OVERVIEW OF OUR APPROACH

CONTRIBUTIONS – GENERALIZED MAX-CLIQUE GRAPH MATCHING

Problem: How to match graphs whose both edges and nodes are weighted?

Given two CST image representatives: \( G_1 \) and \( G_2 \).

\[
\text{maximize } \sum_{e \in E_1} \text{potential}(e) \cdot \text{potential}(G_2(e))
\]

where \( \text{potential}(e) \) and \( \text{potential}(G_2(e)) \) are the potential of the edge and the subset of nodes in \( G_2 \) that are connected by \( e \) respectively.

Proposition of the proposed algorithm:

- \( G_1 \) matches regions with graphs in \( G_2 \) and matches regions spatial relationships with corresponding relationships.
- \( G_2 \) matches regions with spatial relationships by matching pairs of regions and their extent in image collections.

Theorem: Maximin clique subgraph isomorphism between two graphs with weighted edges and nodes.

EXAMPLE: CST MODEL OF WEIMZ MARES

LabelMe Cars

Simultaneous recognition and segmentation of category "car" (represented by the CST model inside rect, and the segmentation-tree (ST) model (1), (front view). CST CVPR 2005.

Simultaneous recognition and segmentation of category "car" (represented by the CST model inside rect, and the segmentation-tree (ST) model) (1), (front view). CST CVPR 2005.

CONTRIBUTIONS – DEFINITION OF REGION NEIGHBORHOODS

1) Regions are exposed to one another through their nearby boundary segments.
2) If boundary parts of two regions are:

- Visible to each other - Nearby
- Partially occluded - Semi-near
- Fully occluded - Non-near

3) Relative degrees of boundary exposure to neighbors = Strength of a region's neighborhoods.
4) Region neighborhoods is asymmetric.

ALGORITHM

1. Each CST model is built up by connecting nodes and mapping them to the ST model.
2. Each ST model is built up by connecting nodes and mapping them to the CST model.
3. The intersections of CST models with ST models give rise to the connected segmentation tree for the image.

RESULTS


REFERENCES


ACKNOWLEDGMENT

The support of the National Science Foundation under grant NS0 07-48934 is generally acknowledged.

MOTIVATION

Objects in 3D world

Their image projections:

- Appearance - Colors of contiguous pixels, 3D objects have distinct locations & finite volume
- Geometric properties - shape, area
different materials on their surfaces, photometric properties value, texture structural shell and embedding of subregions within regions comprised of other objects - parts
- Spatial layout and hierarchy of 3D objects

PROBLEM STATEMENT

ST and CST images, each containing a segmentation of an object category

IDENTIFY all regions occupied by the object in the image set
LINK a model of the category that JOINs captures
- Geometric properties (e.g., shape, area, relative displacement)
- Photometric properties (e.g., intensity contrast along the boundary)
- Embedding (e.g., containment relationships)
- Neighbor relationships and their strengths
- Relations between regions identified in image collections

ST and CST images, the connected model set, segments, any occurrences of the category.

PRIOR WORK vs. PROPOSED OBJECT REPRESENTATION

Top of keypoints

Top-down model

Proposed model: Connected Segmentation Tree

Hierarchical models e.g., segmentation tree [1, 2], the same segmentation tree for different scales

Proposed Voronoi diagram

Boundary pixels and their corresponding Voronoi polygons for points

Generalized Voronoi polygons for regions

Union of Voronoi polygons of boundary pixels

- Regions are neighbors if their generalized Voronoi polygons touch
- Strength of neighborhoods = Percentage of Voronoi polygon's perimeter that is shared

Connected Segmentation Tree -- A Joint Representation of Region Layout and Hierarchy

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CVPR 2006