

# Supervised Evaluation of the Quality of Binary Partition Trees based on Uncertain Semantic Ground-Truth for Image Segmentation Purpose

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## BINARY PARTITION TREE (BPT)

Hierarchical representation of an image based on a metric / feature choice

## PROBLEMATICS

Is the BPT "good" ?

How to evaluate ?

How to chose a good metric / feature to build a BPT ?

## SUPERVISED BPT EVALUATION METHOD

- 1- Choose a Ground-Truth (GT) map of  $k$  GT segments  $S_i$
- 2- Define a node / segment similarity metric  $\Lambda(N, S)$
- 3- Find in the BPT an optimal node  $N_\star$  for each given GT segment  $S$   
Compute a local quality score  $\lambda(S_i) = \Lambda(N_\star, S)$
- 4- Compute a global quality score  $\Gamma$  from the GT map

## 1-GT MAP CHOICE

User

Problem of Uncertain borders

Image

GT map

Semantic labels

- Built area
- Forest area
- Herbeceaous area
- Shadow

## 2- NODE / SEGMENT MATCHING

Comparing a node  $N$  and a GT segment  $S$

Similarity metric  $\Lambda(S, N)$

Examples of the function  $\Lambda$

Jaccard  $J'(N, S) = \frac{|N \cap S|}{|N \cup S|} = \frac{TP}{TP+FP+FN}$

Dice  $D(N, S) = \frac{2|N \cap S|}{|N|+|S|} = \frac{2 \cdot TP}{2 \cdot TP+FP+FN}$

Distance function

Membership function

Uncertainty model

## 3- FINDING MATCHING NODES

Nodes matching in the BPT

GT segments

## 4- GLOBAL QUALITY SCORE

For each  $S_i$

Best matching node  $N_\star^i$

Best similarity score  $\lambda(S_i) = \Lambda(S_i, N_\star^i)$

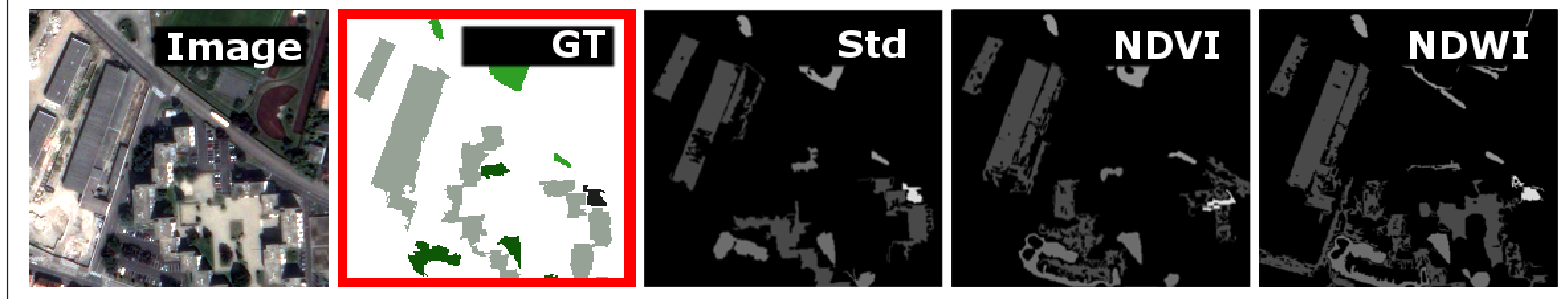
For the GT map composed by  $k$   $S_i$

Average global score  $\Gamma = 1/k \cdot \sum_{i=1}^k \lambda(S_i)$

Weighted global score  $\Gamma = \sum_{\ell \in L} w_\ell \sum_{S_i \in C_\ell} w_i \cdot \lambda(S_i)$

with  $\sum_{\ell \in L} w_\ell = 1$ ,  $\sum_{S_i \in C_\ell} w_i = 1$ , and  $w_\star \geq 0$  where  $L$  is the label set and  $C_\ell$  are the different semantic classes of GT segments

## EXPERIMENTS AND RESULTS



Index	Std	NDVI	NDWI	$N/S$	Time (s)
$D$	<b>0.670</b>	0.523	0.516	51/51	450
$J'$	<b>0.531</b>	0.389	0.399	51/51	484

Global quality scores of  $BPT_{std}$ ,  $BPT_{ndvi}$  and  $BPT_{ndwi}$  from a VHSR image (1000 × 1000 pixels).  $N/S$ : number of BPT nodes retrieved according to the number of reference segments.

## KEYWORDS

- Binary Partition Tree (BPT)
- Supervised evaluation
- Uncertainty
- Semantics
- Segmentation
- Mathematical morphology
- Remote sensing