Quick Research Summary
Shape-Inspired Architectural Design

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Research Topics

• Rendering optimization
  – *real-time shading algorithms, acceleration techniques*

• Imaging
  – *document rectification, image colorization, morphing, gigapixel*

• Geometry processing
  – *architectural design*
Research topics – Gigapixel imagery

Corcovado 67GP image (former world’s largest digital photograph)

Gigapixel video of HKUST
Shape Inspired Architectural Design
Architectural Design

• Input: Three shape templates

• Optimize the building shape so that silhouette from three different viewpoints match each of the three templates
Exterior Objectives

- Single view: silhouette cone by projecting image from camera position.
- Multi-view: intersection of single view silhouette cones.
Objectives

• Find camera position, image position and scale that can generate a satisfying model.
What defines a good model?

- Shape template integrity
- Structural integrity
- Total volume
- ...

poor structural integrity
Optimization algorithm

• Non-linear, non-convex optimization
• Considered different probabilistic techniques, metaheuristics
  – Simulate Annealing (SA)
  – Genetic Algorithm (GA)
  – Particle Swarm Optimization (PSO)
  – Cuckoo Search
• We used a modified version of cuckoo search
  – Maintains multiple solutions at any stage
  – Tries to mutate solutions and provides random restarts
Smoothing

- Convert from voxels to a mesh surface using marching cubes
- New specialized smoothing algorithm based on bilateral filtering with roof flattening
Egypt Museum

Default parameters

Optimized parameters
Design for Possible ACM Headquarters
Bird Shape Building
Conclusion

• Architectural concept design system
  – Initial design from three input shapes
  – Building silhouettes consistent with input shapes
  – Incorporates architectural requirements
  – Modified cuckoo search algorithm

• Later work explored interior planning:
• Discussing exploring interesting real-world uses with architects
Thank you!

More info:
http://www.cse.ust.hk/~psander/