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AN ANIMATED VISUAL ENCODING FOR STABILITY EVALUATION OF PROJECTION TECHNIQUES IN TIME-VARYING HIGH-DIMENSIONAL DATA

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Introduction:
In the modern world, data has taken increasing importance in businesses, and its growing complexity and volume ask for better and more refined algorithms of analysis and exploration. Projection techniques are often used to create 2D representations of these high-dimensional datasets, but the matter of projections for time-varying scenarios is not well studied. We present a visual encoding to express the results of multi-dimensional projection techniques for time-varying data.

Objective:
Provide a visual encoding that enable the visual inspection of the projection techniques' behavior with respect to its projected data movements.

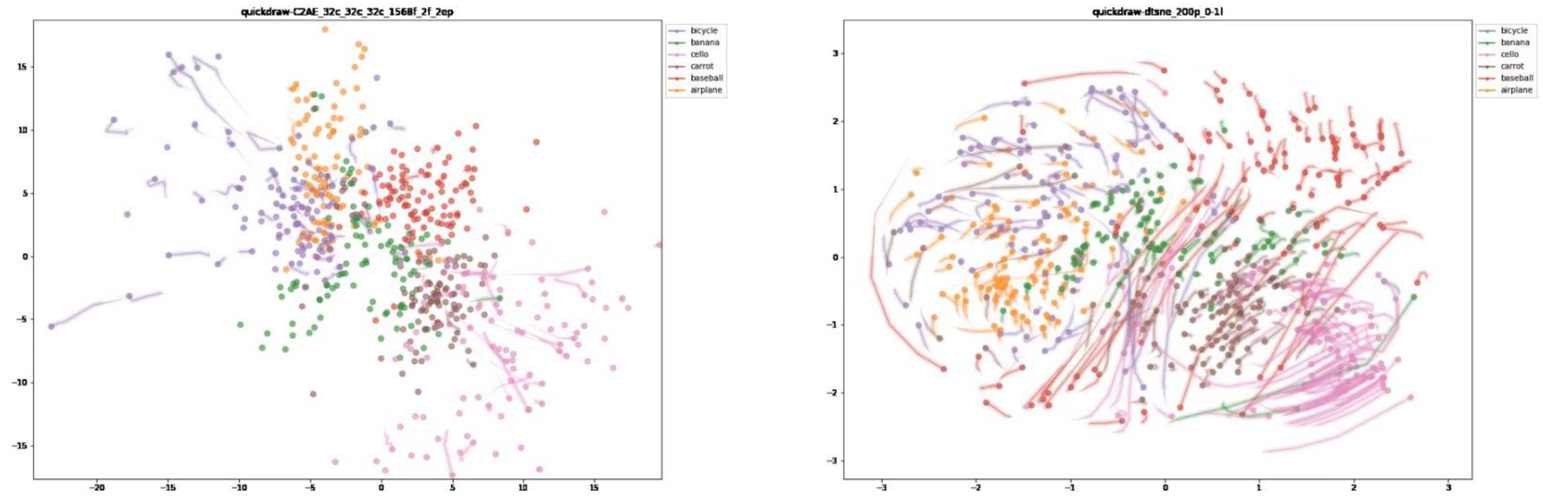
Methods:
We compare four projection techniques applied to three time-dependent labeled datasets of distinct characteristics, according to two data bundling strategies.

Datasets:
- Cartolastd: statistical data on football players, collected along the second turn of the 2017 Brazilian football championship.
- Gaussians: an artificial dataset of multiple isotropic gaussian blobs with diminishing spread.
- Quickdraw: sequences of drawings from Quick, draw! Google's doodle.

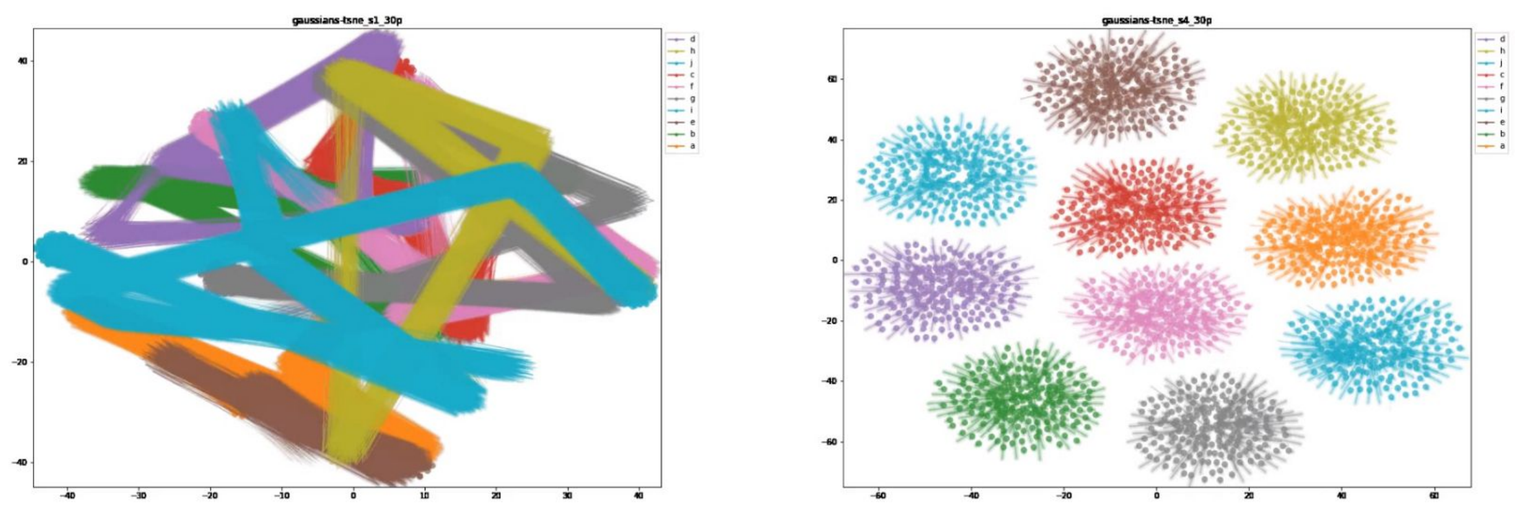
Projection Techniques used:
PCA, t-SNE, dt-SNE, Autoencoder based.

Data bundling stategies:
- Strategy 1: generate one projection for each timestep.
- Strategy 4: generate one projection for all timesteps. The projected data is then presented in its corresponding timestep.

Conclusion:
Preliminary results proved satisfactory, evidentiating instabilities of the 2D projection space and thus enabling a more robust visual comparison between the techniques' projections. Still, there are many properties of interest in multidimensional projections which can't be inferred through this visual encoding, such as mD projection accordance with the respective nD movement or mD neighborhood preservation. As a side result, the proposed encoding also favors the tracking of element positions in 2D space between frame transitions.



Quickdraw dataset projected using Convolutional Autoencoder (left) and dt-SNE (right) with strategy 4. The projection space behavior is evidently distinct between the two, with dt-SNE causing much more 2D movement.



Comparison between strategies 1 (left) and 4 (right) after application of t-SNE in the Gaussian dataset. It's noticeable that strategy 4 has better temporal coherence in the projection space.

Trajectory drawing emphasizes interframe movement of points in the projection space, enabling visual inspection and further comparison of multidimensional projection techniques' behavior for time-dependent data.

Individual videos

All videos in one screen