Computer Vision Module – Session 6

Computer Vision

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Online Training & Certification Course on Artificial Intelligence & Machine Learning

Defence Institute of Advanced Technology (DU), Pune.

Computer Vision

Dr Sunita Dhavale

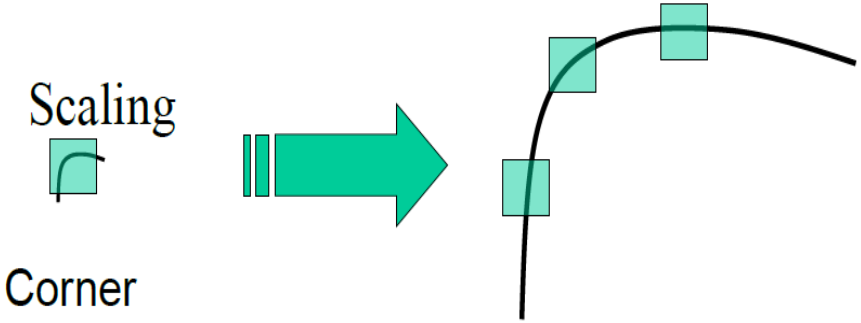
Scale-Invariant Feature Transform (SIFT)

Online Training & Certification Course on AI & ML
Defence Institute of Advanced Technology (DU), Pune.

Outline of Presentation

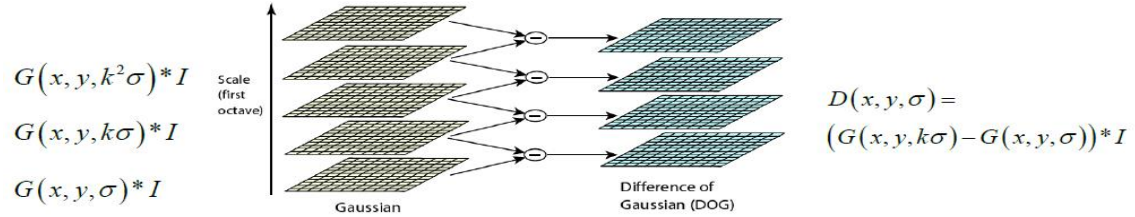
- Introduction
- Scale space extrema detection
- Accurate Keypoint Location
- Keypoint orientation assignment.
- Keypoint descriptors.
- HOG

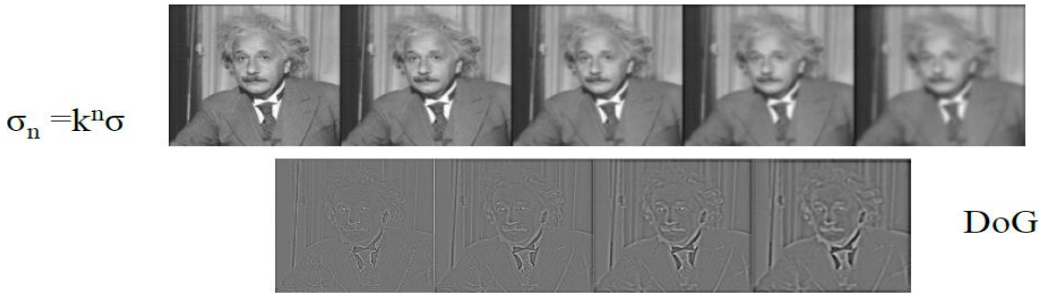
Introduction

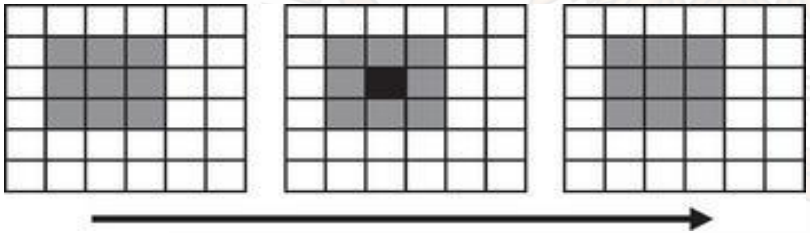


Scale space extrema detection -
(scale invariance, scale space constructed +LoG approximation+finding keypoints-maxima/minima)
Accurate keypoint location
(getting rid of bad points)
Keypoint orientation assignment
(rotation invariant)
Keypoint descriptors
(generate SIFT features)

Scale space extrema detection







The number of octaves and scale depends on the size of the original image

Difference of Gaussian (DoG)

$$DoG: | I(x)*G(\sigma_{n-1}) - I(x)*G(\sigma_n) |$$

Ref: David G. Lowe. **"Distinctive image features from scale-invariant keypoints."** *IJCV*60 (2), pp. 91-110, 2004.

Accurate Keypoint Location

Hessian matrix, H

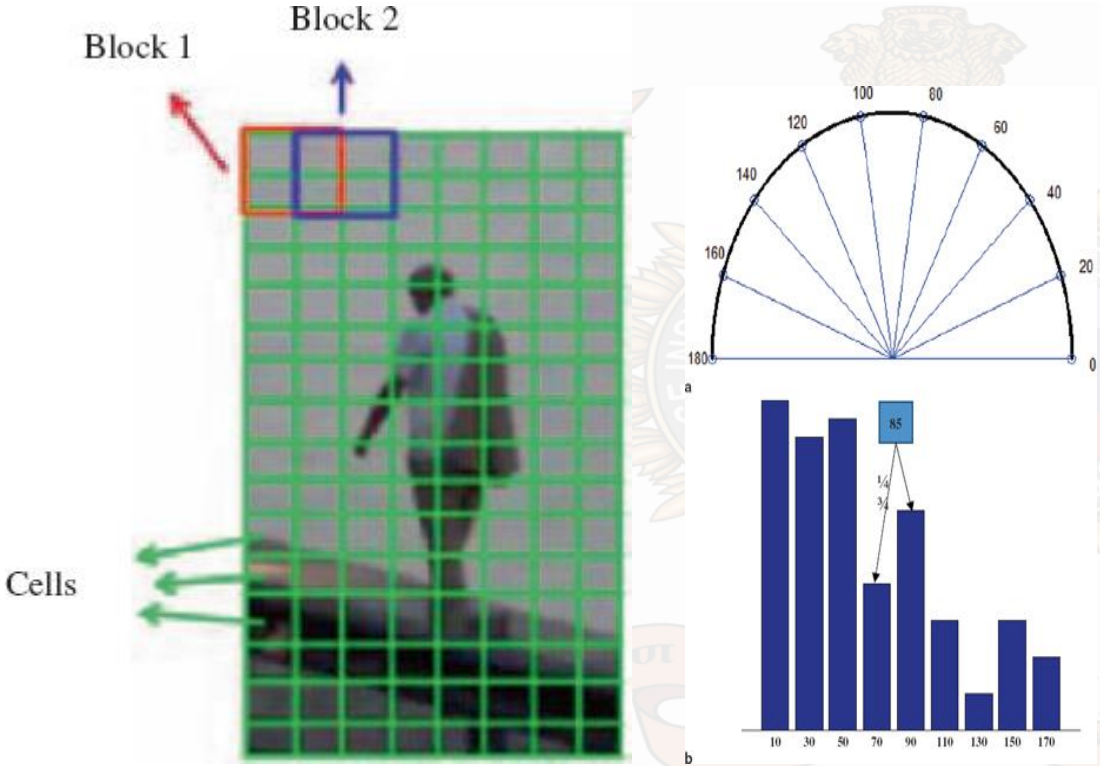
$$\frac{trace(H)^2}{\det(H)} = \frac{(\lambda_1 + \lambda_2)^2}{\lambda_1 \lambda_2} = \frac{(r\lambda_2 + \lambda_2)^2}{r\lambda_2^2} = \frac{(r+1)^2}{r}$$

$$Tr(H)^2 / Det(H) < (T_r + 1)^2 / T_r$$

Next Steps

Keypoint orientation assignment -to make the features rotation invariant
Keypoint descriptors.
Matching Keypoints
Recognition

HOG



- Dividing Image into Blocks
- Quantization of Gradient Histogram
- Feature Vector Synthesis

Reference Material

- 1. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
- 2. R. Szeliski, “Computer Vision: Algorithms and Applications”, Springer 2011.
- 3. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012.
- 4. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
- 5. Sunita Dhavale, “Advanced Image-Based Spam Detection and Filtering Techniques”, Book Published by CyberTech: An Imprint of MKP Technologies, Hershey, PA, USA IGI Global, March 2017, ISBN13: 9781683180135|ISBN10: 1683180135|EISBN13: 9781683180142|DOI: 10.4018/978-1-68318-013-5.

<<Epilogue>>

- We will meet in next scheduled lecture.
- Submit the given assignments in time.
- Feel free to ask your questions.
- Email: sunitadhavale@diat.ac.in

Thank You!