FeatureNMS: Non-Maximum Suppression by Learning Feature Embeddings

Niels Ole Salscheider

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Motivation

- State of the art object detectors: CNN designs
- They usually generate multiple detections per object
- Non-Maximum Suppression removes duplicates
  - Heuristic based on IoU
Motivation

- But assumptions of classical NMS do not always hold in crowded scenes
  ⇒ Idea: Rely on (visual) features in these cases!
Classical NMS

- Classical NMS compares IoU against threshold $N$
  - $\text{IoU} \leq N \Rightarrow \text{No duplicate}$
  - $\text{IoU} > N \Rightarrow \text{Duplicate}$
FeatureNMS

- FeatureNMS uses two IoU thresholds $N_1$ and $N_2$

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- $N_1 < \text{IoU} \leq N_2 \Rightarrow \text{Use similarity metric}$
  - Embedding distance $\geq T \Rightarrow \text{No duplicate}$
  - Embedding distance $< T \Rightarrow \text{Duplicate}$
Feature Embedding

- Add network head to detection CNN

⇒ Predict embedding vector per detection

- Trained using Margin Loss
  - Same object: Distance below $\beta - \alpha$
  - Different objects: Distance above $\beta + \alpha$
Evaluation

- CrowdHuman dataset
- Train RetinaNet detector on training set, run on test set
- Post-process raw outputs with different NMS algorithms
Recall

Precision

FeatureNMS ($N_1 = 0.1$, $N_2 = 0.9$)
FeatureNMS ($N_1 = 0.0$, $N_2 = 1.0$)
FeatureNMS ($N_1 = -\varepsilon$, $N_2 = 1.0$)
AdaptiveNMS (with ground truth density)
SoftNMS (Gaussian penalty function, $\sigma = 0.5$)
Classical NMS (IoU threshold $N = 0.5$)
Conclusions

- FeatureNMS achieves state of the art performance
- It outperforms other approaches on the CrowdHuman dataset
- Learnt similarity metric is very discriminative
Thank you for your kind attention!

Feel free to contact me if you have any questions:
salscheider@fzi.de