ReBeDe: Reasoning Beyond Detection

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High-Level Reasoning and Activity Detection from Full Motion Video

Upcoming Activities Involving Track 1:

vehicle (3) @ 09:46 (fran

Extracting semantic meaning from raw full-motion video (FMV)

Large volumes of raw FMV are captured daily from surveillance platforms across the Department of Defense (DoD) and other U.S. Government agencies – so much that most of this information cannot realistically be exploited in a timely fashion by human analysts. This means that important events can go unnoticed, and strategic opportunities are missed.

CACI's ReBeDe technology is a breakthrough computational engine created by our artificial intelligence (AI) experts that combines modern machine learning with classical AI to reason over and extract semantic meaning from video content. ReBeDe significantly improves analyst workflow by enabling efficient, automated exploitation of video content by processing the output from a FMV multi-object tracker. The ReBeDe engine uses machine learning and graph theory to exploit spatiotemporal relationships among tracked entities in video to uncover high-level activities such as people entering or exiting vehicles and facilities, people exchanging objects, people loading and unloading objects from a vehicle, and more. These activities and relationships form an activity graph that can be used to empower downstream applications like monitoring and alerting, semantic search, video summarization, and anomaly detection.

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Features

- Combines machine learning with a graph theoretic approach to eliminate the need for large amounts of labeled training data
- New activities easily defined using an intuitive graph query language
- Automatic textual report generation from activity graphs
- Quickly extract and view activity clips from a larger video on demand
- Efficient semantic search of a video or collection of videos

Benefits

- Enables rapid understanding of long video sequences in minutes instead of hours
- Significantly improves analyst workflow by enabling efficient, automated video exploitation
- Enhances and empowers applications like monitoring and alerting, semantic search, video summarization, and anomaly detection



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How ReBeDe Works

ReBeDe centers around the concept of a "spatiotemporal proximity graph," which is automatically constructed from the object tracks put out by a FMV multi-object tracking engine.

When the tracker processes a video, it generates tracks for all detected objects. These tracks consist of a track identification, a class label (such as a vehicle or person), and a sequence of bounding boxes representing the location of the tracked object in each frame of video where it is present. ReBeDe builds a spatiotemporal proximity graph from these tracks, with nodes representing distinct tracked objects (such as a specific vehicle) and the edges between objects identifying periods of close spatial proximity. From this spatiotemporal graph, the activity extractor identifies higher level activities (like entering or exiting a vehicle or facility, or people exchanging objects) through subgraph matching queries.

Analysts can extend ReBeDe's activity detection abilities by defining queries for additional activities. Detected activities are represented by "activity nodes" with "participant edges" to the track nodes representing the participating entities. These track nodes, activity nodes, and participant edges collectively induce a high-level activity graph. Downstream tools, which operate on top of the activity graph, allow analysts to generate textual summary reports from a video, rapidly explore a video by viewing activity clips, and efficiently search over videos.

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ACTIVITY GRAPH