Autotagging to Improve Text Search for 3D Models

Corey Goldfeder   Peter Allen
Columbia University

- Motivation: Keyword search for 3D models
  - Unlike images, 3D models are not usually embedded in text content
  - How can we search unlabeled geometry?

- Challenges
  - Lack of reliable datasets
  - Distances are metric but semantics are not
  - Representations of geometry are nonunique

Autotags

- Solution: automatic annotation
  - Given an unlabeled model, assign descriptive tags
  - Probabilistically propagate tags and confidences between similar models
  - Perform keyword search on autotags

- We use Google 3DWarehouse as a corpus
  - 192,343 user contributed 3D models
  - Tags are only moderately reliable
  - Too many tags to train explicit models
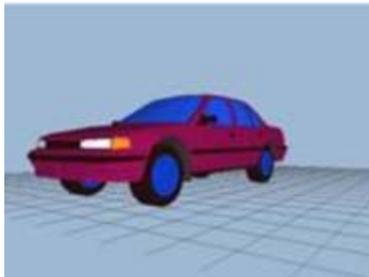
Autotagging Algorithm

- ## Geometric Similarity

  - Given unlabeled model ω and corpus model ω_x, define $P(\omega \approx \omega_x) = (1 - D(\omega_x, \omega_y))^2$ as their similarity, where D is L² on Zernike descriptors
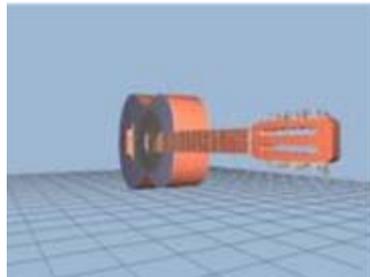
- ## Tag Propagation Rule

  - Given the N nearest neighbors of ω, and a tag λ^i

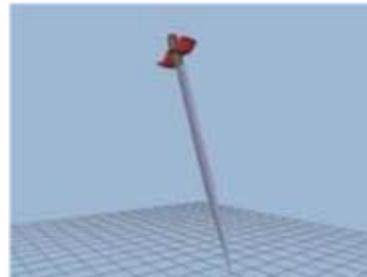$$P(\lambda^i, \omega) = \bigcup_{n=1}^{|N|} P(\omega \approx \omega_n) \wedge P(\lambda^i, \omega_n)$$

Results on Benchmark Models
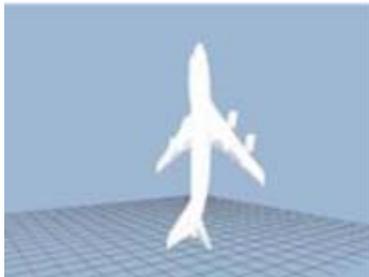

car, vehicle, sedan, dodge, charger

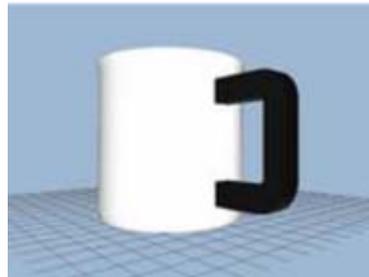steel string, guitar, string, seagull, acoustic guitar

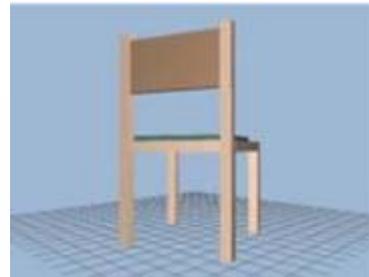sword, blade, *sign*, *architecture*, *landscape*

house, instrument, musical instrument, musical, piano

airplane, *house*, aircraft, plane, jet

mug, drink, beverages, coffee, *interior*

chair, wood, furniture, wooden, simple chair

animal, human, biped, man, a*ircraft*

Images from the Princeton Shape Benchmark

Demo

- Columbia Shape Search

- Try it yourself at <u>shape.shorturl.com</u>

Experimental Results

Discriminative Power
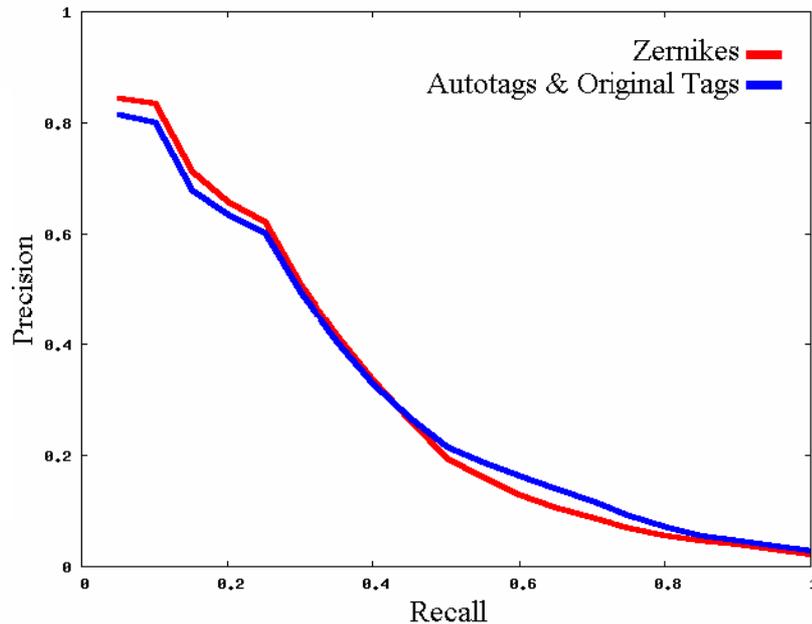
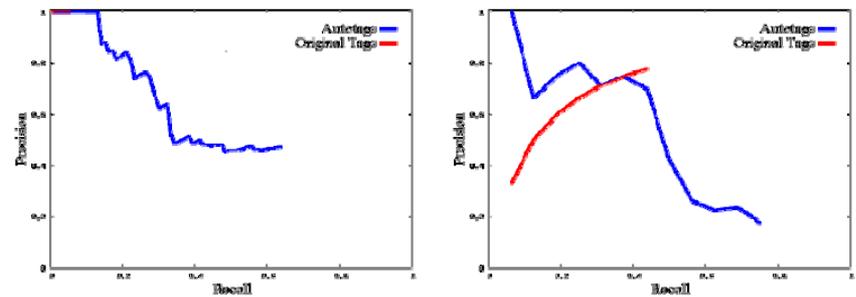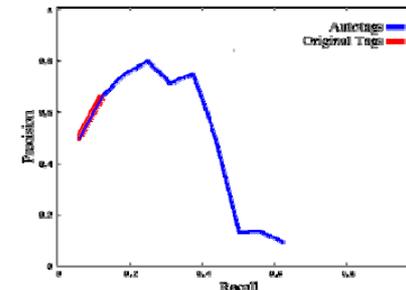

Tag Quality

(a) Search for "airplane"

(b) Search for "sword"

(c) Search for "head"

Conclusions and Future Work

- **Conclusions**
  - Autotags transfer most of the discriminative power of Zernike descriptors into text search
  - Along with anchor text, etc. we can roughly replicate the performance of Zernikes using text

- **Future Work**
  - Different shape descriptors
  - Finer-grained priors for reliability of corpus tags
  - Local clustering to reduce sample bias in corpus

- See also our poster in SMI '08 and our winning entry in SHREC '08 (classification track)

- Thanks to Google for providing the dataset

- Questions?