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Isomap

3.

So this is the original figure.

really helps there much more than PCA does.

embedding of Isomap.

As your datasets increase in non-linearity, like bends and curves, PCA's power to help

3:20 / 3:20 1.25x HD

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Similar to PCA, Isomap is also an unsupervised learning technique that reduces the dimensionality of your dataset. No labels or classifications are needed to guide it except your raw data. You can literally apply Isomap to any dataset during your exploratory

analysis. In fact you should transform your high dimensionality datasets with Isomap when they do not exhibit the behavior you want, having been passed through PCA.

PCA is faster than Isomap and works well in most situations, but its limitation is that it assumes a linear relationship exist between your features. What happens when your data has a non-linear structure? Take for instance a set of images produced by photographing the rotation one of those fancy, $1500 office chairs about its Y-axis. From a stationary camera's perspective, the rotation is a non-linear transformation, not well suited at all for PCA:

Authman's Commando Chair: Non-linear, and linear transformation examples...

In reality though, just by spinning the chair, you're really only altering a single degree of freedom. Dimensionality reduction aims to derive a set of degrees of freedom that can then be used to reproduce a lower dimensional embedding of your data, so a non-linear reduction algorithm should be able to recognize that within this image space, the sequence of pictures lie along a single-dimensional, continuous curve.

On the other hand, if the camera were translated directly up and down rather than rotating the chair itself, then that would be an example of a linear transformation *from the camera's perspective*, and PCA and other linear reduction techniques would be better

suited for reducing the dimensionality of the resulting dataset:

In order to address non-linear situations, Isomap uses an entirely different approach to the dimensionality reduction problem. One that is highly efficient, albeit more processor intensive than PCA. Nonetheless, for non-linear relationships it is a must. Its goal: to uncover the intrinsic, geometric-nature of your dataset, as opposed to simply capturing your datasets most variant directions.


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