Overview of my work

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Collaborators:
My research

• Solve scene understanding problems
• E.g. given an image of a fish
  – Recognition
  – Reconstruction
  – Retrieval

• using:
  – 2D and 3D Data
  – Models that exploit 
    \textit{Class-specific nature}
Overview of my work

- Reconstruction
- Recognition
- Retrieval
- Other representations
- Other experiments
Overview: class-specific models and representations
Reconstruction

Single, multi-view with various class specific priors and object representations
Reconstruction: Local shape models

Incomplete image

Patch-based methods incorporating transformation

[Mansfield et al. 2010]
[Wexler et. al. 2007]
Reconstruction: Local shape model

• Voting-based completion
  – Smoothly overlapping cube regions from codebook

Incomplete shape

Diffusion

Our method

Incomplete shape
Single view reconstruction

- **Given**
  - One image, surface parametrization
  - Silhouette constraints
  - Intuitive user input

- **Retrieve 3D as a global solution of a simple convex problem solved linearly.**
Reconstruction: Global shape models

• Using
  – Parametric surfaces and analytic correspondences

• [Prasad et al., CVPR 10]
  – Given many images of clownfish we were able to use their curves to build a deformable clownfish model and explain the viewpoint and pose in each image also.
Dataset from image search
Result
Global: Reconstruction and completion

Shape completion using an RBM class model

Volumetric reconstruction benefits from RBM shape prior
Extension to structured objects

- Assuming repeated elements (petals) in a particular configuration allows for a non-convex but well-behaved optimization.
Recognition, segmentation, localization
Class-specific detection, segmentation
Class specific localization with reconstruction
Recognition/detection/classification in 3D

- The basic process
Star-shaped ISM representation

Training data

Test shape: normalized votes
Recognition: Intermediate-level ISM

- Intermediate level implicit shape models (ISM) [Knopp et al. 2011]
  - Voting based
Recognition on real SfM data

- Bike: 12 out of 15
- Plant: 0 out of 81
- Cube: n/a
- People: 18 out of 18
- People: 11 out of 33
- Woman: 47 out of 100
Recognition + 3D Scene segmentation

- Given a training data of the specific class, find that class in the scene.

Example of training data:

Results:
Intermediate patch based representations for localization
Retrieval
3D retrieval engine of 3d-coform.eu using BoW inspired approaches

• Shape search is used to search collection of 3D data.
Improving retrieval with intermediate class structure

- Learning structure pairs and triplets for **fast** improved retrieval

- Learning class-specific structure for **accuracy**
Improving retrieval with intermediate class structure

- Search needs simple, fast models
  - Weak, local structure
More representation learning
Representations presented so far

• Surfaces: patch-based, parametric global
• Objects: freeform surfaces, monge patches, ISM based, RBM based.

• Coming up:
  – Constellation models for 3D object classes
  – Kernel density estimate representations of images
  – Architectural context-free grammars
Learning representations: Intermediate parse trees for architectural styles [Weissenberg et al. 13]
Learning representations: Global + local cues for shape understanding

• Constellation models for part localization

[Prasad et al. 11]

— Can be further propagated to learn spatially smooth dense correspondences
Other forays
SomeoneLikeThat: An exemplar driven dating app

- Using machine learning in a social network to learn dating preferences

Figure 1: A picture of our current web application and phone app prototypes with ~50 test users.