Competition Project: Phase 1

Machine leaning approaches towards classifying  
 visual water-stress for soybeans

Abhishek Ranjan Singh *Electrical and Computer Engineering*  
*North Carolina State University*Raleigh, NC, USA  
arsingh3@ncsu.edu

Adam Christopher Watts  
*Wilson College of Textiles  
North Carolina State University*Raleigh, NC, USA  
[acwatts4@ncsu.esu](mailto:acwatts4@ncsu.esu)

Sankalp Singh Gaharwar  
*Computer Science*   
*North Carolina State University*Raleigh, NC, USA  
ssgaharw@ncsu.edu

*Abstract*—This electronic document is a “live” template and already defines the components of your paper [title, text, heads, etc.] in its style sheet. *\*CRITICAL: Do Not Use Symbols, Special Characters, Footnotes, or Math in Paper Title or Abstract*. (*Abstract*)

Keywords—component, formatting, style, styling, insert (key words)

# Introduction (*Heading 1*)

……………………………………………………………………………………………………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

# Methodology

## Data

A training set consisting of 1025 agricultural soybean photos each with a resolution of 640X480 pixels was provided. The training set consisting of 5 classes listed in Table 1. Visual inspection of the photos revealed a wide range of exposure levels with some photos being underexposed and rather dark while others overexposed and rather bright.

Table 1. Soybean plant classifications and descriptions.

|  |  |
| --- | --- |
| **Categorical Number** | **Classification Description** |
| 0 | No Wilting |
| 1 | Leaflets folding inward at secondary pulvinus, no turgor loss in leaflets or petioles |
| 2 | Slight leaflet or petiole turgor loss in upper canopy |
| 3 | Moderate turgor loss in upper canopy |
| 4 | Severe turgor loss throughout canopy |

Image augmentation was performed by using Keras ImageDataGenerator class to synthetically extend the training set to 3075. The first 1025 images were the original training set while the remaining 2050 consisted of 2 complete rounds of augmentation using the parameters found in Table 2. The parameters and values were chosen to emulate the variation found in the provided data set.

Table 2. Keras ImageDataGenerator parameters

|  |  |
| --- | --- |
| **Parameter** | **Value / Boolean** |
| Rescale | 1.0/255 |
| Shear Range | 0.1 |
| Zoom Range | 0.25 |
| Horizontal Flip | True |
| Rotation Range | 25 |
| Fill Mode | ‘Wrap’ |

Color….. do we need color….. Maybe do grayscale… only?

Histogram equalization

## Architecture

First attempts came from a CNN from ( Hands-On Machine Learning with Scikit-Learn and TensorFlow)…

With optimizer SGD… poor convergence….

2nd attempt was using data augmentation and histogram equalization….

3rd attempt: batch Normalization

4th attempt: Max pooling of 4 prior to Dense layer. Very large dense MLP 4K – 2K

5th Attempt: optimization with dropout

# Results

……………………………………………………

##### Acknowledgment *(Heading 5)*

The preferred spelling of the word “acknowledgment” in America is without an “e” after the “g”. Avoid the stilted expression “one of us (R. B. G.) thanks ...”. Instead, try “R. B. G. thanks...”. Put sponsor acknowledgments in the unnumbered footnote on the first page.

##### References

The template will number citations consecutively within brackets [1]. The sentence punctuation follows the bracket [2]. Refer simply to the reference number, as in [3]—do not use “Ref. [3]” or “reference [3]” except at the beginning of a sentence: “Reference [3] was the first ...”

Number footnotes separately in superscripts. Place the actual footnote at the bottom of the column in which it was cited. Do not put footnotes in the abstract or reference list. Use letters for table footnotes.

Unless there are six authors or more give all authors’ names; do not use “et al.”. Papers that have not been published, even if they have been submitted for publication, should be cited as “unpublished” [4]. Papers that have been accepted for publication should be cited as “in press” [5]. Capitalize only the first word in a paper title, except for proper nouns and element symbols.

For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation [6].

1. G. Eason, B. Noble, and I. N. Sneddon, “On certain integrals of Lipschitz-Hankel type involving products of Bessel functions,” Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. *(references)*
2. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.
3. I. S. Jacobs and C. P. Bean, “Fine particles, thin films and exchange anisotropy,” in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350.
4. K. Elissa, “Title of paper if known,” unpublished.
5. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
6. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
7. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

**IEEE conference templates contain guidance text for composing and formatting conference papers. Please ensure that all template text is removed from your conference paper prior to submission to the conference. Failure to remove template text from your paper may result in your paper not being published.**