

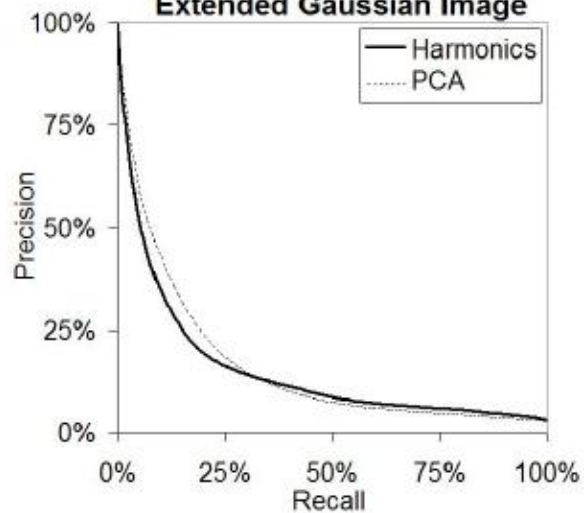
PCA Representations vs Spherical Harmonic Representations

- Descriptors Used:
 - Extended Gaussian Image
 - Radial Distribution
 - Spherical Extent Function
 - Sectors
 - Shape Histogram
 - Voxel
- PCA Representations composed of 64×64 grids

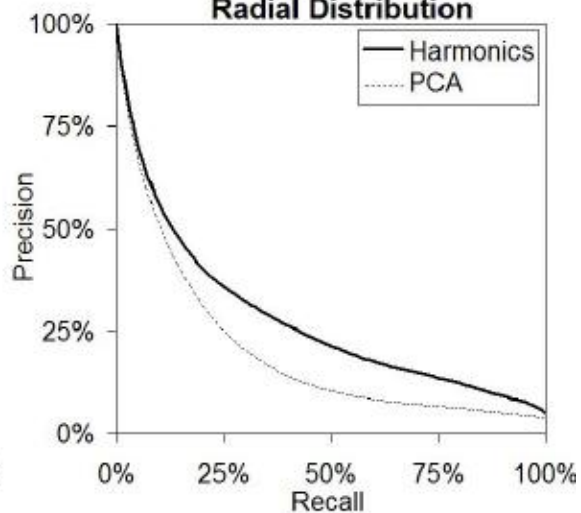


Precision vs. Recall

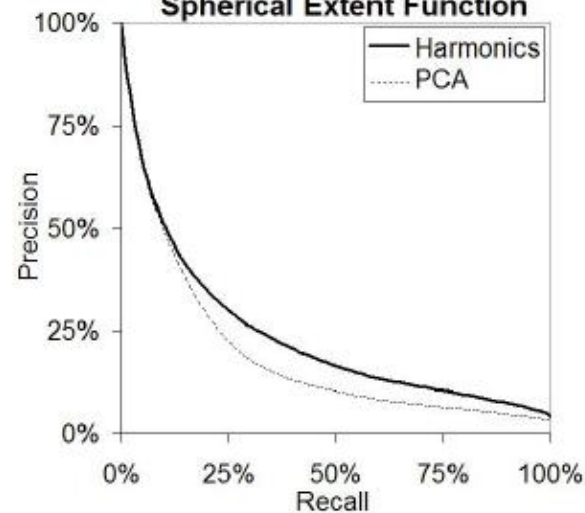
Extended Gaussian Image



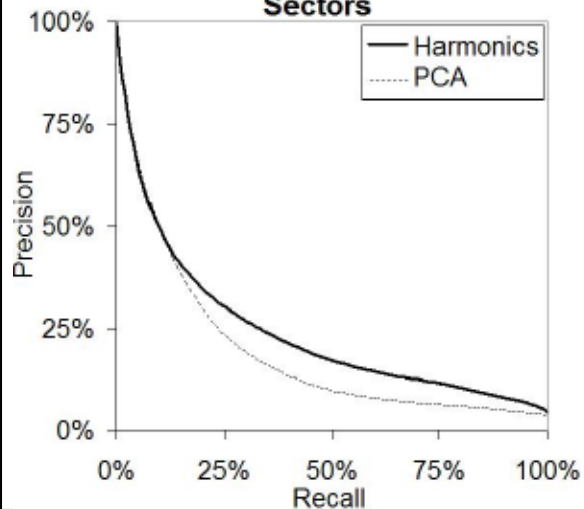
Radial Distribution



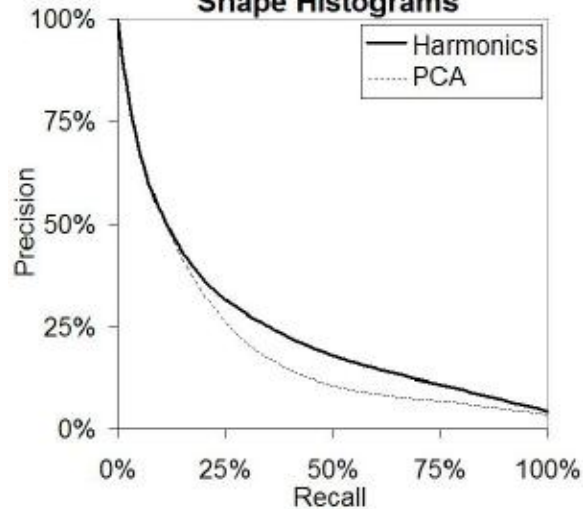
Spherical Extent Function



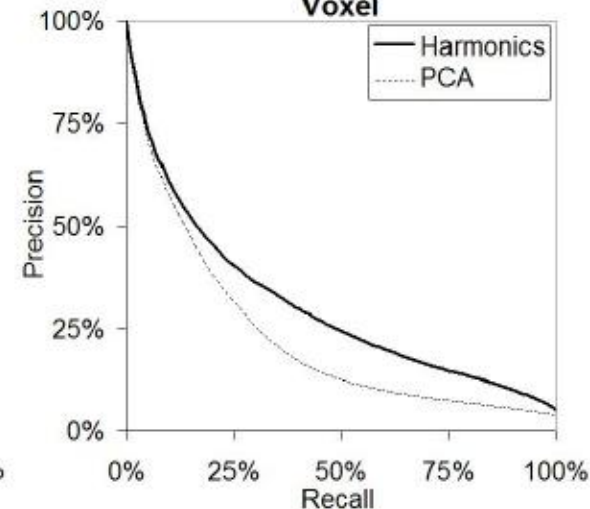
Sectors



Shape Histograms



Voxel



Advantages of Spherical Harmonics

- Allows more compact versions of every descriptor tested than PCA
- Model retrieval in 3D model search engine is more efficient

Representation	PCA-Aligned	Harmonic
EGI	64×64	32
Spherical Extent Function	64×64	32
Radial Distribution	$2 \times 64 \times 64$	2×32
Sectors	64×64	32
Shape Histogram	$4 \times 64 \times 64$	4×32
Voxel	$32 \times 64 \times 64$	32×32

Translation Invariance

- In this paper, translations are normalized
- Only works for whole-object to whole-object comparisons
- Future Work: alternative is translation invariance

$$1) \quad \left\| f - g \right\|_2 \geq \left\| |\hat{f}| - |\hat{g}| \right\|_2$$

$$2) \quad |\hat{g}(w)| = |\hat{f}(R(w))|$$

Conclusion and Future Work

- Spherical Harmonics in this paper are more robust and concise than PCA
- [3D Search Engine using voxel descriptor!](#)
- Future Work
 - Explore spherical harmonic methods that define a spherical function up to rotation
 - Extend to Translation and Scale-Invariant methods