Detection of vegetation fraction from images captured with low cost device

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Objective

- Feasible way to bring precision agriculture to developing countries.
- Detect the vegetation fraction of agricultural systems estimate production

Dataset

- 2 bean plantations
- Skyhook Helikite
- 18 images of the first crop and 22 images of the second
- Ground truth image mapped by 3 agronomists in regions of 16 x 16 pixels
- 29556 positive class examples (vegetation) and 11404 negative class

Figure 1: Helikite

Dataset - Examples

Figure 2: Samples from database

Vegetation indexes

- Several index, but need NIR information
- We use 6 methods

1. Normalized green-red difference index
   - $NGRDI = \frac{G-R}{G+R}$
2. Excess green
   - $ExG = 2g - r - b$
3. Color index of vegetation
   - $CIVE = 0.441r - 0.881g + 0.385b + 18.78745$
4. Vegetativen
   - $VEG = \frac{g}{r^a b^{(1-a)}}$ where a = 0.667
5. Excess green minus excess red
   - $ExGR = ExG - 1.4r - g$
6. Woebbeckindex
   - $WI = \frac{g-b}{r+g}$

$$r = \frac{R}{(R+G+B)}; g = \frac{G}{(R+G+B)}; b = \frac{B}{(R+G+B)}$$

ROC Curve

- The ROC curve help to illustrate the discriminating ability of a binary classifier
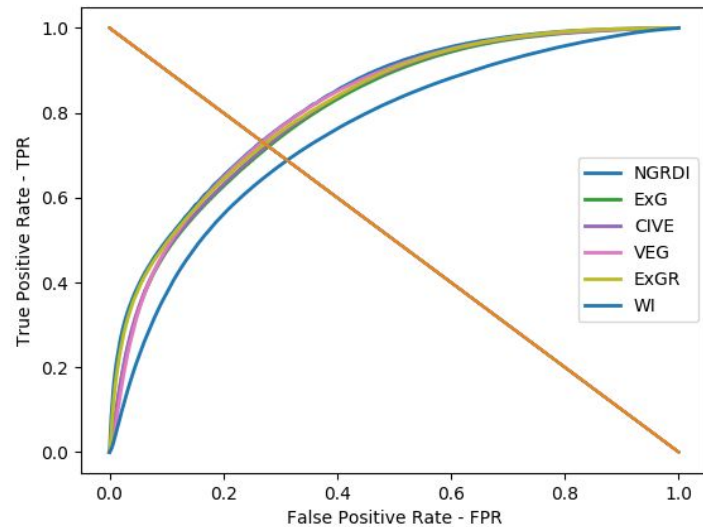

Figure 3: ROC curve

Fusion and Filter

- Early:
  - Arithmetic mean
  - Geometric mean
- Late:
  - Majority
- Filtering methods:
  - Blur
  - Mean
  - Gaussian
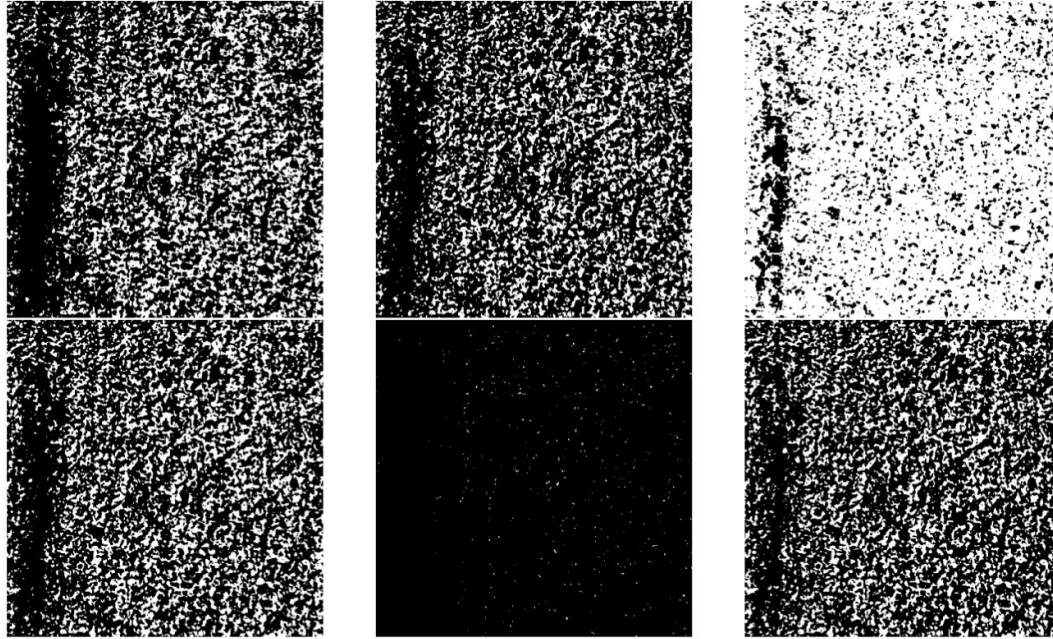 - Bilinear

Results - Index

Figure 4: Index result for the input example, in order up to right

NGRDI, ExG, CIVE, VEG, ExGR and WI

Result - Index

- Despite the differences between the indexes, when we apply the process for all input images and plot the ROC, they all have a similar behaviour, as we can see in the figure below.
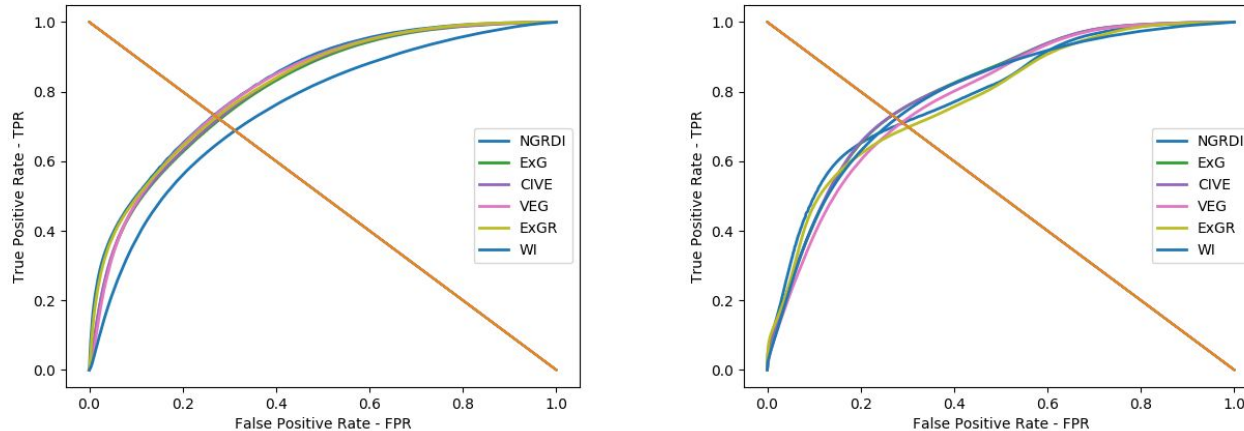

Figure 5: ROC curve for both databases

Results - Fusion

Method	Accuracy crop 1	Accuracy crop 2
NGRDI	0.733	0.710
ExG	0.720	0.732
CIVE	0.723	0.732
VEG	0.731	0.711
ExGR	0.727	0.698
WI	0.688	0.723
Arithmetic mean	0.723	0.733
Geometric mean	0.725	0.732
Majority	0.719	0.735

Table 1: Fusion accuracy

Results - Filters

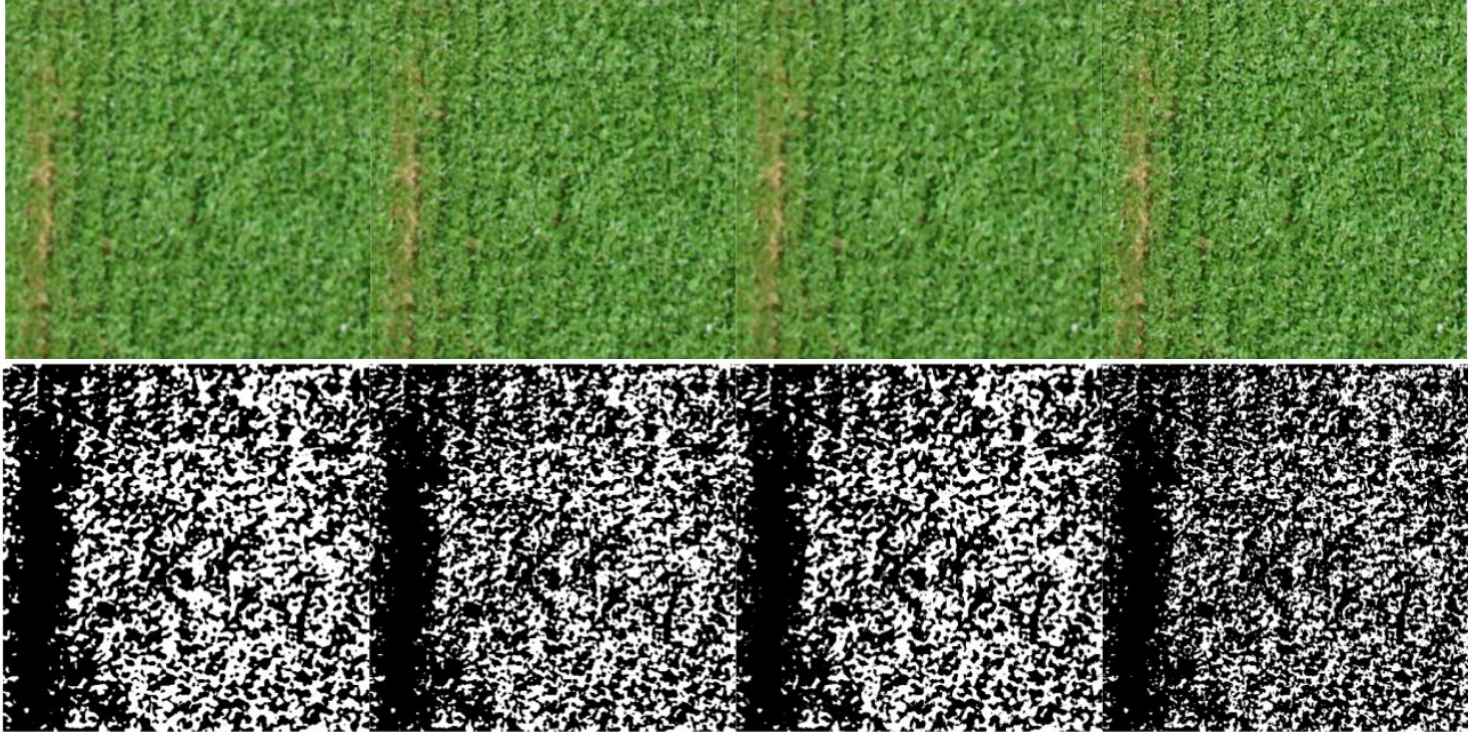

Figure 6: Example of filtered input and NGRDI predictions

Results - Filter Accuracy

Filter	Accuracy crop 1	Accuracy crop 2
No filter	0.733	0.710
Blur	0.800	0.791
Gaussian	0.777	0.768
Mean	0.784	0.785
Bilinear	0.736	0.720

Table 2: Filters accuracy

Results - Blur ROC

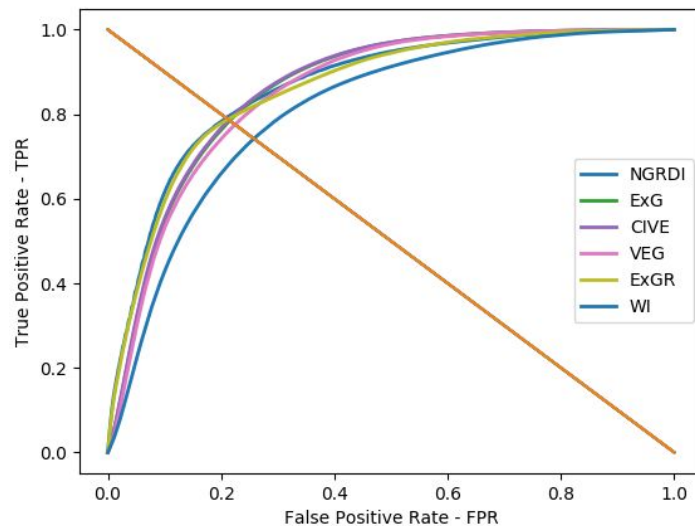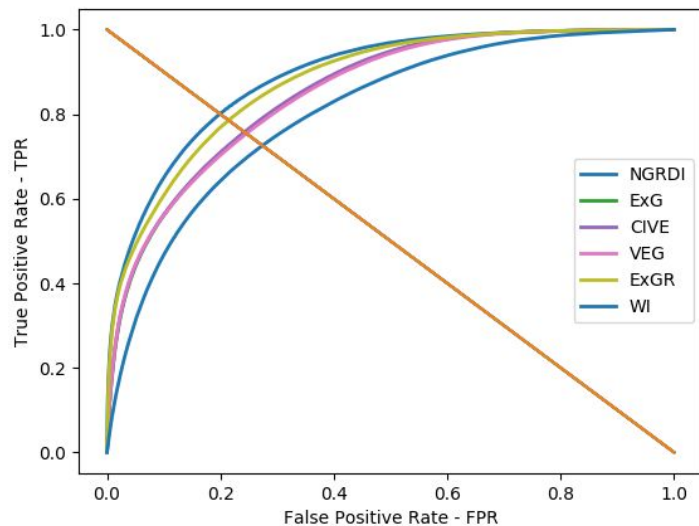Figure 7: ROC Curve for blurred input

Results - Comparison no filter and Blur

Method	Accuracy crop 1	Accuracy crop 2
NGRDI	0.733	0.710
ExG	0.720	0.732
CIVE	0.723	0.732
VEG	0.731	0.711
ExGR	0.727	0.698
WI	0.688	0.723
Arithmetic mean	0.723	0.733
Geometric mean	0.725	0.732
Majority	0.719	0.735

Table 3: No filter accuracy

Method	AUC	EER	FAR	FRR	Accuracy
NGRDI	0.890	0.389	0.199	0.199	0.800
ExG	0.852	0.313	0.243	0.243	0.756
CIVE	0.854	0.313	0.242	0.242	0.758
VEG	0.851	0.287	0.2465	0.246	0.754
ExGR	0.878	0.328	0.214	0.214	0.786
WI	0.804	0.348	0.274	0.274	0.726
Arithmetic Mean	0.862	0.330	0.233	0.233	0.767
Geometric mean	0.862	0.014	0.233	0.233	0.767
Majority					0.759

Table 4: Blur accuracy

Thank you!