

Navigation & Discovery of 3D models in CAD Repositories



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The Shape Search

- Searching for 3D shape
 - Shape representations
 - View based
 - Search algorithms \pm clustering
 - Without clustering
 - User input
 - 2D sketch/3D file
 - User interaction
 - Traditional 1D space, proposed 3d space



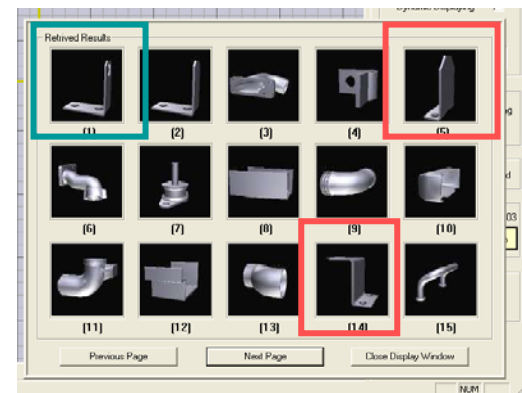
Search, Navigation, Discovery

- Search
 - query the system with an input and get the top results based on similarity distance
- Navigation
 - moving oneself sequentially around an environment, deciding at each step where to go next based on the task and parts of the environment seen so far
- Discovery
 - Observing patterns based on shape characteristics in the interaction space influencing styles of navigation



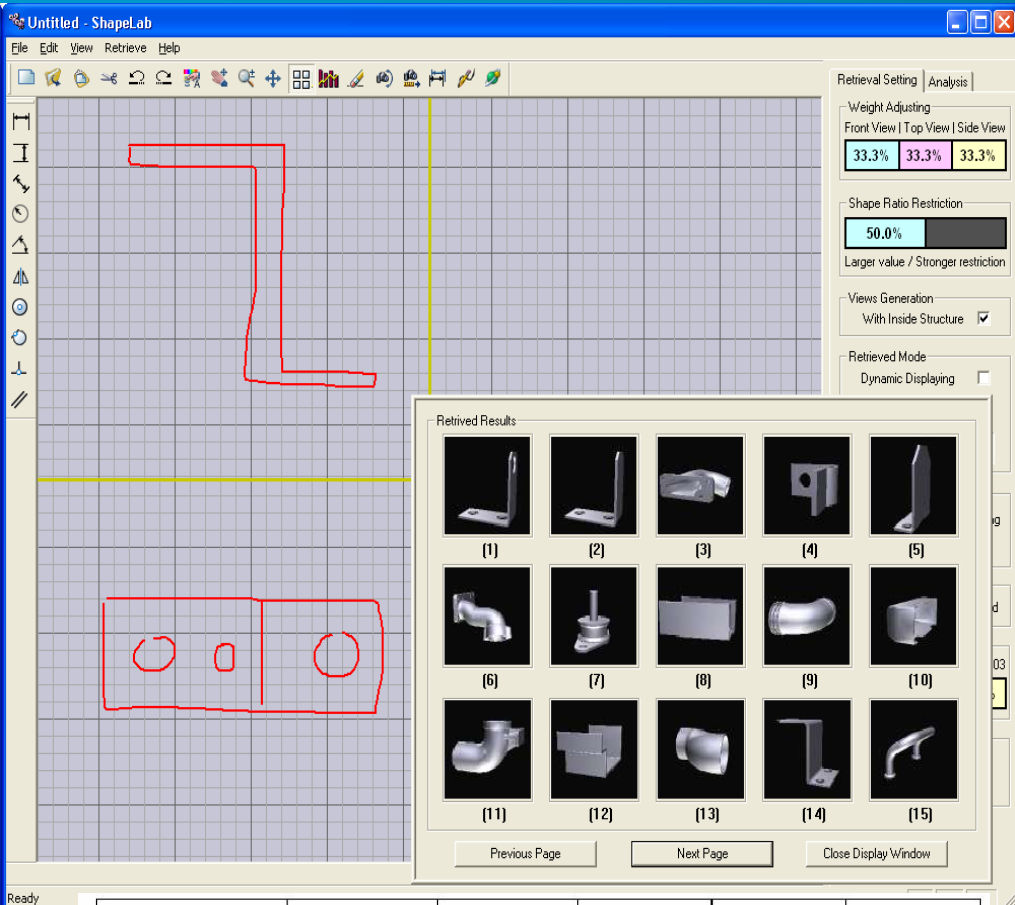
Issues in CAD Repositories

- 1000s of results
- Its not a single static search
- Search is an information gathering activity
- The similarity ranking reflects the distance of models only to the query
- Browsing through the database
- Clustering





Traditional 1D interface



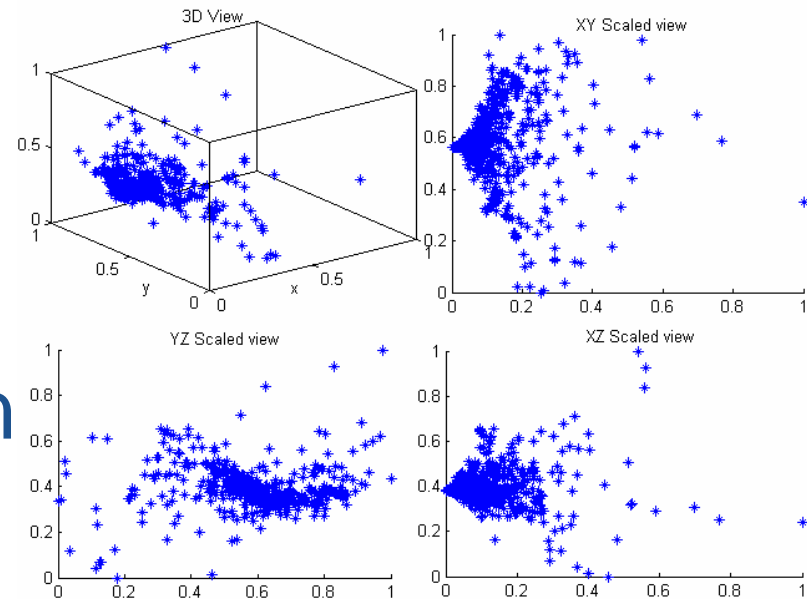
- Results in pages
- Similarity among the results not considered
- Models similar in different views

A Set of Similar Models					
A Set of Different Views from One Perspective					



Multi-dimensional Scaling

- Use the dissimilarity matrix
- Final configuration such that the original pairwise distances are maintained within some tolerance
- Metric/non-metric
- Optimization procedure
- Squared stress criterion





The new 3D interface



User testing

- 3D interface
 - needs training
 - Faster
 - Users observed patterns
 - Get other related parts
 - Intuitive
 - Navigation controls
 - Images overlapping

	1D			3D		
	3	5	8	3	5	8
user 1	6	11	20	4	11	23
user 2	17	46	53	9	12	37
user 3	8	11	38	6	13	24
user 4	12	19	27	4	9	12
user 5	13	15	22	5	15	29
user 6	12	18	34	3	11	23
user 7	9	15	45	6	19	24
user 8	14	16	29	4	12	16
user 9	11	20	24	4	8	21
user 10	10	13	26	6	20	22
average	11.2	18.4	31.8	5.1	13	23.1



Graphics bits

- ~900 images
- 256 x 256, mipmaps to 1x1
- Compressed textures DXT1, no alpha
- DirectX
- ATI Radeon 9500 pro



Concerns

- How to handle more images?
- Buffering
 - Cube buffering
 - Sphere buffering
- Display meshes instead of thumbnails
- Virtual Reality Environments?
- FastMap ~ dynamic MDS
- Clustering



“Bring me that horizon...”

- Captain Jack Sparrow

- The proposed interface in 3D is better
- But expanding it for huge repositories need graphic strategies
- High dimensional Space?
- Use clustering hierarchies