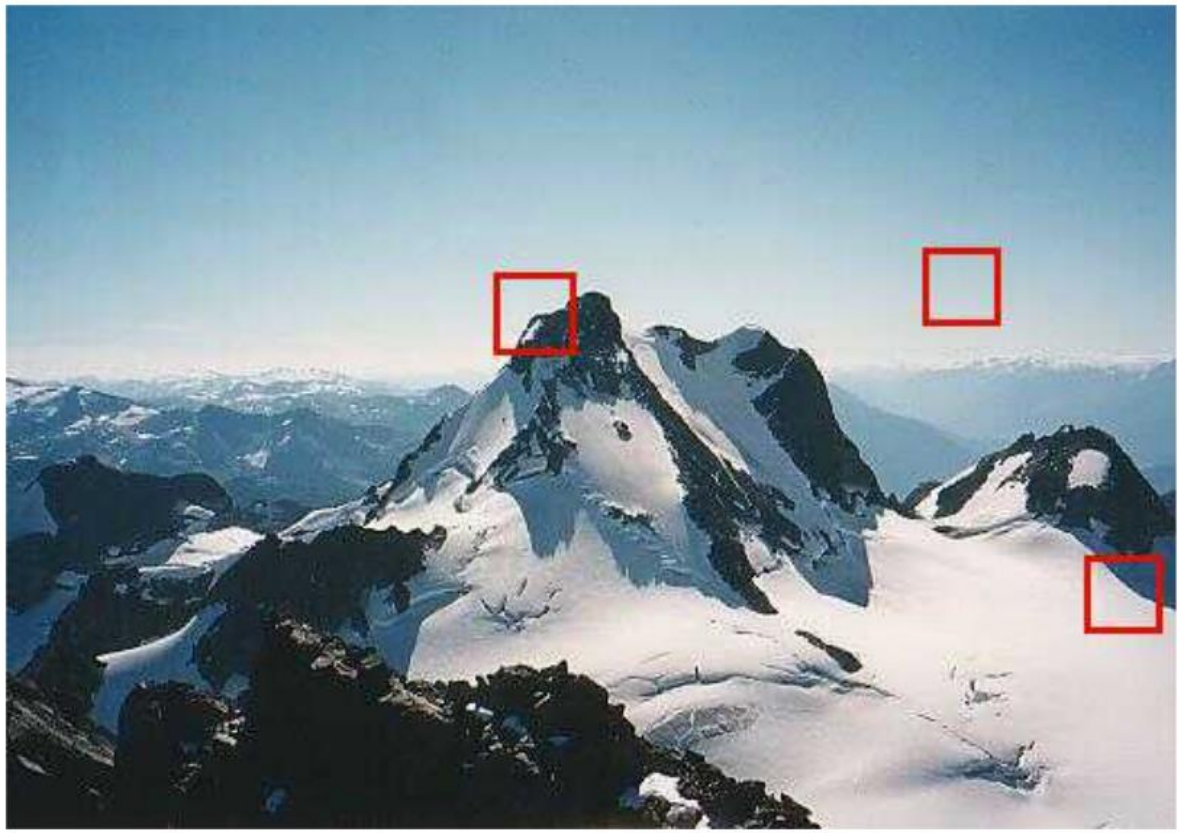
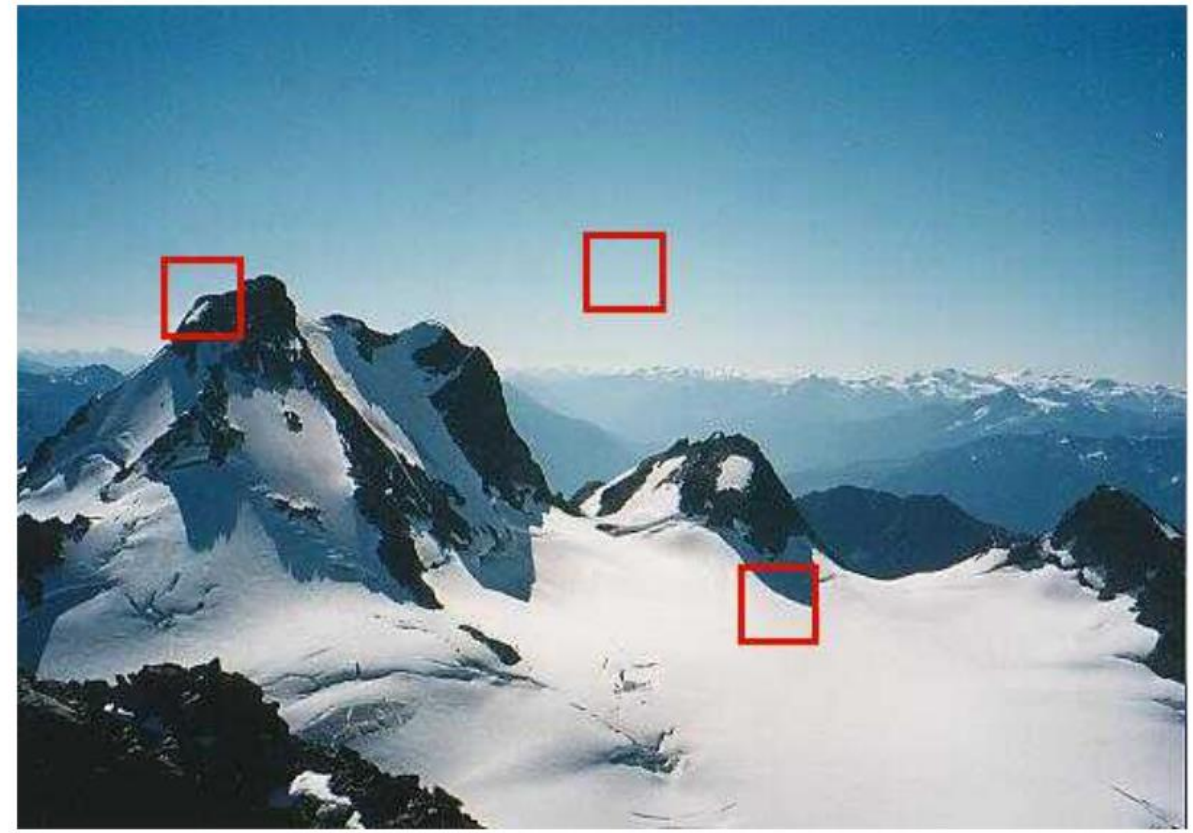
Príznaky


1

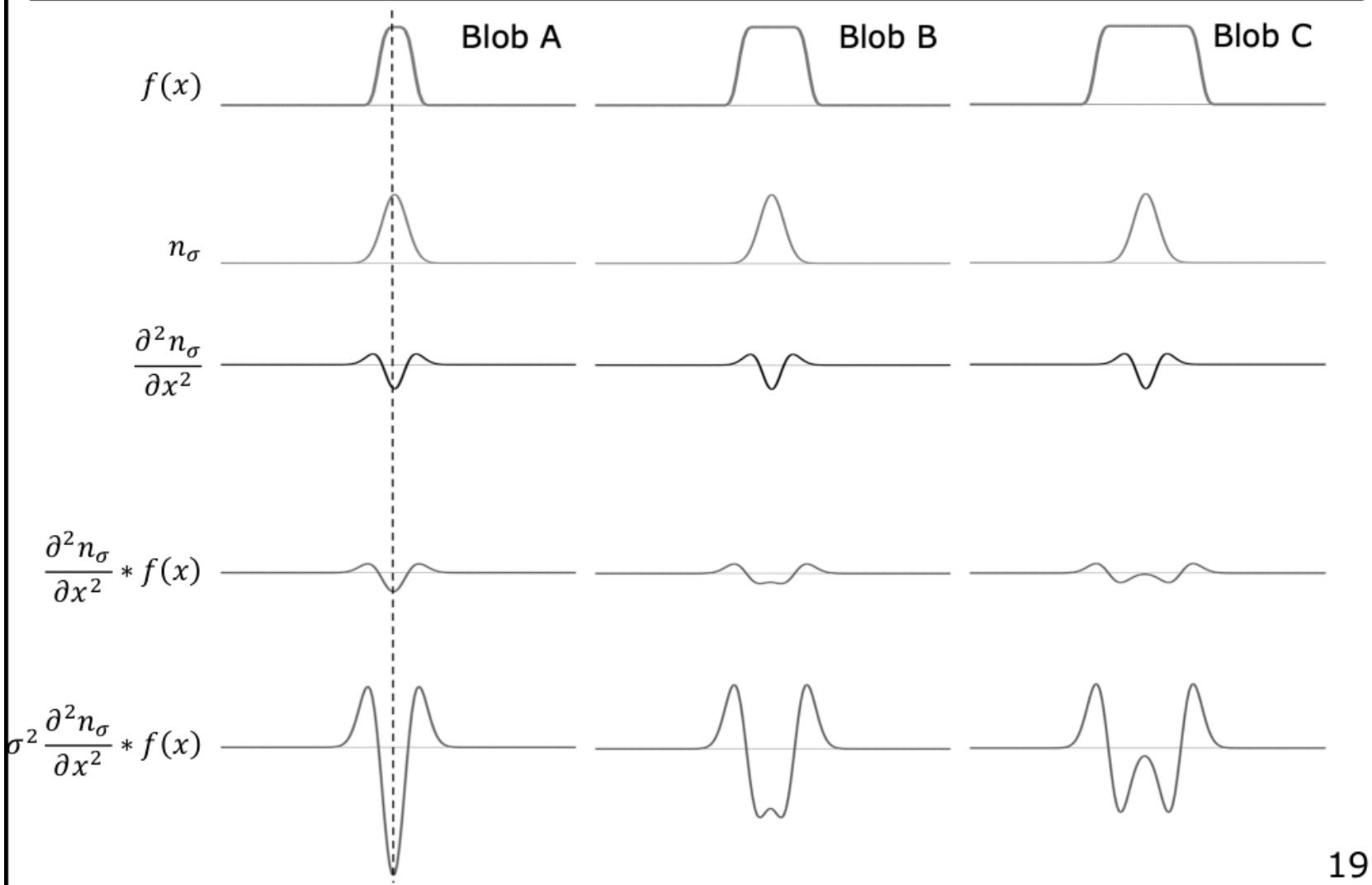




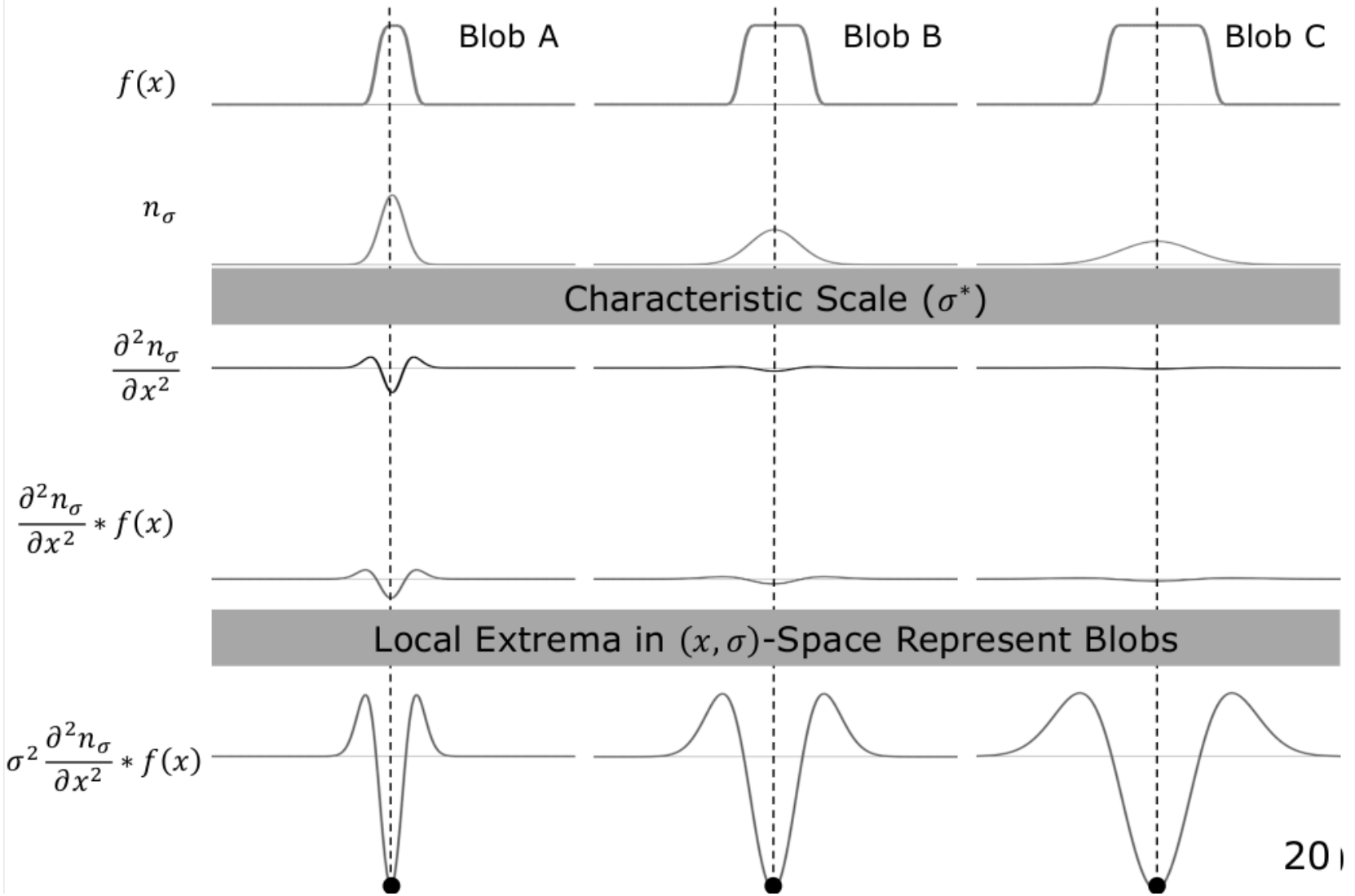
Príznak

- *Bohatý obsah* (zmena jasu, variácia farieb) v rámci **lokálneho okna**
- vhodne zvolená **signatúra** - pre porovnanie s inými príznakmi
- Vyhranená **pozícia** v rámci obrázka
- **Invariantné** voči natočeniu a škálovaniu
- Nesenzitívne voči zmene osvetlenia

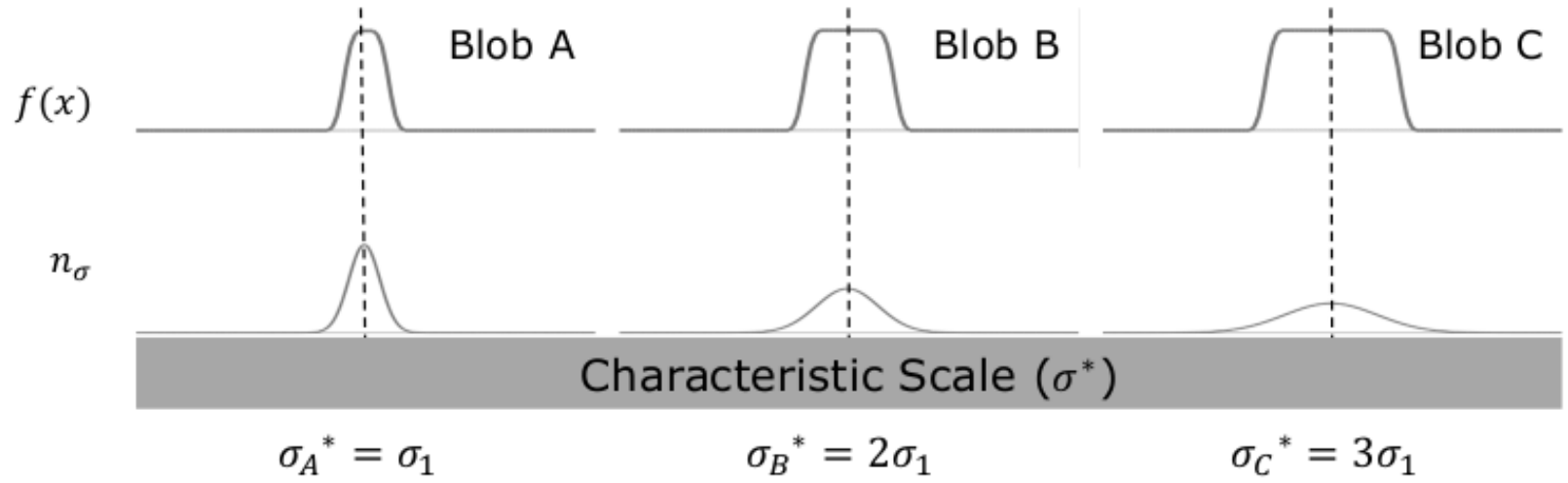
1D Blob and 2nd Derivative of Gaussian



1D Blob and 2nd Derivative of Gaussian



Characteristic Scale and Blob Size



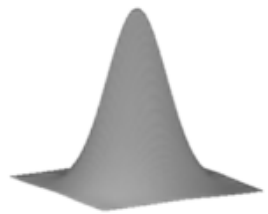
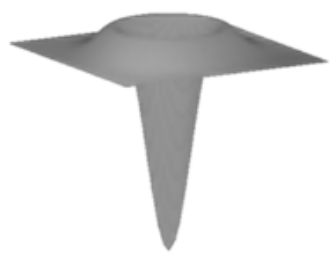
Characteristic Scale: The σ at which σ-normalized 2nd derivative attains its extreme value.

Characteristic Scale $\propto$ Size of Blob

$$\frac{\text{Size of Blob A}}{\text{Size of Blob B}} = \frac{\sigma_A{}^*}{\sigma_B{}^*} \; ; \quad \frac{\text{Size of Blob B}}{\text{Size of Blob C}} = \frac{\sigma_B{}^*}{\sigma_C{}^*}$$

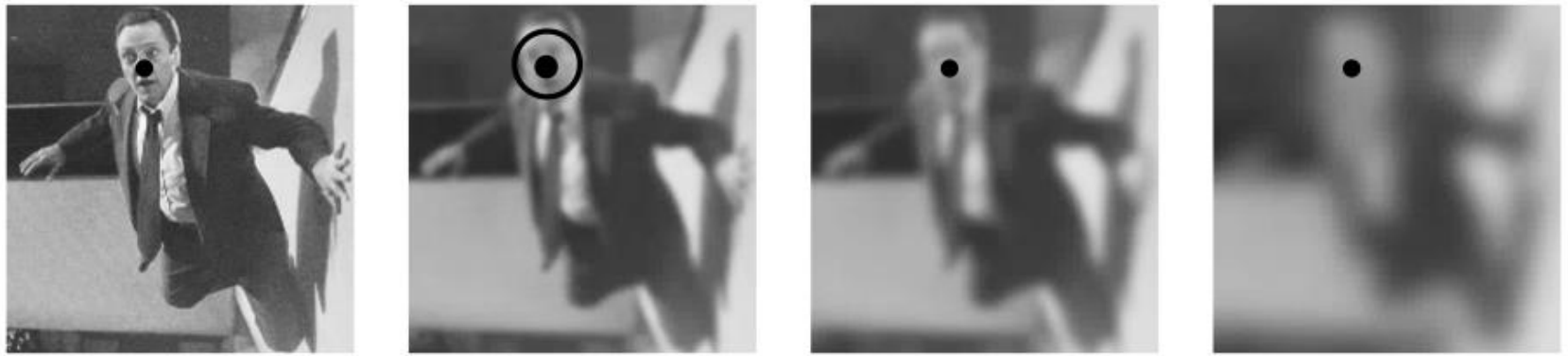
2D Blob Detector

Normalized Laplacian of Gaussian (NLoG) is used as the 2D equivalent for Blob Detection.

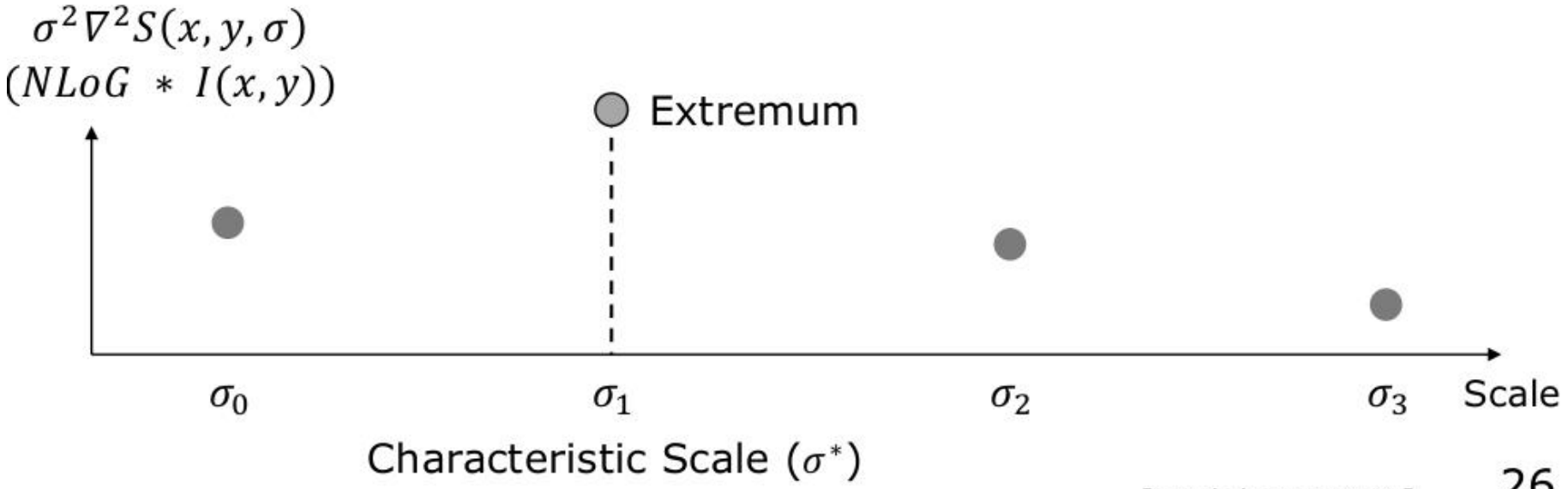
Laplacian	Gaussian	LoG	NLoG
$\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}$			
	n_σ	$\nabla^2 n_\sigma$	$\sigma^2 \nabla^2 n_\sigma$

Location of Blobs given by Local Extrema after applying Normalized Laplacian of Gaussian at many scales.

Blob Detection using Local Extrema



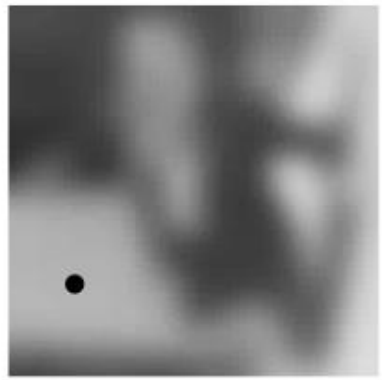
$S(x, y, \sigma_0)$ $S(x, y, \sigma_1)$ $S(x, y, \sigma_2)$ $S(x, y, \sigma_3)$ ...



[Lindeberg 1994]

Blob Detection using Local Extrema

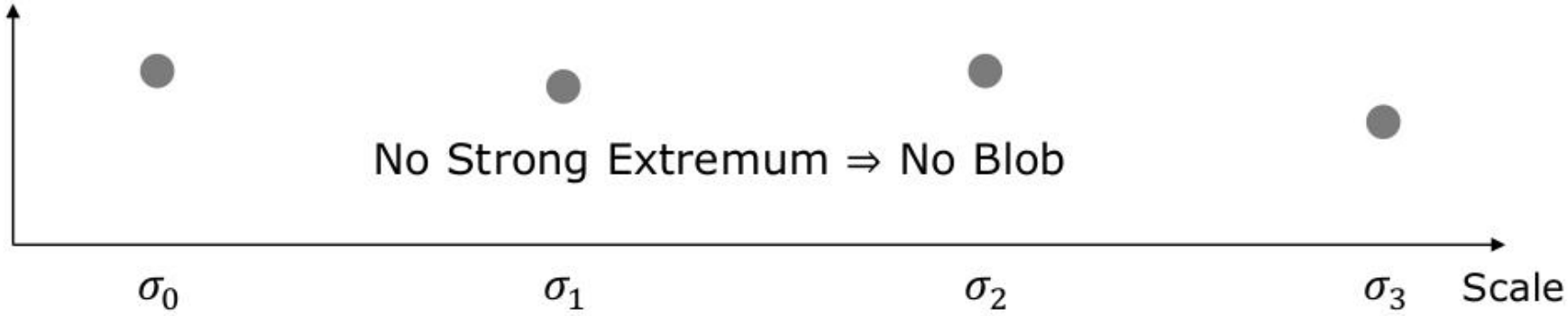


...

$S(x, y, \sigma_0)$ $S(x, y, \sigma_1)$ $S(x, y, \sigma_2)$ $S(x, y, \sigma_3)$

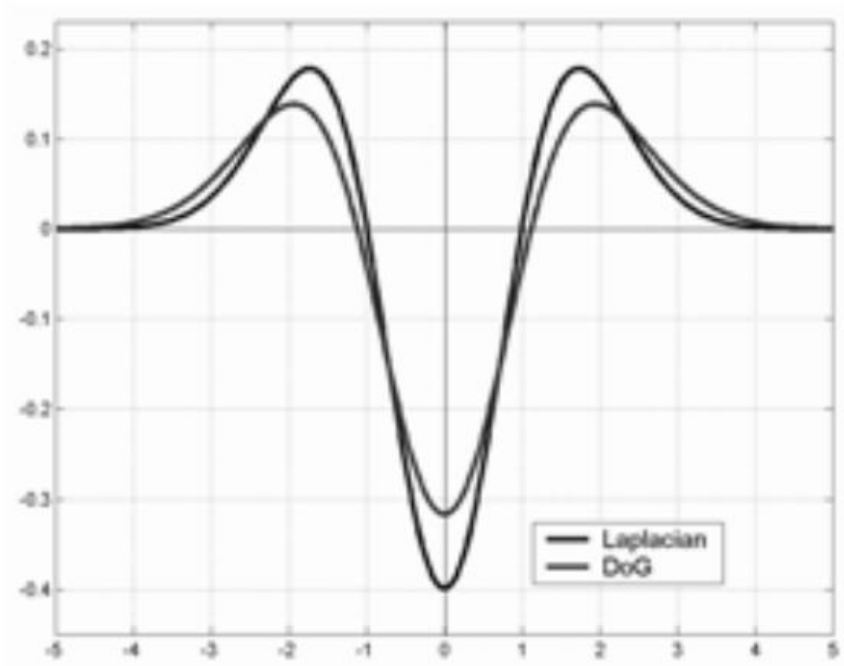
$\sigma^2 \nabla^2 S(x, y, \sigma)$
$(NLoG * I(x, y))$



[Lindeberg 1994]

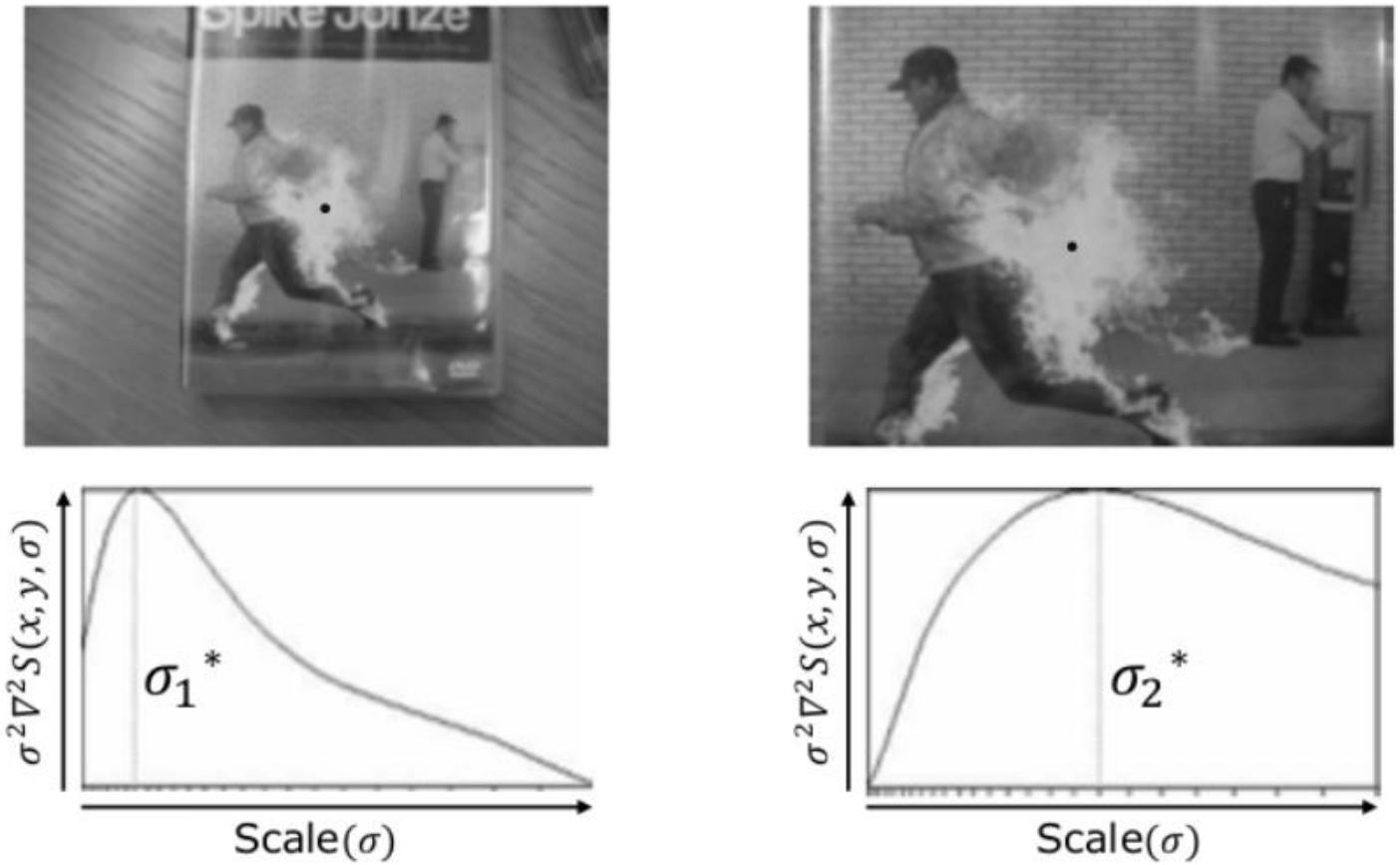
Fast NLoG Approximation: DoG

Difference of Gaussian (DoG) $= (n_{s\sigma} - n_{\sigma}) \approx (s-1)\underbrace{\sigma^2 \nabla^2 n_{\sigma}}_{\text{NLoG}}$



$$\boxed{\text{DoG} \approx (s-1)\ \text{NLoG}}$$

SIFT Scale Invariance



$\frac{\sigma_1{}^*}{\sigma_2{}^*}$: Ratio of Blob Sizes

[Mikolajczyk 2002]

Computing the Principal Orientation

Use the histogram of gradient directions

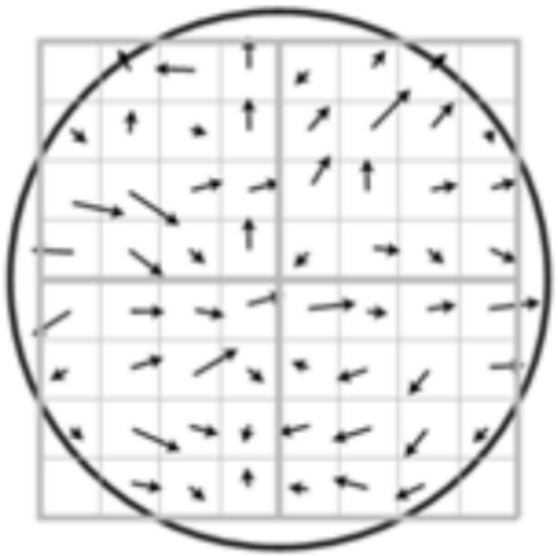
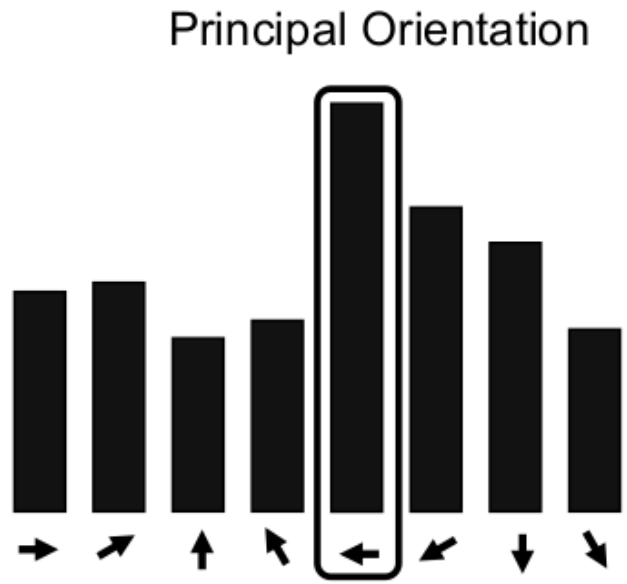


Image gradient directions

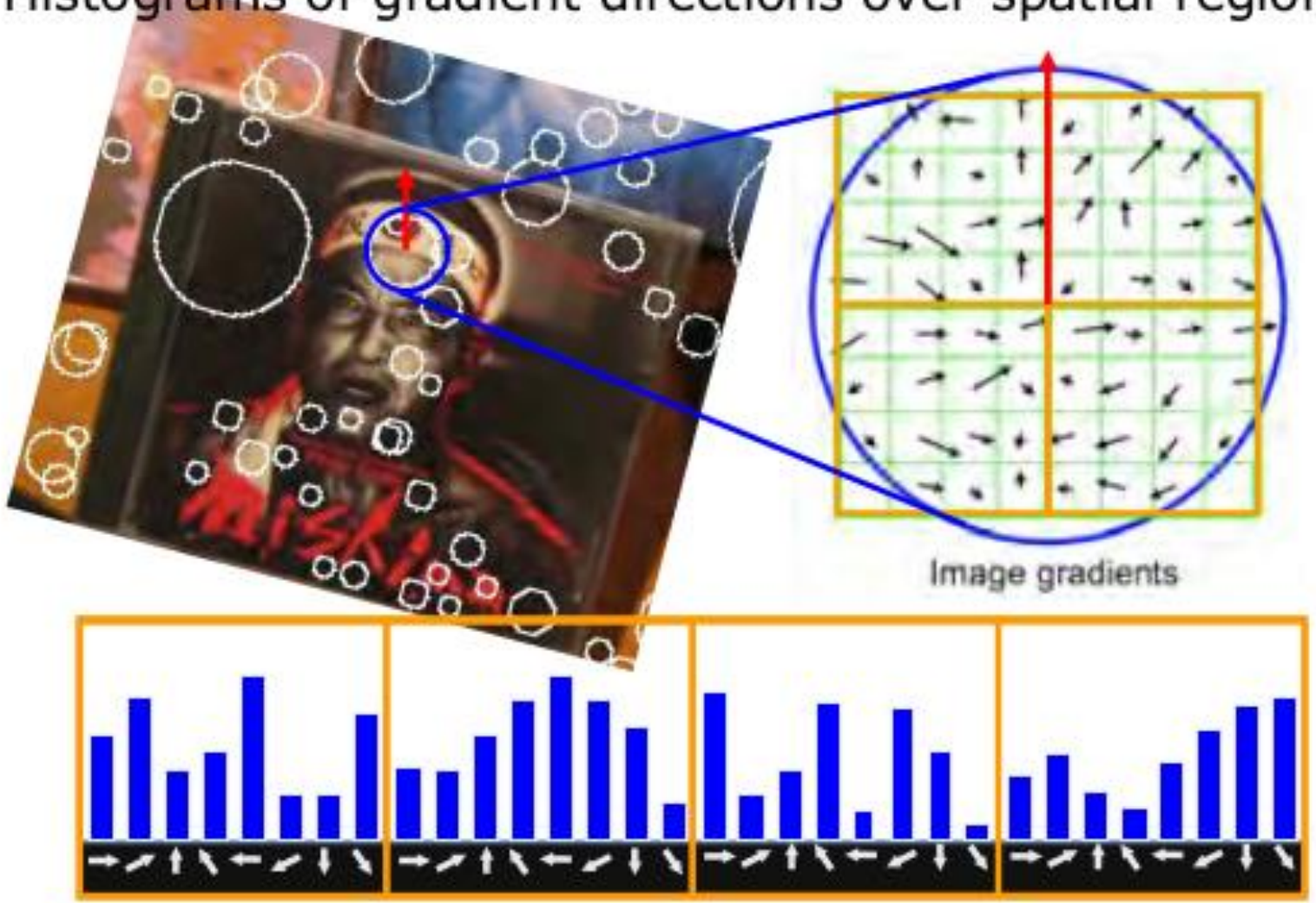
$$\theta = \tan^{-1}\left(\frac{\partial I}{\partial y} / \frac{\partial I}{\partial x}\right)$$

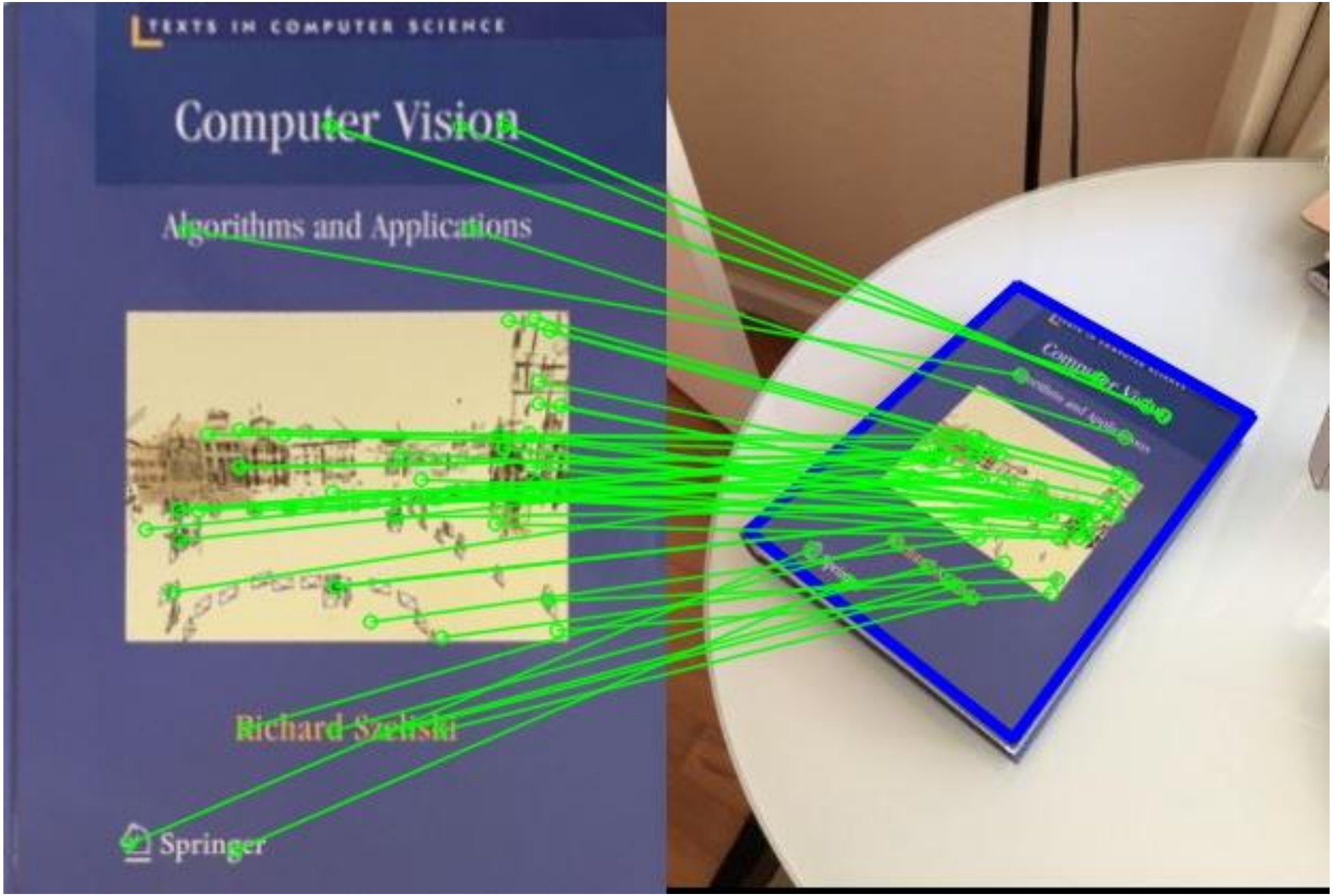


Choose the most prominent gradient direction

SIFT Descriptor

Histograms of gradient directions over spatial regions

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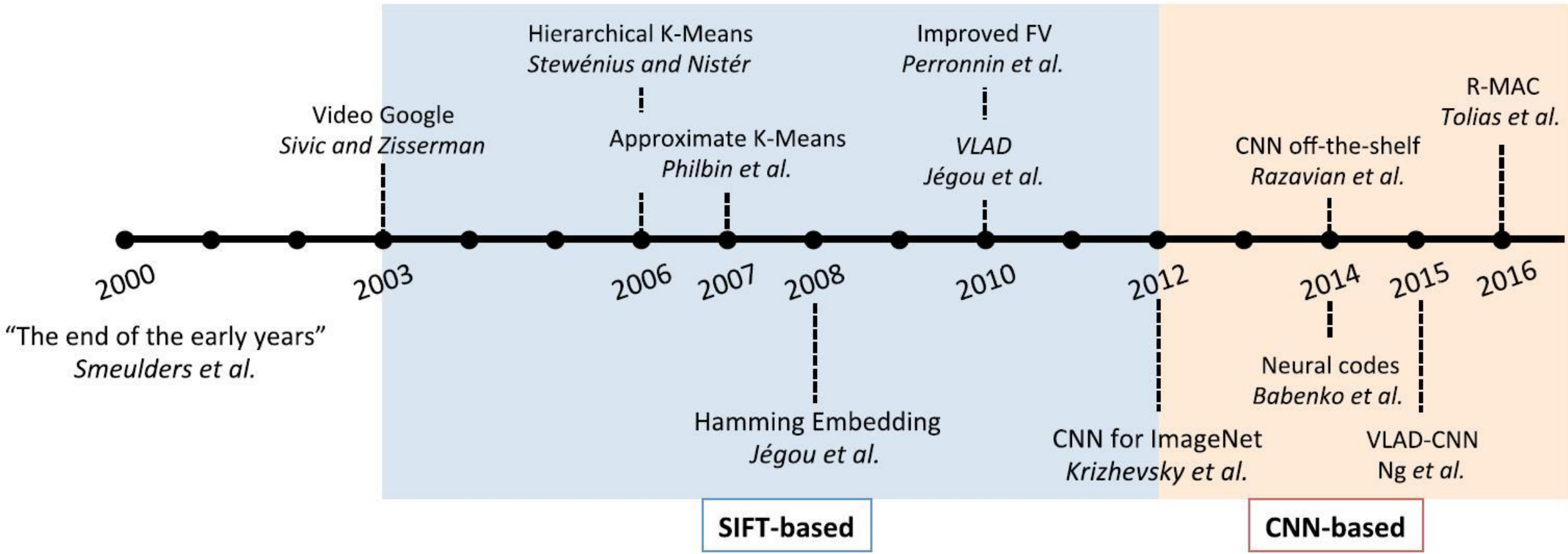
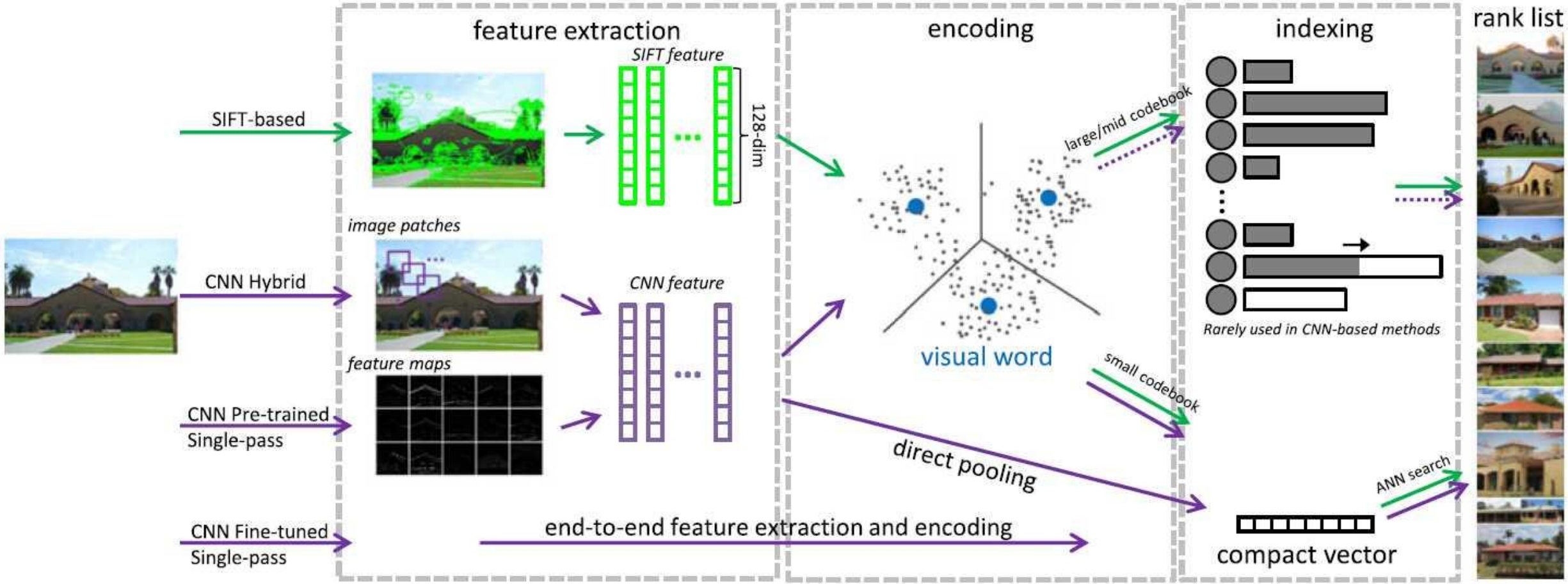

Hierarchical K-Means
Stewénius and Nistér
Improved FV
Perronnin et al.
R-MAC
Tolias et al.
Video Google
Sivic and Zisserman
Approximate K-Means
Philbin et al.
VLAD
Jégou et al.
CNN off-the-shelf
Razavian et al.
2000
2003
2006
2007
2008
2010
2012
2014
2015
2016
"The end of the early years"
Smeulders et al.
Hamming Embedding
Jégou et al.
Neural codes
Babenko et al.
CNN for ImageNet
Krizhevsky et al.
VLAD-CNN
Ng et al.
SIFT-based
CNN-based


feature extraction
encoding
indexing
rank list
SIFT-based
SIFT feature
128-dim
image patches
CNN Hybrid
CNN feature
feature maps
CNN Pre-trained
Single-pass
CNN Fine-tuned
Single-pass
large/mid codebook
visual word
small codebook
direct pooling
end-to-end feature extraction and encoding
Rarely used in CNN-based methods
ANN search
compact vector