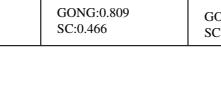
Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
interleave points:1034 dim:6 classes:6										
interleave points:857 dim:3 classes:3										
interleave points:1098 dim:3 classes:3										
ionosphere points:351 dim:34 classes:2										
iris points:147 dim:4 classes:3										
italianwin points:102 dim:6 classes:13										
Javier-Gen points:600 dim:3 classes:3										
Javier-Gen points:400 dim:3 classes:4										
Javier-Gen points:500 dim:3 classes:5										
lenses points:24 dim:5 classes:3										

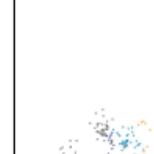
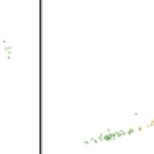
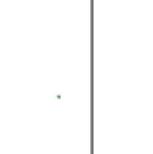
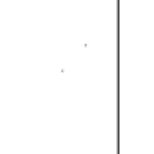
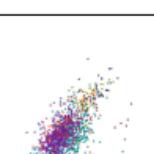
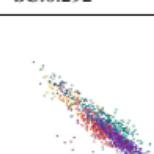
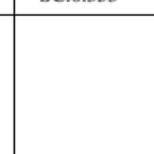
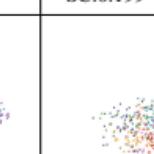
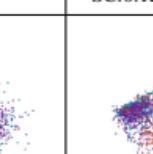
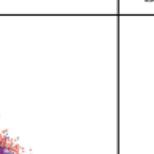
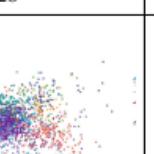
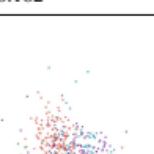
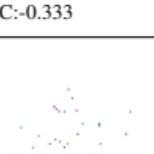
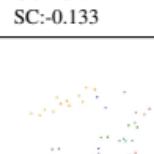
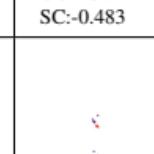
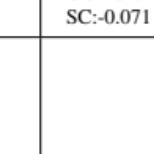
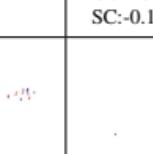
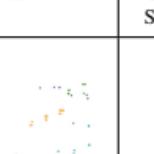
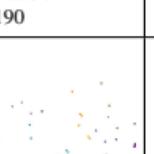
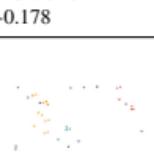
Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
movement-l points:360 dim:90 classes:15										
ms-interle points:496 dim:3 classes:3										
ms-interle points:571 dim:3 classes:3										
ms-interle points:185 dim:3 classes:3										
ms-interle points:205 dim:3 classes:3										
ms-interle points:1821 dim:3 classes:3										
ms-interle points:1892 dim:3 classes:3										
ms-interle points:309 dim:3 classes:3										
ms-interle points:292 dim:3 classes:3										
ms-interle points:325 dim:3 classes:3										

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
music-net-points:171 dim:9 classes:6	 GONG:0.576 SC:0.671	 GONG:0.464 SC:0.819	 GONG:0.983 SC:0.531	 GONG:0.980 SC:0.933	 GONG:0.947 SC:0.922	 GONG:0.975 SC:0.959	 GONG:0.946 SC:0.844	 GONG:0.980 SC:0.908	 GONG:0.958 SC:0.923	 GONG:0.899 SC:-0.450
n100-d10-c points:100 dim:10 classes:3	 GONG:0.941 SC:0.710	 GONG:0.969 SC:0.771	 GONG:1.000 SC:0.896	 GONG:1.000 SC:0.896	 GONG:0.990 SC:0.888	 GONG:0.973 SC:0.787	 GONG:0.759 SC:0.369	 GONG:0.968 SC:0.664	 GONG:0.987 SC:0.874	 GONG:0.828 SC:0.388
n100-d10-c points:100 dim:10 classes:3	 GONG:0.622 SC:0.171	 GONG:0.498 SC:0.170	 GONG:0.868 SC:0.368	 GONG:0.805 SC:0.450	 GONG:0.729 SC:0.456	 GONG:0.625 SC:0.147	 GONG:0.282 SC:-0.058	 GONG:0.618 SC:0.165	 GONG:0.742 SC:0.382	 GONG:0.480 SC:-0.051
n100-d10-c points:100 dim:10 classes:5	 GONG:0.726 SC:0.193	 GONG:0.751 SC:0.469	 GONG:0.899 SC:0.486	 GONG:0.922 SC:0.595	 GONG:0.821 SC:0.545	 GONG:0.695 SC:0.266	 GONG:0.529 SC:0.029	 GONG:0.706 SC:0.295	 GONG:0.825 SC:0.507	 GONG:0.751 SC:0.297
n100-d10-c points:100 dim:10 classes:5	 GONG:0.472 SC:0.018	 GONG:0.282 SC:0.121	 GONG:0.727 SC:0.092	 GONG:0.641 SC:0.267	 GONG:0.616 SC:0.259	 GONG:0.441 SC:0.209	 GONG:0.356 SC:-0.043	 GONG:0.458 SC:0.024	 GONG:0.425 SC:0.075	 GONG:0.383 SC:0.174
n100-d5-c3 points:100 dim:5 classes:3	 GONG:0.975 SC:0.726	 GONG:0.968 SC:0.789	 GONG:0.987 SC:0.830	 GONG:0.987 SC:0.861	 GONG:0.983 SC:0.859	 GONG:0.971 SC:0.596	 GONG:0.887 SC:0.388	 GONG:0.977 SC:0.762	 GONG:0.983 SC:0.855	 GONG:0.911 SC:0.398
n100-d5-c3 points:100 dim:5 classes:3	 GONG:0.675 SC:0.135	 GONG:0.718 SC:0.320	 GONG:0.815 SC:0.310	 GONG:0.778 SC:0.401	 GONG:0.728 SC:0.399	 GONG:0.494 SC:-0.307	 GONG:0.484 SC:-0.081	 GONG:0.659 SC:0.181	 GONG:0.707 SC:0.308	 GONG:0.678 SC:0.100
n100-d5-c5 points:100 dim:5 classes:5	 GONG:0.526 SC:0.022	 GONG:0.586 SC:0.241	 GONG:0.736 SC:0.259	 GONG:0.653 SC:0.313	 GONG:0.703 SC:0.314	 GONG:0.513 SC:0.090	 GONG:0.578 SC:-0.081	 GONG:0.653 SC:0.300	 GONG:0.702 SC:0.270	 GONG:0.502 SC:0.017
n100-d5-c5 points:100 dim:5 classes:5	 GONG:0.525 SC:0.006	 GONG:0.338 SC:-0.067	 GONG:0.688 SC:0.014	 GONG:0.546 SC:0.118	 GONG:0.581 SC:0.020	 GONG:0.473 SC:-0.329	 GONG:0.331 SC:-0.195	 GONG:0.544 SC:0.049	 GONG:0.591 SC:0.049	 GONG:0.550 SC:-0.099
n500-d10-c points:500 dim:10 classes:3	 GONG:0.995 SC:0.848	 GONG:0.999 SC:0.878	 GONG:1.000 SC:0.902	 GONG:1.000 SC:0.932	 GONG:0.999 SC:0.931	 GONG:0.999 SC:0.878	 GONG:0.995 SC:0.820	 GONG:0.995 SC:0.862	 GONG:1.000 SC:0.930	 GONG:0.997 SC:0.738

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
n500-d10-c points:500 dim:10 classes:3										
	GONG:0.809 SC:0.446	GONG:0.814 SC:0.455	GONG:0.868 SC:0.531	GONG:0.854 SC:0.552	GONG:0.856 SC:0.550	GONG:0.793 SC:0.324	GONG:0.479 SC:0.097	GONG:0.663 SC:0.260	GONG:0.830 SC:0.529	GONG:0.760 SC:0.175
n500-d10-c points:500 dim:10 classes:5										
	GONG:0.864 SC:0.493	GONG:0.758 SC:0.454	GONG:0.925 SC:0.620	GONG:0.918 SC:0.658	GONG:0.876 SC:0.617	GONG:0.823 SC:0.482	GONG:0.684 SC:0.323	GONG:0.801 SC:0.427	GONG:0.859 SC:0.611	GONG:0.917 SC:0.526
n500-d10-c points:500 dim:10 classes:5										
	GONG:0.487 SC:0.036	GONG:0.526 SC:0.169	GONG:0.687 SC:0.183	GONG:0.664 SC:0.289	GONG:0.630 SC:0.230	GONG:0.545 SC:-0.018	GONG:0.366 SC:-0.055	GONG:0.543 SC:0.075	GONG:0.639 SC:0.252	GONG:0.673 SC:0.066
n500-d5-c3 points:500 dim:5 classes:3										
	GONG:0.978 SC:0.706	GONG:0.950 SC:0.730	GONG:0.972 SC:0.693	GONG:0.968 SC:0.764	GONG:0.963 SC:0.756	GONG:0.963 SC:0.516	GONG:0.883 SC:0.546	GONG:0.952 SC:0.692	GONG:0.959 SC:0.754	GONG:0.967 SC:0.649
n500-d5-c3 points:500 dim:5 classes:3										
	GONG:0.511 SC:0.037	GONG:0.553 SC:0.102	GONG:0.653 SC:0.085	GONG:0.598 SC:0.133	GONG:0.589 SC:0.137	GONG:0.526 SC:-0.001	GONG:0.676 SC:-0.005	GONG:0.573 SC:0.007	GONG:0.584 SC:0.121	GONG:0.615 SC:-0.077
n500-d5-c5 points:500 dim:5 classes:5										
	GONG:0.696 SC:0.265	GONG:0.584 SC:0.214	GONG:0.732 SC:0.261	GONG:0.713 SC:0.353	GONG:0.667 SC:0.312	GONG:0.628 SC:0.041	GONG:0.511 SC:0.092	GONG:0.663 SC:0.261	GONG:0.692 SC:0.320	GONG:0.766 SC:0.362
n500-d5-c5 points:500 dim:5 classes:5										
	GONG:0.427 SC:0.029	GONG:0.450 SC:0.062	GONG:0.550 SC:0.051	GONG:0.518 SC:0.081	GONG:0.499 SC:0.099	GONG:0.422 SC:-0.139	GONG:0.453 SC:-0.051	GONG:0.473 SC:0.036	GONG:0.508 SC:0.102	GONG:0.530 SC:0.038
olive points:572 dim:8 classes:3										
	GONG:0.995 SC:0.527	GONG:0.991 SC:0.781	GONG:0.999 SC:0.804	GONG:0.999 SC:0.867	GONG:0.925 SC:0.847	GONG:0.884 SC:0.147	GONG:0.888 SC:0.246	GONG:0.908 SC:0.032	GONG:0.892 SC:0.205	GONG:0.989 SC:0.716
page-block points:5473 dim:10 classes:5										
	GONG:0.738 SC:0.120	GONG:0.706 SC:0.760	GONG:0.937 SC:0.809	GONG:0.942 SC:0.822	GONG:0.909 SC:0.699	GONG:0.895 SC:-0.926	GONG:0.941 SC:-0.133	GONG:0.935 SC:0.600	GONG:0.918 SC:-0.464	GONG:0.940 SC:0.177
parkin-son points:195 dim:11 classes:2										
	GONG:0.913 SC:0.138	GONG:0.797 SC:0.351	GONG:0.923 SC:0.211	GONG:0.814 SC:0.372	GONG:0.841 SC:0.489	GONG:0.824 SC:0.264	GONG:0.787 SC:0.360	GONG:0.865 SC:0.337	GONG:0.816 SC:0.259	GONG:0.832 SC:0.250

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
pima-india points:768 dim:8 classes:2										
processed-points:303 dim:13 classes:5										
satimage points:4435 dim:36 classes:6										
scene points:996 dim:295 classes:5										
seeds points:210 dim:7 classes:3										
shuttle-bi points:43500 dim:9 classes:7										
shuttle-sm points:14500 dim:9 classes:7										
soybean points:562 dim:36 classes:15										
spambase points:4601 dim:57 classes:2										
Statlog-Im points:2310 dim:19 classes:7										

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
test—int points:2179 dim:3 classes:3										
tse300 points:244 dim:49 classes:8										
twosquare- points:968 dim:3 classes:4										
UnEvenDens points:905 dim:3 classes:2										
waveform points:5000 dim:21 classes:3										
wdbc-class points:569 dim:30 classes:2										
white-ball points:5473 dim:10 classes:5										
wine points:178 dim:13 classes:3										
worldmap points:151 dim:12 classes:5										
world-11d points:151 dim:10 classes:5										

Name	PK	PD	PDK	PDD	LDA	GDA	NCA	RANDOM	PCA	t-SNE
world-9d points:192 dim:3 classes:13										
	GONG:0.691 SC:0.233	GONG:0.617 SC:0.238	GONG:0.914 SC:0.292	GONG:0.885 SC:0.353	GONG:0.731 SC:0.199	GONG:0.777 SC:0.126	GONG:0.759 SC:0.011	GONG:0.886 SC:0.326	GONG:0.784 SC:0.162	GONG:0.906 SC:0.387
yeast points:1452 dim:7 classes:10										
	GONG:0.353 SC:-0.100	GONG:0.374 SC:-0.333	GONG:0.441 SC:-0.133	GONG:0.441 SC:-0.483	GONG:0.417 SC:-0.071	GONG:0.338 SC:-0.164	GONG:0.366 SC:-0.186	GONG:0.390 SC:-0.190	GONG:0.348 SC:-0.178	GONG:0.408 SC:0.200
zoo points:101 dim:16 classes:7										
	GONG:0.921 SC:0.431	GONG:0.651 SC:0.333	GONG:0.960 SC:0.517	GONG:1.000 SC:0.965	GONG:0.883 SC:0.320	GONG:0.944 SC:0.321	GONG:0.909 SC:0.249	GONG:0.935 SC:0.275	GONG:0.925 SC:0.385	GONG:0.962 SC:0.209