

THE USE OF IMAGES TO ACCESS RISK OF LODGING

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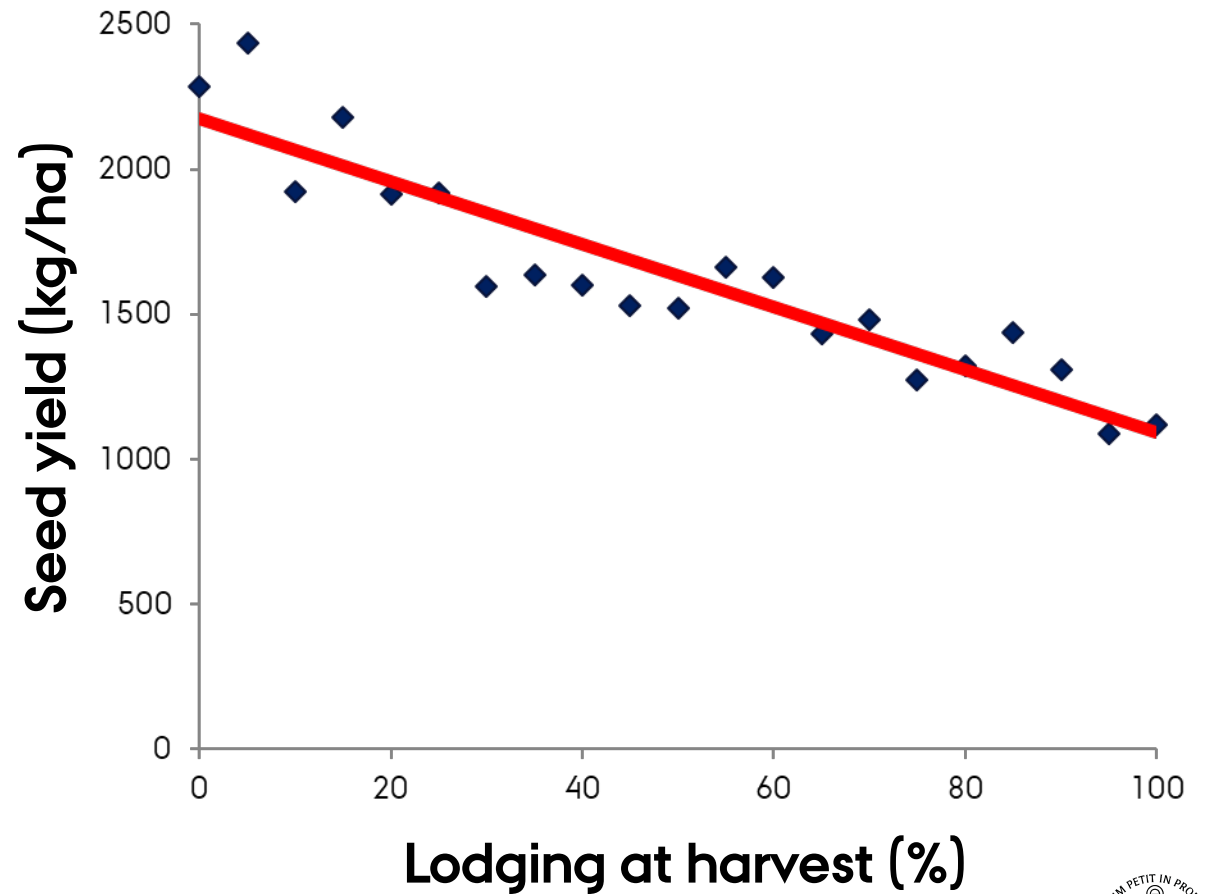




- ❖ PHD (06/2017), South China Agriculture University
- ❖ PHD thesis: Study on nursery plug tray seeding performance evaluation of hybrid rice. (using image analysis)
- ❖ Major in: Agricultural Engineering
- ❖ Supported by CSC(China Scholarship Council), I am now a post-doc in Aarhus University, 8/2018-8/2019



DAMAGE CAUSED BY LODGING



HOW TO ACCESS LODGING IN PLOT EXPERIMENT



Lodging score:5



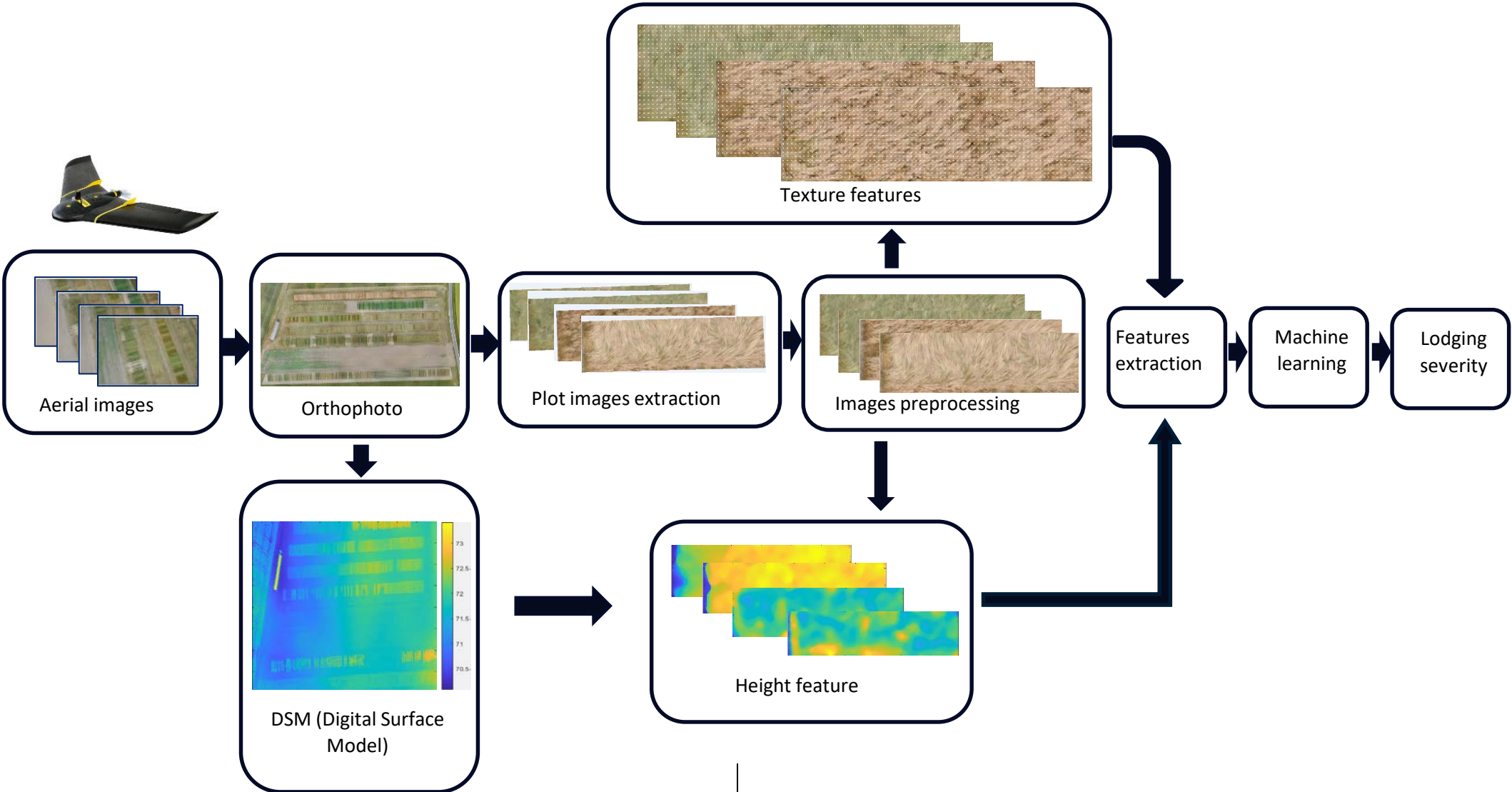
Lodging score:40



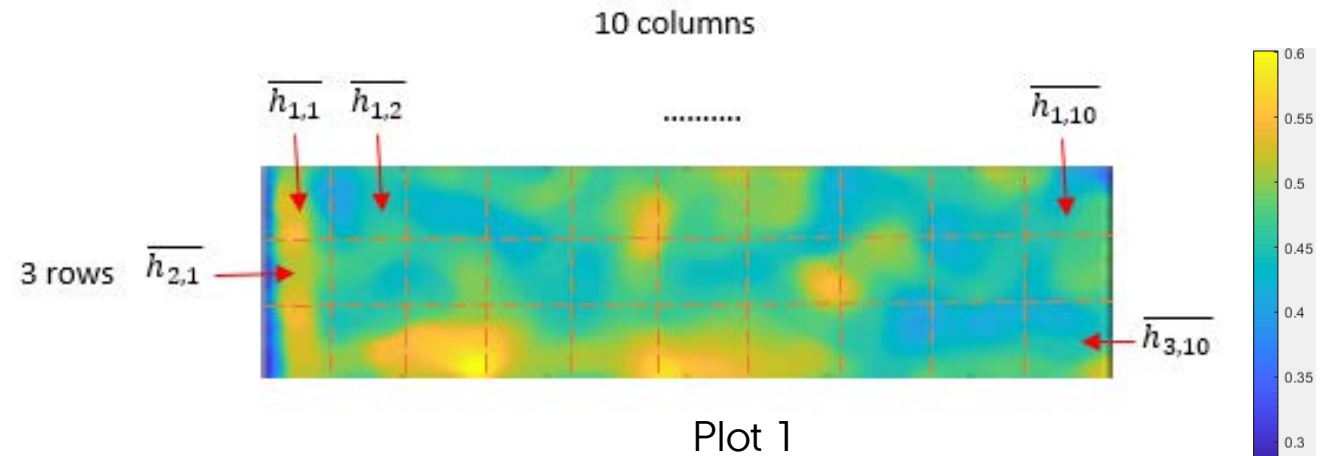
Lodging score:80

- ❖ Lodging scores are important to evaluate effect of different treatments in the individual plots
- ❖ Toshifumi, 2012, Japan, Canopy height measurement by photogrammetric analysis of aerial images: application to buckwheat lodging evaluation
- ❖ Chu, 2017, USA, Assessing lodging severity over an experimental Maize Field using UAS images
- ❖ We use drone images to assess lodging in grass seed crop

THE USE OF IMAGES TO ACCESS LODGING



PLANT HEIGHT FEATURE



Height feature vector of plot 1: $[\overline{h_{1,1}} \quad \overline{h_{1,2}} \quad \dots \quad \overline{h_{1,10}} \quad \dots \quad \overline{h_{2,1}} \quad \dots \quad \overline{h_{3,10}}]$

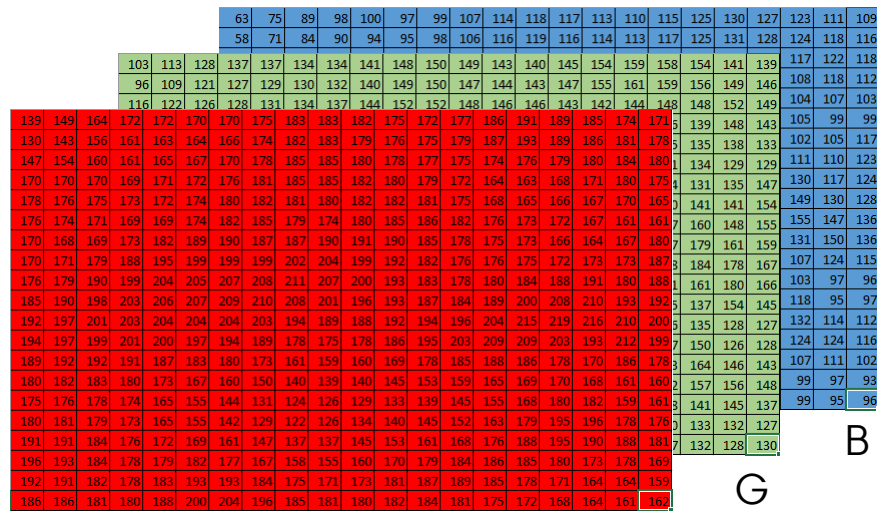
⋮

Height feature vector of plot n: $[\overline{h_{1,1}} \quad \overline{h_{1,2}} \quad \dots \quad \overline{h_{1,10}} \quad \dots \quad \overline{h_{2,1}} \quad \dots \quad \overline{h_{3,10}}]$

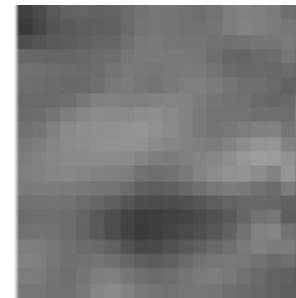


TEXTURE FEATURES

Image texture gives us information about the spatial arrangement of color or intensity in an image or selected region



Texture Feature	Formula
Energy	$\sum_i \sum_j P_d^2(i, j)$
Entropy	$-\sum_i \sum_j P_d(i, j) \log P_d(i, j)$
Contrast	$\sum_i \sum_j (i - j)^2 P_d(i, j)$
Homogeneity	$\sum_i \sum_j \frac{P_d(i, j)}{1 + i - j }$
Correlation	$\frac{\sum_i \sum_j (i - \mu_x)(j - \mu_y) P_d(i, j)}{\sigma_x \sigma_y}$

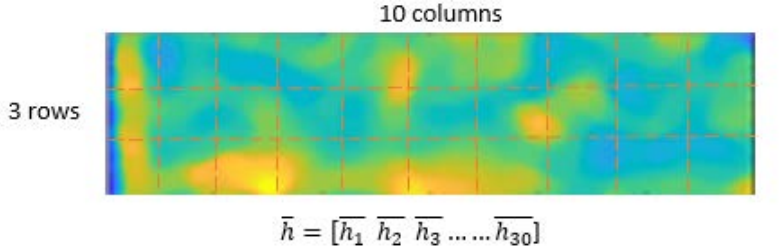


Gray image of R Channel

Mathematics and Statistics algorithm



RESULTS

Feature		Training sets			Test sets		
 <p>10 columns</p> <p>3 rows</p> <p>$\bar{h} = [\bar{h}_1 \ \bar{h}_2 \ \bar{h}_3 \ \dots \ \bar{h}_{30}]$</p>	Lodging score	0-30	31-60	61-100	0-30	31-60	61-100
	classification	Minor	Moderate	Major	Minor	Moderate	Major
	number	420	130	215	422	101	200
	Right number	408	57	167	410	39	163
	Average accuracy	83%			85%		

Flight dates: from May to July, 2016 to 2018



RESULTS

Feature		Training sets			Test sets		
 <p data-bbox="109 768 746 861">Texture feature: Hog feature (Histograms of Oriented Gradient)</p> <p data-bbox="122 911 772 1003">Flight date : from May to July, 2016 to 2018</p>	Lodging score	0-30	31-60	61-100	0-30	31-60	61-100
	classification	Minor	Moderate	Major	Minor	Moderate	Major
	number	400	90	180	403	96	183
	Right number	383	11	154	396	14	154
	Average accuracy	82%			83%		

CONCLUSION

- ❖ We are able to detect lodging by an accuracy of 82 to 85%
- ❖ Both height and texture features are useful even though they are very different methods
- ❖ We are unfortunately not at this moment able to predict lodging in time to use it for application of plant growth regulators



CONCLUSION AND PERSPECTIVES

- ❖ We are able to detect lodging by an accuracy of 82 to 85%
- ❖ Both height and texture features are useful even though they are very different methods
- ❖ We are unfortunately not at this moment able to predict lodging in time to use it for application of plant growth regulation

- ❖ Images at a certain resolution will be able to show fields or part of the fields where we can expect high risk of lodging
- ❖ Images can be used to tell which cultivars or areas have an especially high risk for lodging
- ❖ We will continue the work on predicting lodging



