



Inria's participation at ImageCLEF 2013 Plant Identification Task

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The ImageCLEF2013 Plant Task



Scan or “Scan-like” of Leaf
“SheetAsBackground”
uniform (white) background

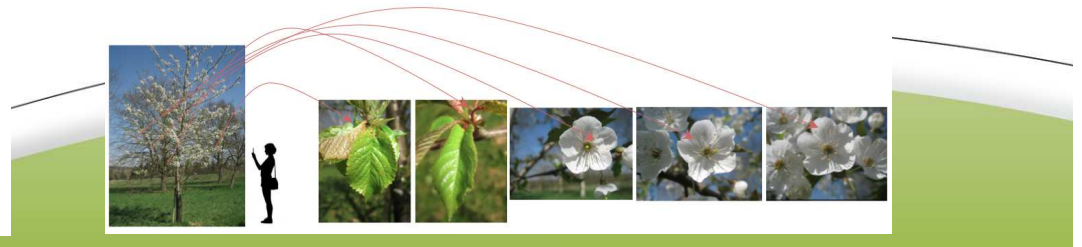
Leaf - Flower - Fruit - Bark - Entire
“NaturalBackground”
with more or less cluttered background

“Species retrieval” task:

- 20985 train images covering 250 species
- 5092 test images without ground truth
- for each test image give a list of species

Specific metric attempting to reduce some bias due to repetitive test images from a same individual plant (same “event”)

$$S = \frac{1}{U} \sum_{u=1}^U \frac{1}{P_u} \sum_{p=1}^{P_u} \frac{1}{N_{u,p}} \sum_{n=1}^{N_{u,p}} S_{u,p,n}$$



Inria PlantNet participation



Scan or “Scan-like” of Leaf
“SheetAsBackground”
uniform (white) background

1. Shape approaches
+ information fusion
-> multiples features
-> multiples image tests

Leaf - Flower - Fruit - Bark - Entire
“NaturalBackground”
with more or less cluttered background

- 2.a. Large scale matching approach
+ information fusion
->multiple features
->multiple image tests
->flowering time

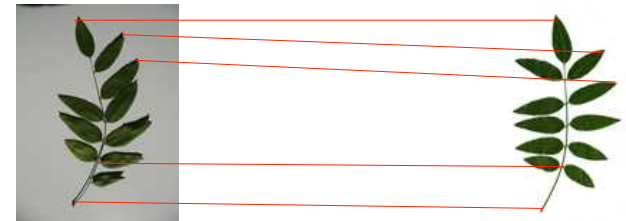
2.b. Fisher vector +SVM approach

SheetAsBackground category

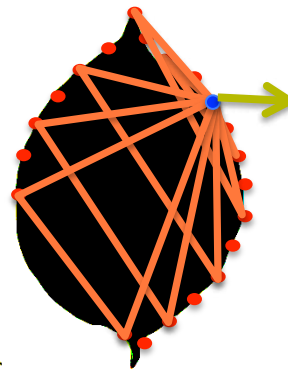
Multiscale triangular shape descriptors

[Mouine2013]

- local matching of shapes
- robust & fast to compute
- validated on various leaf databases



Segmentation
(Otsu-like)
+
Uniform
quantization



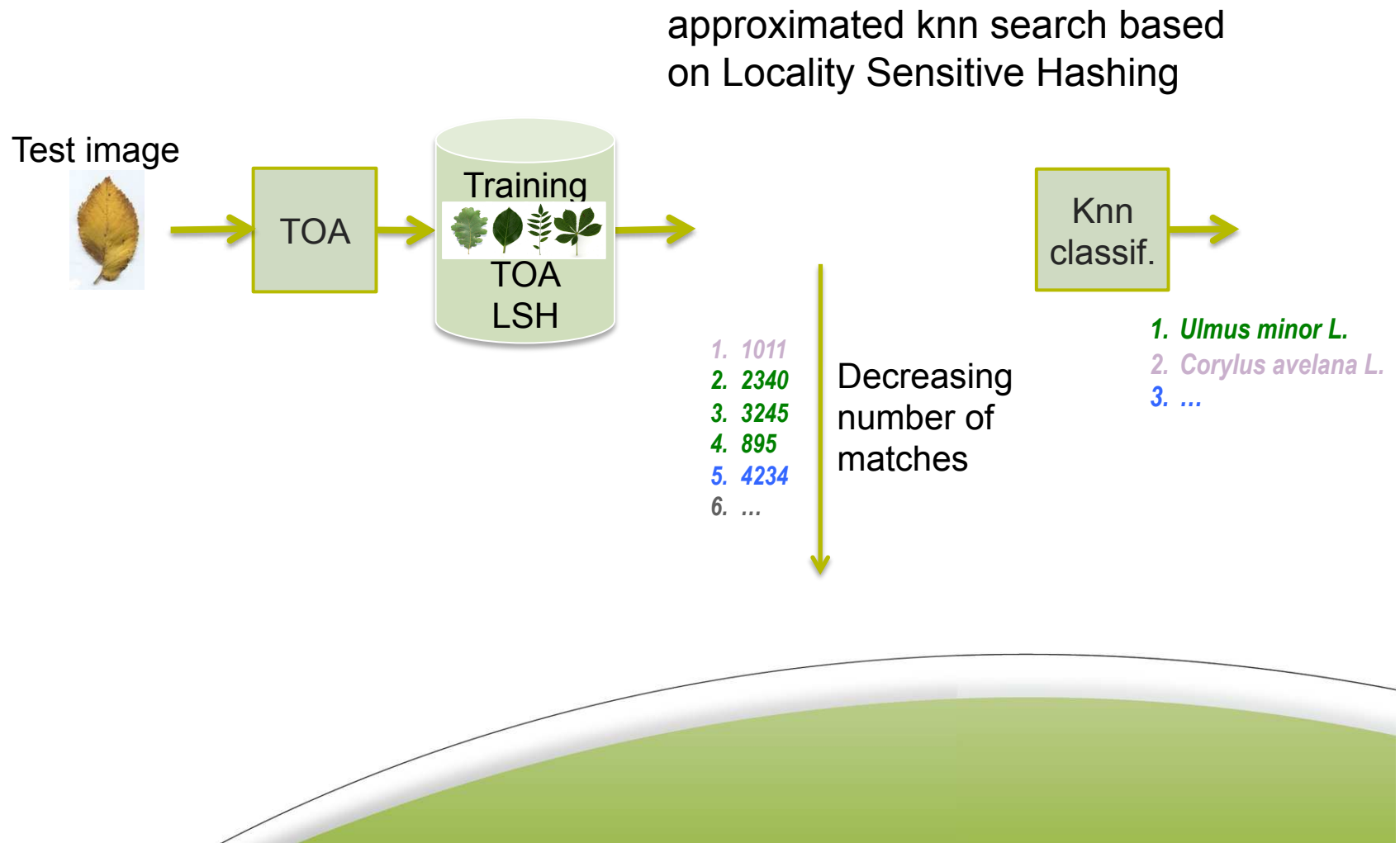
400 local features described with 20 triangles

2 versions:

- TOA**: successive Oriented Angles
- TSLA**: Length and Angles



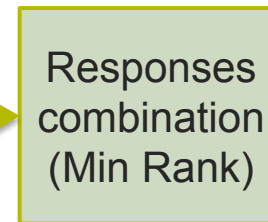
SheetAsBackground category Matching



SheetAsBackground category

Combining test images from a same plant observation
→ *Inria PlantNet Run 1*

Test images with a
same
“IndividualPlantID”



Run 1

1. 1011
2. 2340
3. 3245
4. 895
5. 4234
6. ...

1. 999
2. 4879
3. 3245
4. 9873
5. 1011
6. ...

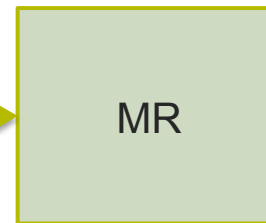
1. 1011
2. 999
3. 2340
4. 4879
5. 3245
6. 895
7. 9873
8. 4234
9. ...

1. *Ulmus minor* L.
2. *Corylus avelana* L.
3. *Ulmus laevis* L.
4. ...

SheetAsBackground category

Combining test images from a same plant observation
→ *Inria PlantNet Run 2*

Test images with a
same
“IndividualPlantID”



Run 2

1. 1011
2. 2340
3. 3245
4. 895
5. 4234
6. ...
1. 999
2. 4879
3. 3245
4. 9873
5. 1011
6. ...

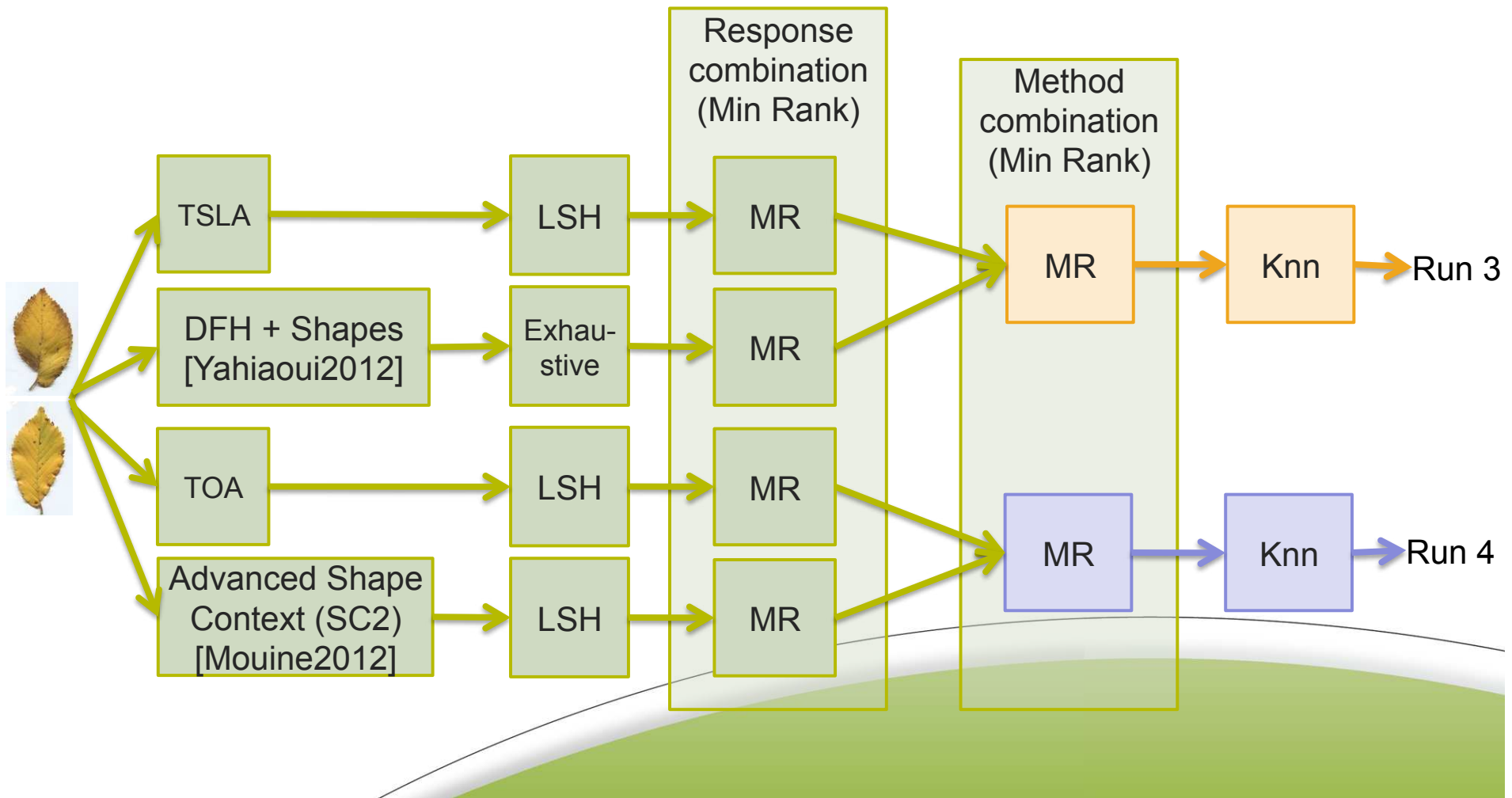
1. 1011
2. 999
3. 2340
4. 4879
5. 3245
6. 895
7. 9873
8. 4234
9. ...

1. *Ulmus minor* L.
2. *Corylus avelana* L.
3. *Ulmus laevis* L.
4. ...

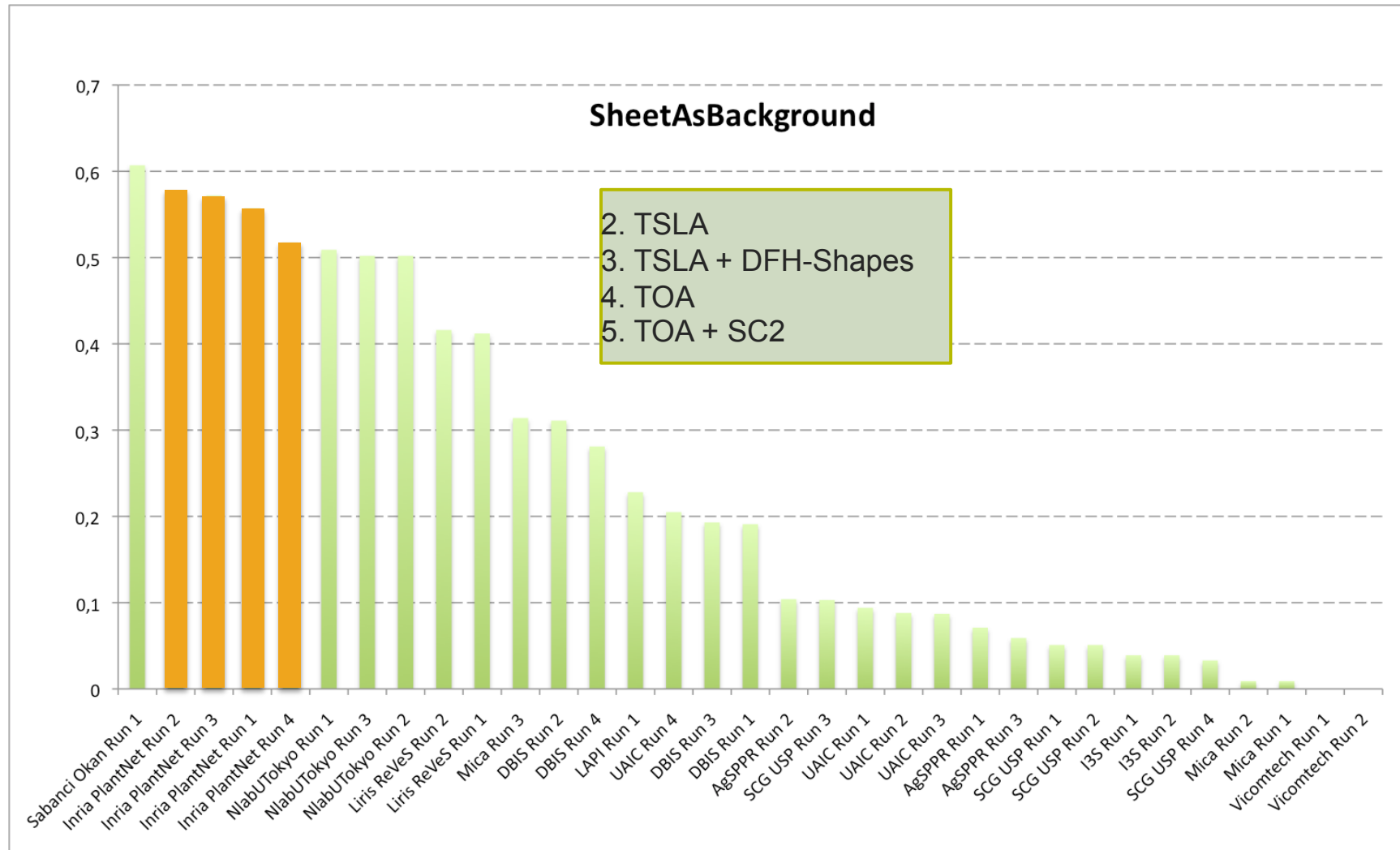
SheetAsBackground category

Combining with two previous successful shape based approaches

→ *Inria PlantNet Run 3&4*



SheetAsBackground category Results



Inria PlantNet participation



Scan of Leaf
“SheetAsBackground”
Most of the time white uniform background

1. Shape approaches
+ information fusion
-> multiples features
-> multiples image tests

Leaf - Flower - Fruit - Bark - Entire
“NaturalBackground”
with more or less cluttered background

- 2.a. Large scale matching approach
+ information fusion
->multiple features
->multiple image tests
->flowering time

2.b. Fisher vector approach + SVM

NaturalBackground category

Main steps (Inria PlantNet Run 1, 2 & 3)

For each view (flower, fruit, leaf, stem, entire)

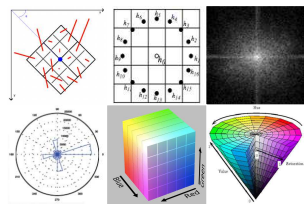
Interest point
detection

Local
features

Matching with
RMMH

Response list
to probabilities

Late fusion
-features
-images

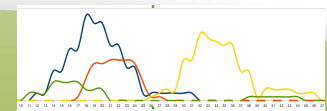


(1011 1010010100)
Key Value



$$P(C^k) = \sum_{f \in F} w(f) * P(C_f^k)$$

Flowering
time



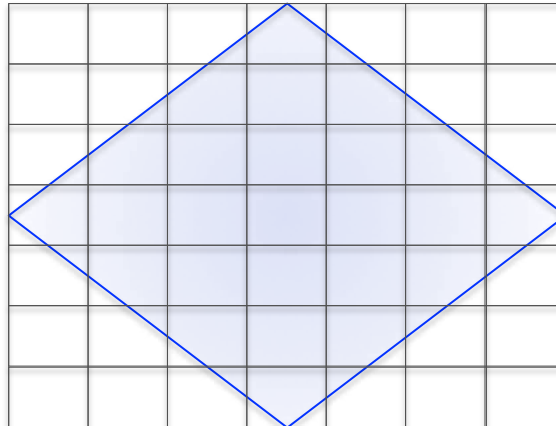
Constrained Harris corner detection

Inria PlantNet Run 1, 2 & 4

Favoring local descriptions at the center



Multiscale Harris color
corner detection



Rhomboid mask + 7x7 grid

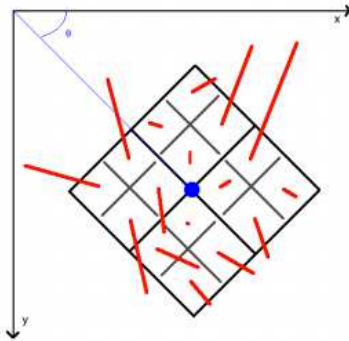


200 "best" points following
the grid with a Gaussian
like distribution

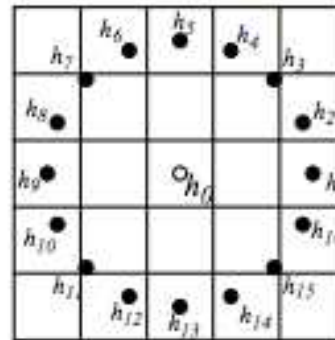


Local features

SURF



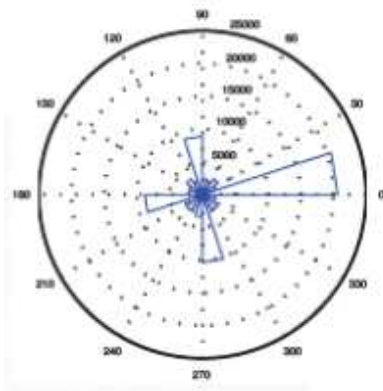
rotation invariant Local Binary Pattern (ri-LBP)



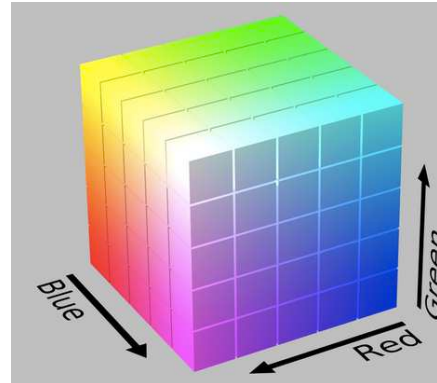
Fourier 2D



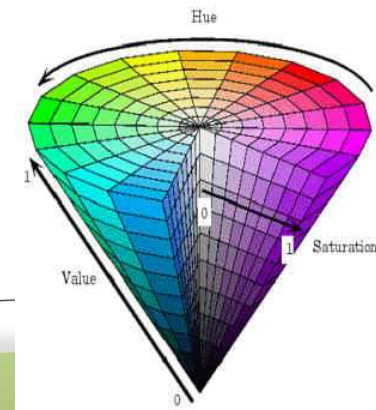
Edge Orientation Histogram



Weighted RGB (color+texture)



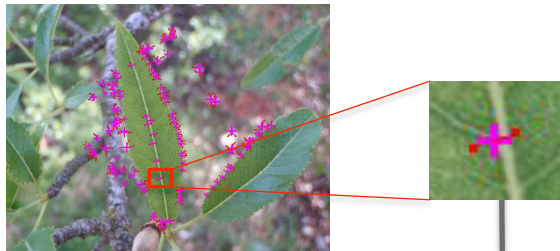
HSV histogram



Large Scale Matching with RMMH

Random Maximum Margin Hashing [A. Joly, O. Buisson, CVPR 2011]

- **non supervised**: class label not used
- **improve precision** of knn search comparing with an exhaustive search



$(\mathbf{x}_1 \mathbf{x}_2 \mathbf{x}_3 \dots \mathbf{x}_n)$

Ex: SURF

RMMH

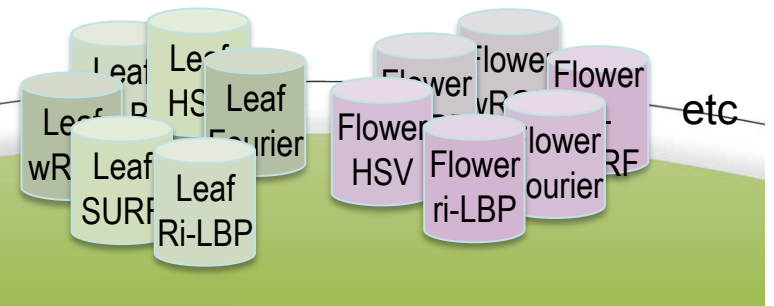
Hash code = 256 bits

(1 0 1 1 1 0 1 0 0 1 0 1 0 0)

Key **Value**

Search with Multi-Probe queries [A. Joly, O. Buisson, ACM 2008]

Each type of descriptor use a **independent index**
 6 types of descriptor x 5 plants views -> 30 visual indices



Local features are **embedded jointly in compact hash codes**











$$h(\mathbf{x}) = \text{sgn} \left(\sum_{i=1}^m \alpha_i^* \kappa(\mathbf{x}_i^*, \mathbf{x}) + b_m \right)$$

m objects selected at random



Converting an image response list into a probability distribution

≈ Adaptive Knn rule according to the **plant** (not only the most similar images)
 -> **favoring visual diversity within a same species**

Query	1	2	3	4	5	6	7	8	9	...
										
Species	SN	VT	SN	SN	VT	VT	SN	FO	VT	Others (noisy)
Individual PlantID	SN1	VT1	SN1	SN2	VT2	VT3	SN1	FO1	VT4	Others (noisy)

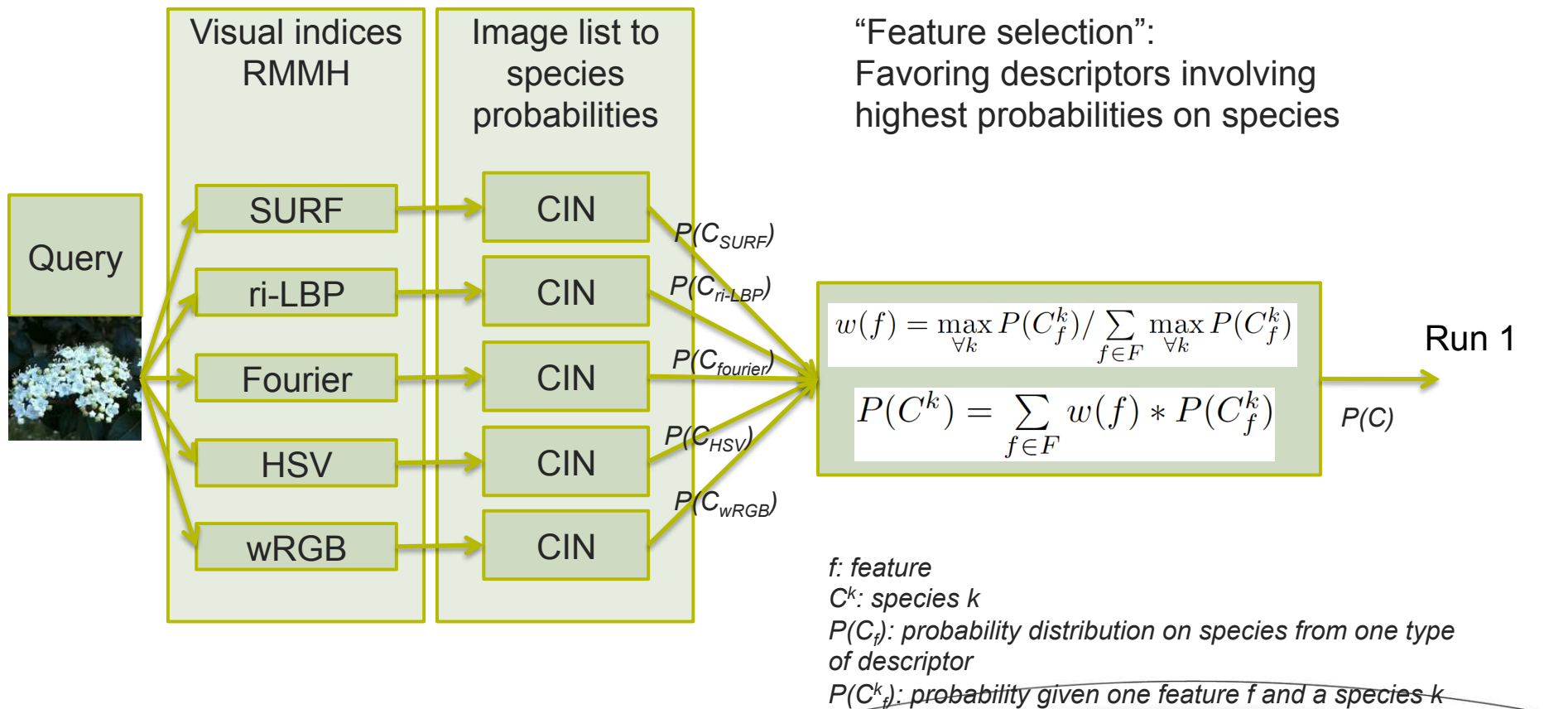
4 similar plant observations for VT > 2 similar plant observations for SN
 $p(VT) > p(SN)$

Method used here:

- Require at least 2 distinct plants (2 IndividualPlantIDs)
- Keep only the 2 most similar images from distinct individual plants
- Based on the average of the number of matches

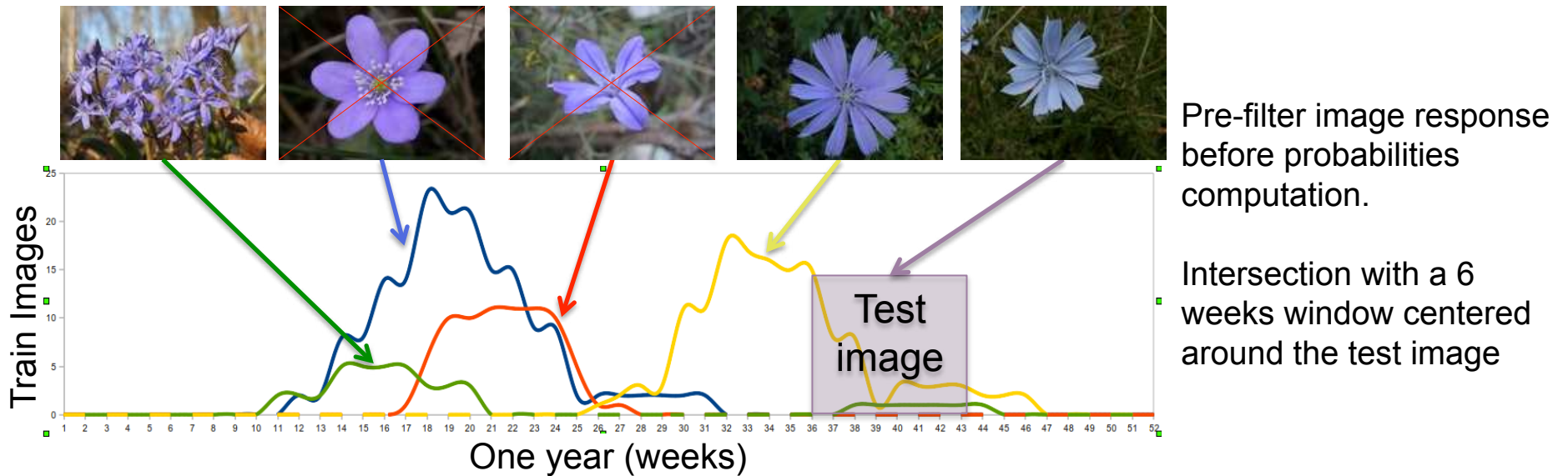
Weighted combination for late fusion of descriptors

→ *Inria PlantNet Run 1*

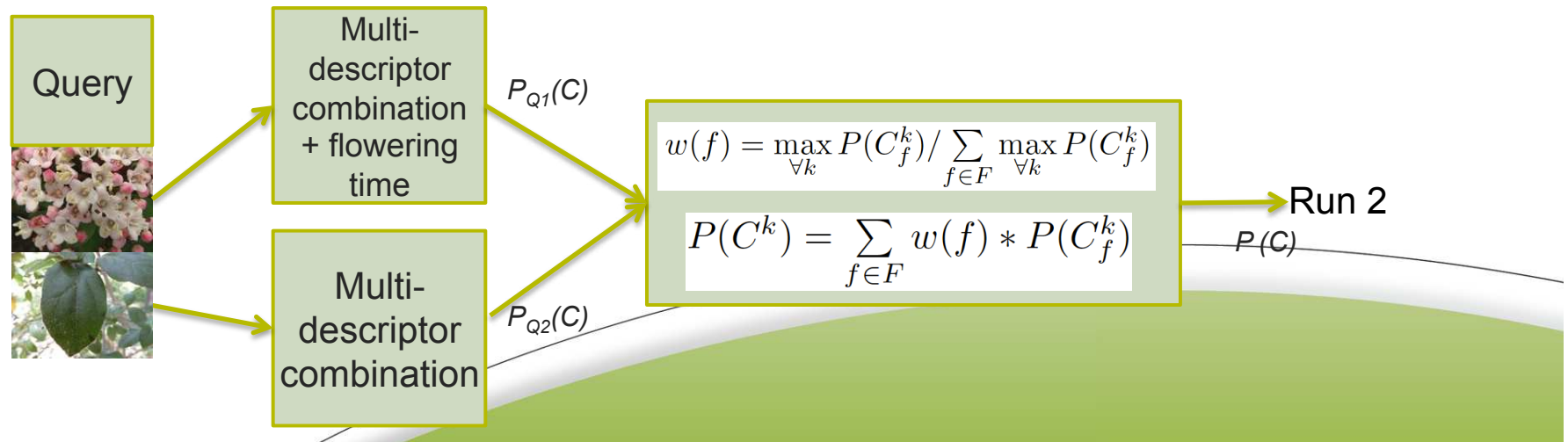


Flowering time & multiple image queries

→ *Inria PlantNet Run 2*



+ test images from a same individual plant: weighted combination schema



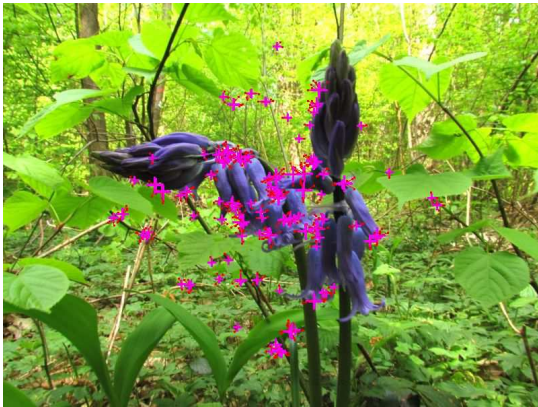
Reduced resources use with segmentation

→ *Inria PlantNet Run 3*

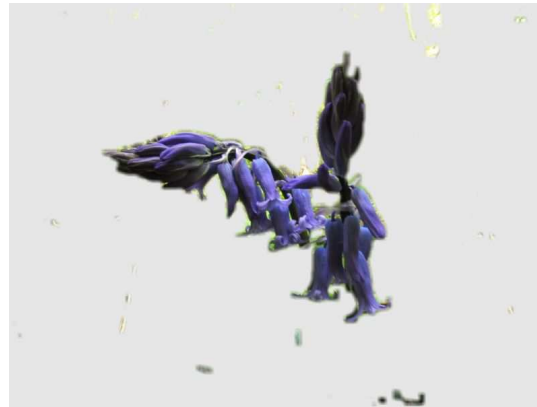
same as Inria PlantNet Run 1

Attempt segmentation: less background descriptions

-30% local descriptions by picture on average



Initial point selection (run1)



Segmentation mask for
points filtering

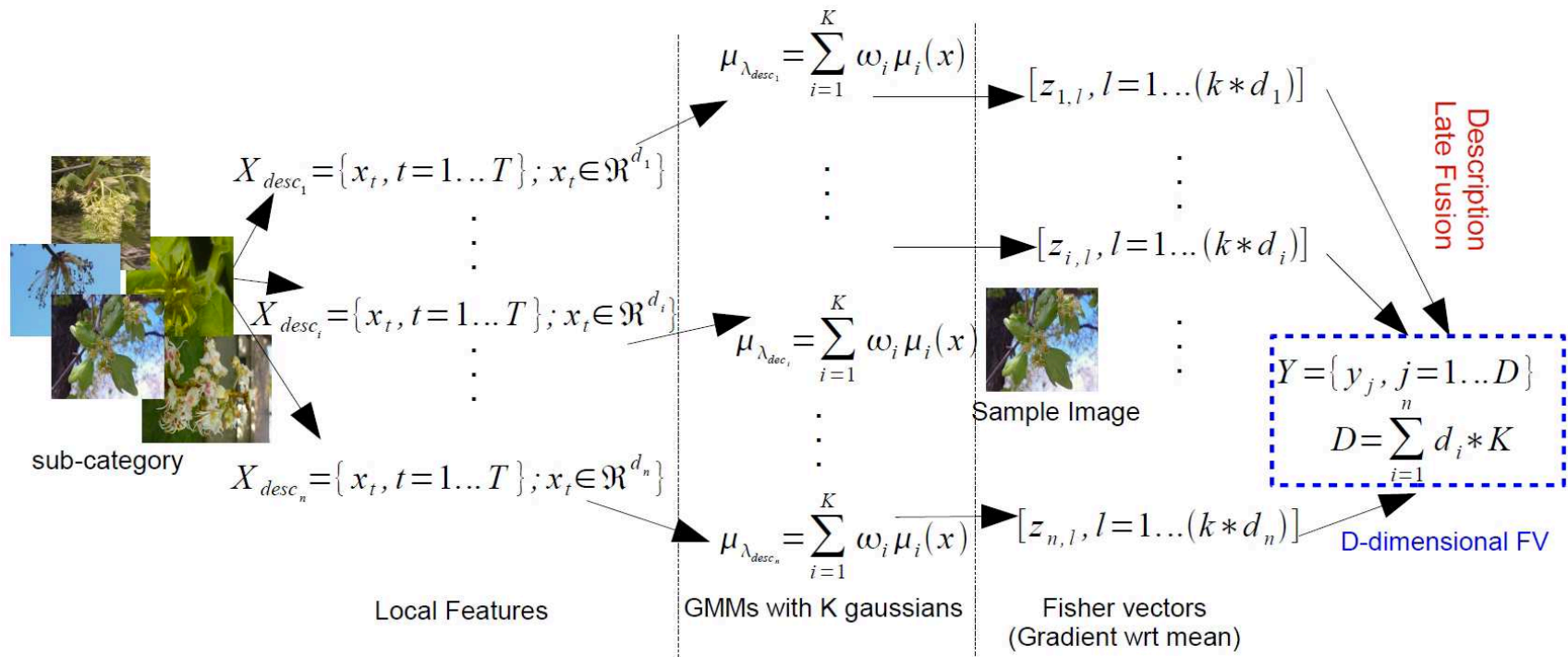


Filtered points

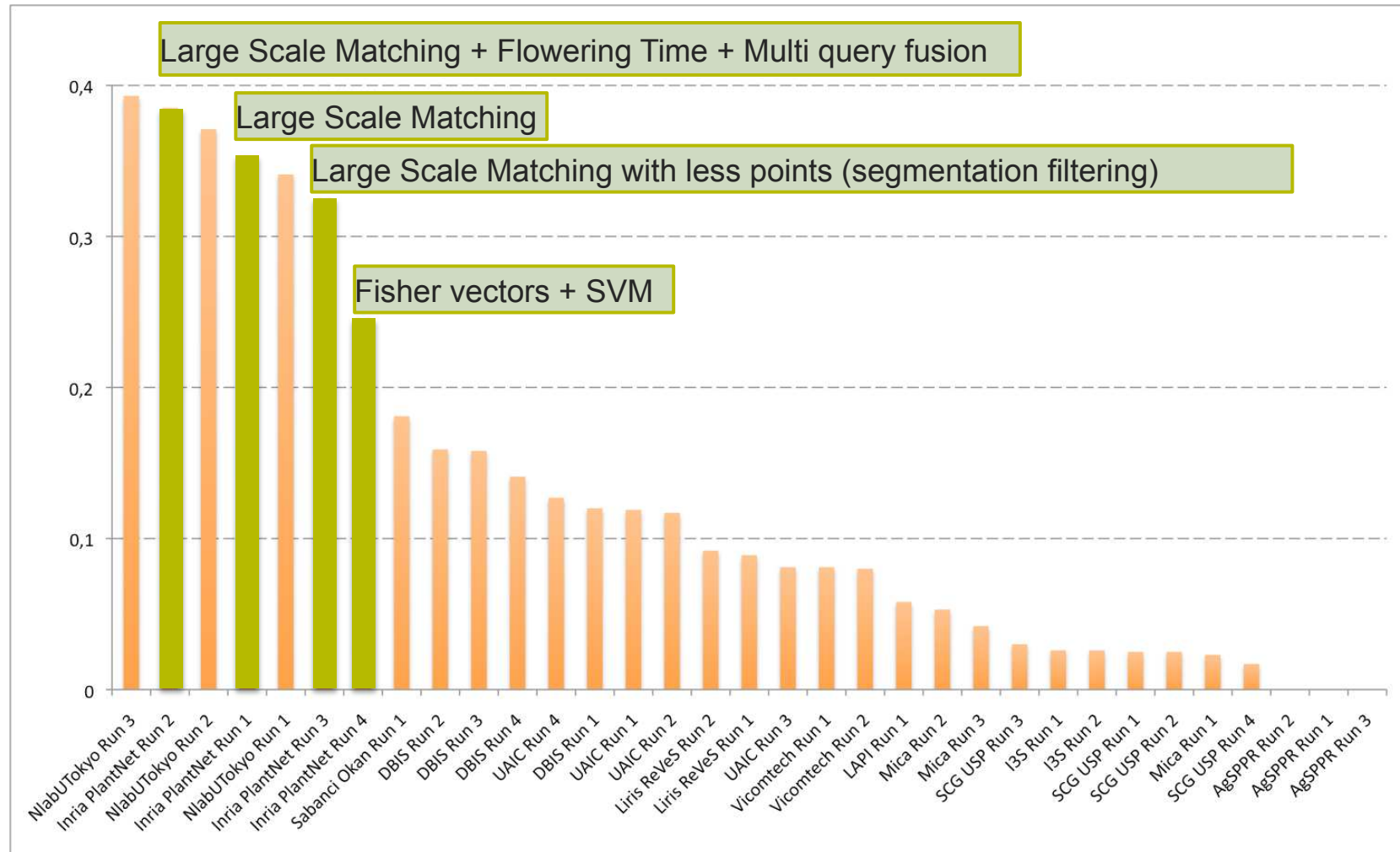
Embedding schema with Fisher Vectors

→ *Inria PlantNet Run 4*

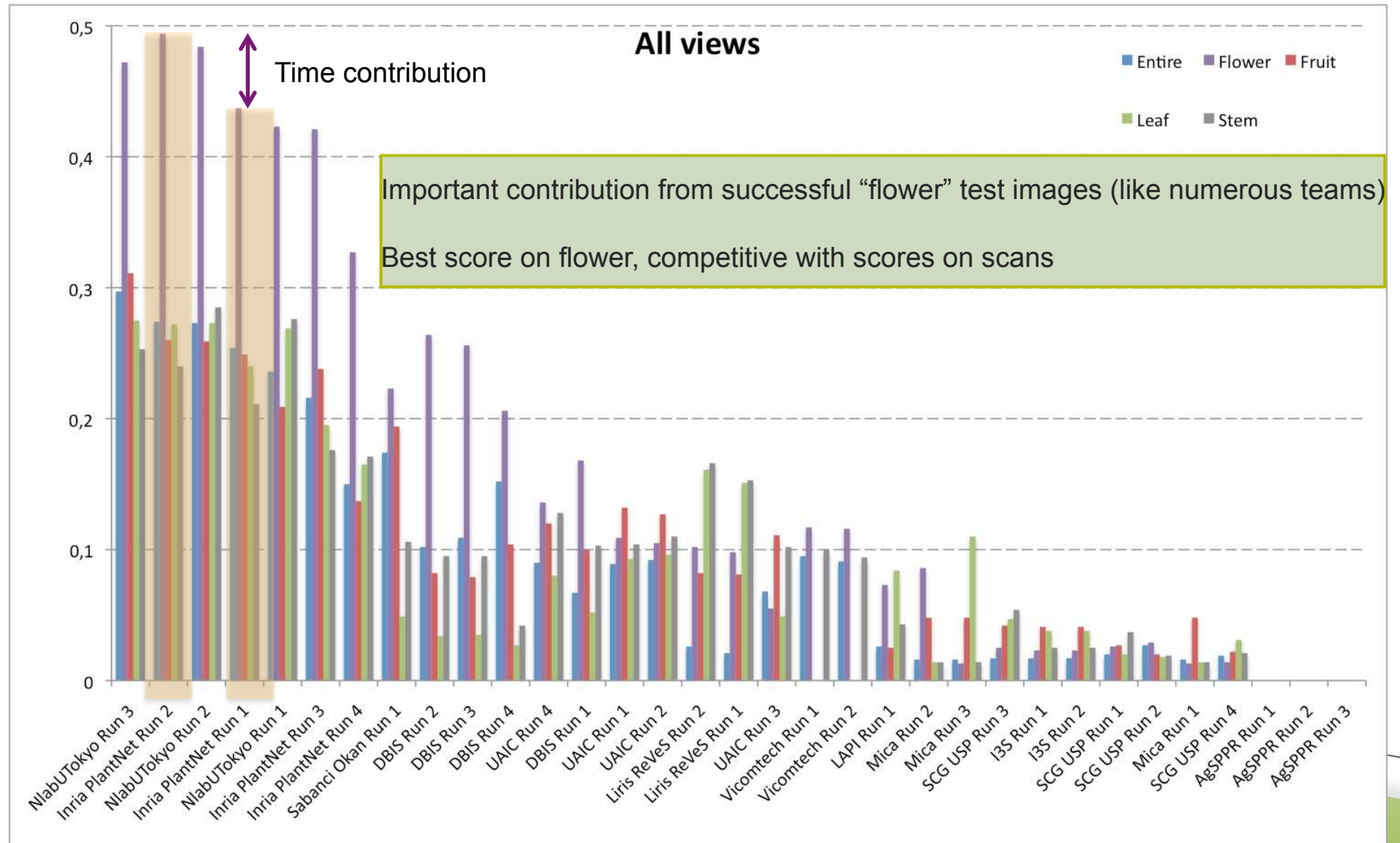
Fusion of descriptors embedded with Fisher Vectors + SVM classifiers



Results NaturalBackground category

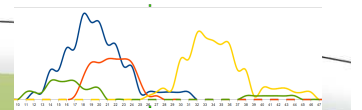
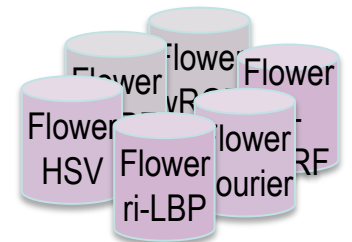


Results details NaturalBackground



Conclusions

- shape matching for scans
- combination of test images coming from a same plant
- feature extraction at the center for photos
- efficient visual search engine with RMMH
- independent indices for each type of visual description
- late fusion
- a profitable use of time for flower



Future work

Better operators for fusion and combination mechanism

New descriptors

Better use of metadata (geolocation, optical parameters)

More investigations on Fisher Vectors ?

Pl@ntNet mobile app: yet in production

Method used in “Inria PlantNet Run 2” = beta version (next update)

Try it now!

(IOS)



And contribute to the next year
task with new images!