Principal Component Analysis (PCA)

PCA is a useful statistical technique that has found application in fields such as face recognition and image compression, and is a common technique for finding patterns in data of high dimension. In this paper also given the step by step how the PCA is done in the mathematical side.

There is also mathematical background and techniques that is used in PCA, although not all of them are used in the PCA but it explicitly required to do the mathematical process. In this paper, it covers in statistic point, which based around set of data and how to anlyse that set in terms of relationship between individual point in data set for example standard deviation, variance, covariance, matrix covariance. Variance and standard deviation which is identical , is another measure of the spread of data in a data set. If Variance and standard deviation is one dimensional, Data set that is more than 1 dimensional can’t be measured by variance and standard deviation, so to measure calculate covariance between 2 dimension it can be used by Covariance. If more than 3 dimensional It can be solved by The covariance Matrix.

Matrix Algebra is use to provide a background for matrix algebra required in PCA, such as Eigenvectors and Eigenvalues. This is a basic knowledge to solve the PCA.

Eigenvectors is only can be found for square matrices, and not every square matrix has eigenvectors. For example, if there is a n x n matrix that have eigenvectors, there are n of eigenvectors.

Another property of eigenvectors is that even if I scale the vector by some amount before I multiply it, I still get the same multiple of it as a result, as in Figure 2.3. This is because if you scale a vector by some amount, all you are doing is making it longer,not changing it’s direction. Lastly, all the eigenvectors of a matrix are perpendicular, ie. at right angles to each other, no matter how many dimensions you have. By the way,another word for perpendicular, in maths talk, is orthogonal. Eigenvalues are closely related to eigenvectors, so that both of them always come in pair. Eigenvalues is on scalar eigenvectors is on vectors

In this paper also cover the application of PCA in computer vision. First is the Representation. When using these sort of matrix techniques in computer vision, we must consider representation of images. And there are also PCA to find patterns, where Each image is  pixels high by  pixels wide. For each image we can create an image vector as described in the representation section. We can then put all the images together in one big image-matrix.