Carnegie Mellon University
The Robotics Institute

AirObject

A Temporally Evolving Graph Embedding for Object Identification

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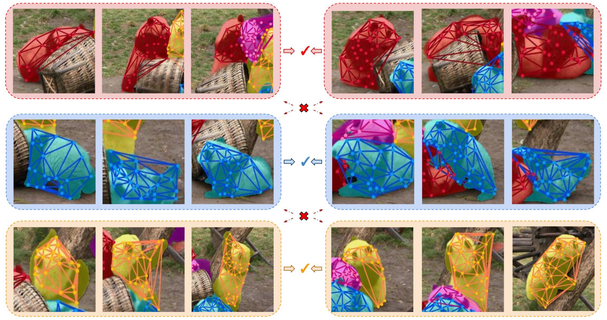
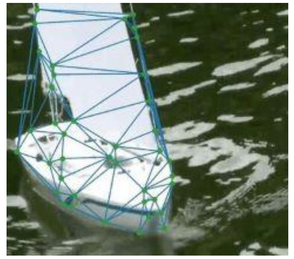
1. Class-agnostic Temporal Object Matching

- Object encoding and identification are vital for many robotic tasks
- Prior methods track objects or use fixed single-frame representation
- We propose AirObject, a method to capture the temporally evolving object structure as the camera or object moves
- The Object Encoding and Matching process is class-agnostic

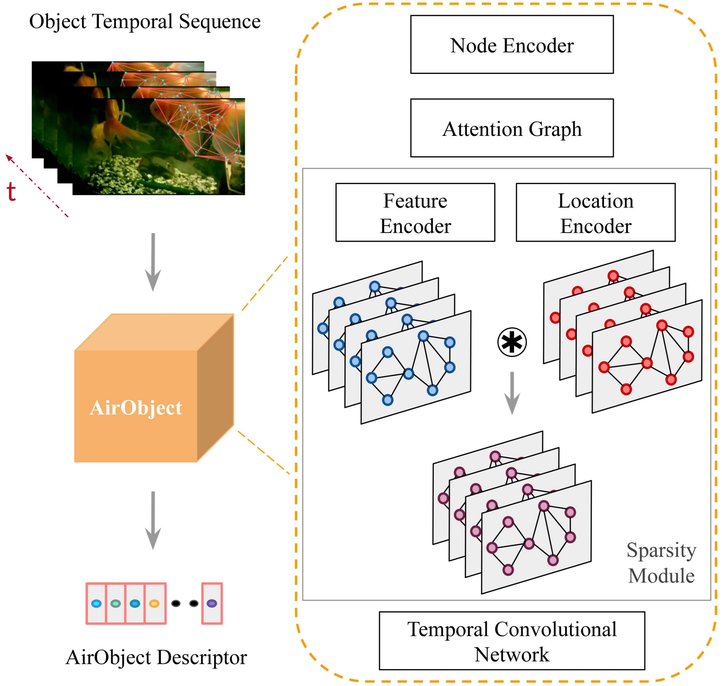


2. Topological Object Graph Representations



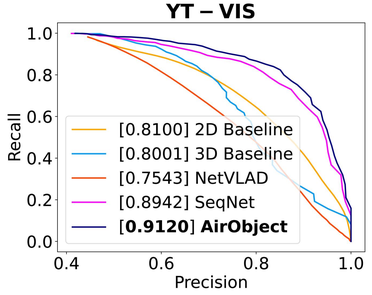
- Delaunay triangulation based topological object graphs to **learn** the **geometric relationship of keypoints**

3. Simple & Effective Temporal Object Encoding



- Leverages **keypoint position, appearance & object graph**
- **Reasons** about object structure & global feature interaction of distinctive local keypoints using **graph-attention**
- Encodes both **appearance & sparse descriptor location**
- Aggregates **temporally evolving structural knowledge** using a single-layer Temporal Convolutional Network

4. State-of-the-art Video Object Identification



- State-of-the-art performance despite higher dimensionality of SeqNet descriptors
- Large performance gap between single-frame and temporal methods indicating **importance of temporal information**
- AirObject Descriptors are robust to **severe occlusion**, **perceptual aliasing**, **viewpoint shift**, **deformation**, and **scale transform**
- AirObject provides **general class-agnostic semantic knowledge** for real-world robotic applications