

Video Analytics: Template Matching (Week 6)

Video Analytics

- Video is a display of moving visual media, which can be seen as a sequence of still images.
 - In a general sense: Video is metadata i.e. data that provides information about other data.
- In video analytics, the metadata is processed in real-time and transformed into intelligent data. Examples include:
 - Generation of descriptions of what is happening in the video.
 - Detect and track objects.
- Potential applications are: Motion tracking, object tracking, license plate recognition, facial recognition, crowd detection, indoor people tracking, etc.

Template Matching: Motion/Object tracking

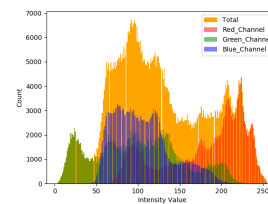
- Template matching (TM) method detects different types of objects with the help of a template.
 - The generated templates from detection module are passed on to the tracking module.
 - TM initiates the tracking process with a given input reference template.
- TM works without tedious training procedures.



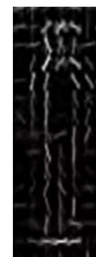
Template Matching



Image template



Histogram template



HoG descriptor template

Template Matching: Appearance

- For template matching, the appearance matrix can be used as it is, or the following matrices can be used:

- Sum of Absolute Differences (SAD)

Find set of pixels $(k, l) \in S$ with **min/max** difference.

$$SAD(k, l) = \sum_{(i,j) \in T} |I_1(i, j) - I_2(i + k, j + l)|$$

- Sum of Squared Difference (SSD)

Find set of pixels $(k, l) \in S$ with **min/max** difference.

$$SSD(k, l) = \sum_{(i,j) \in T} |I_1(i, j) - I_2(i + k, j + l)|^2$$

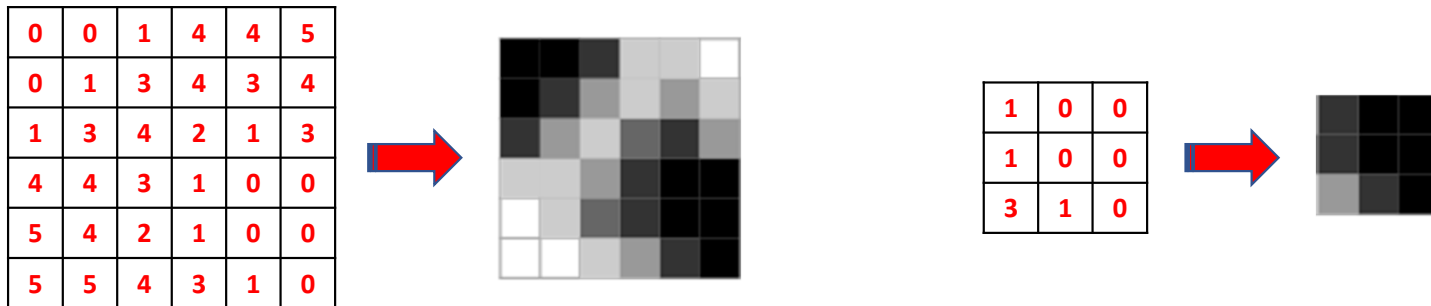
Template Matching: Appearance

- Normalised Cross Correlation (NCC)
Find set of pixels $(k, l) \in S$ with **min/max** difference.

$$NCC(k, l) = \frac{\sum_{(i,j) \in T} I_1(i, j) \cdot I_2(i + k, j + l)}{\sqrt{\sum_{(i,j) \in T} I_1(i, j)^2 \cdot \sum_{(i,j) \in T} I_2(i + k, j + l)^2}}$$

Template Matching: Appearance: DIY

- Assume a 6x6 matrix, and 3x3 template.



- Form a group, and evaluate SAD, SSD, and NCC.

$$SAD(k, l) = \sum_{(i,j) \in T} |I_1(i, j) - I_2(i + k, j + l)|$$

$$SSD(k, l) = \sum_{(i,j) \in T} |I_1(i, j) - I_2(i + k, j + l)|^2$$

$$NCC(k, l) = \frac{\sum_{(i,j) \in T} I_1(i, j) \cdot I_2(i + k, j + l)}{\sqrt{\sum_{(i,j) \in T} I_1(i, j)^2 \cdot \sum_{(i,j) \in T} I_2(i + k, j + l)^2}}$$