Syntactic Approach for Anomaly Detection in Visual Surveillance

Overview

- Goal: To detect abnormal events in surveillance videos
- Approach:
  - Events are modeled using attribute grammars.
  - Specific event of interest is recognized by parsing the input.
  - Abnormal events are detected when the input does not follow the grammar to some degree.

Primitives

- Input symbols: “primitive events” extracted from tracking data
  - e.g., stop, disappear
- Attributes: Additional features associated with primitive event
  - e.g., location, object id

Attribute Grammar

- PARKING \rightarrow \text{DRIVE} \text{IN} \text{appear} \text{disappear} (\text{isPerson}(\text{appear}, \text{class}))
- \text{DRIVE} \text{IN} \rightarrow \text{appear} \text{start} \text{STOP}^1 \text{STOP}^2 (\text{isVehicle}(\text{appear}, \text{class}))
- \text{DSTOP}^1 \text{STOP}^2 \rightarrow \text{stop} \text{STOP}^1 \text{loc} := (\text{stop}, \text{loc}) \text{STOP}^2 \text{loc}
- \text{DSTOP}^1 \text{STOP} := \text{stop} \text{STOP}^1 \text{loc} := (\text{stop}, \text{loc})

Context-free grammar

Attribute evaluation rules & Semantic conditions

Handling multiple threads/objects

- Semantic condition on the attribute tid (thread id)
- Match the input id with tid

Handling Uncertainty

- Semantic conditions have probability values
- Soft thresholding: e.g., Near(loc1, loc2)
- (Syntactic) Production probability as in stochastic Context-free grammar
- Recognition: when input is successfully parsed with high probability

Online parsing

- Prediction
- Completion (check semantic conditions)
- Scanning (match input symbol & tid)

Handling multiple threads/objects

Input: appear (id=1) start (id=1) appear (id=2) disappear (id=2)

Results

- Recognizing specific events of interest
- Recognizing normal events
- Detecting abnormal events

- Illegal parking
- Unusual walking path

Other abnormal events detected: parking and not entering building, staying too long inside parked car