International Interdisciplinary Congress on Renewable Energies, Industrial Maintenance, Mechatronics and Informatics
Booklets

RENIECYT 1702902 CONACYT

RENIECYT - LATINDEX - Research Gate - DULCINEA - CLASE - Sudoc - HISPANA - SHERPA UNIVERSIA - Google Scholar DOI - REDIB - Mendeley - DIALNET - ROAD - ORCID

Title: Meteorological patterns recognition using Artificial Neural Networks programmed with the Swish activation function

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Editorial label ECORFAN: 607-8695
BCIERMMI Control Number: 2021-01
BCIERMMI Classification (2021): 271021-0001

Pages: 07
RNA: 03-2010-032610115700-14

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Introduction

In the last twenty-five years, the use and advance of Artificial Neural Networks (ANN) within a great variety of fields of science has been well known; this document will first give an introduction to the theory of ANNs and their different types.

why the ANN are used to a great extent in the field of pattern recognition with the different algorithms that can build them in addition to the formulas that compose them.

Review their adequacy for the patterns recognition in images and its use in the detection of two meteorological phenomena types using the Swish activation function, which has shown, on other types of functions, a good performance in the recognition tasks as well as the feedback type and quality obtained on ANN learning.

Methodology

As part of the study of Artificial Intelligence (AI), Artificial Neural Networks (ANN) have, within their neurons, the evaluation mechanisms that allow their learning. These mechanisms are known as **activation functions**, which are mathematical equations that are responsible to return a result from input values.

Activation Function types:

1. Binary step or unit step
2. Linear
3. Non-Linear

Non-Linear activation function

1. Sigmoid or logistic: $f(x) = \frac{1}{1+ e^{-x}}$
2. Rectified Lineal Unit (ReLU), and its variations
3. Complex non-linear

Swish activation function

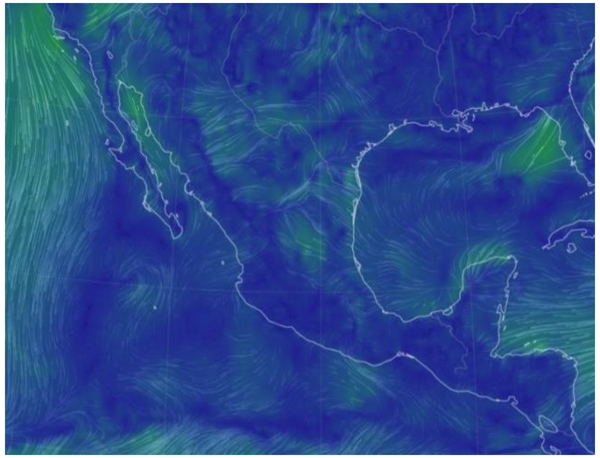
$$y = x * sigmoid(x), \text{ replacing}$$

$$y = x * \left(\frac{1}{1 + e^{-x}}\right) = \left(\frac{x}{1 + e^{-x}}\right)$$

Backward propagating ANN is a gradient calculation method for learning; owe their recent success to the fact that they are considered computationally efficient and their fields of application lean towards pattern recognition (Wechsler, 1992).

Meteorological phenomenon and numerical models

Data outputs are in tabular format, but through third-party software or utilities it is possible to generate the corresponding graphics



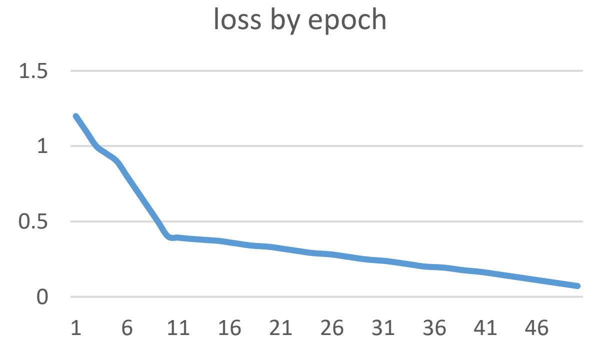
Wind references are sought in the Mexican Republic to identify three groups:

- North wind
- South wind
- Atlantic wind

The use of Mexican Republic images is proposed, with the same dimension of 640x480 pixels.

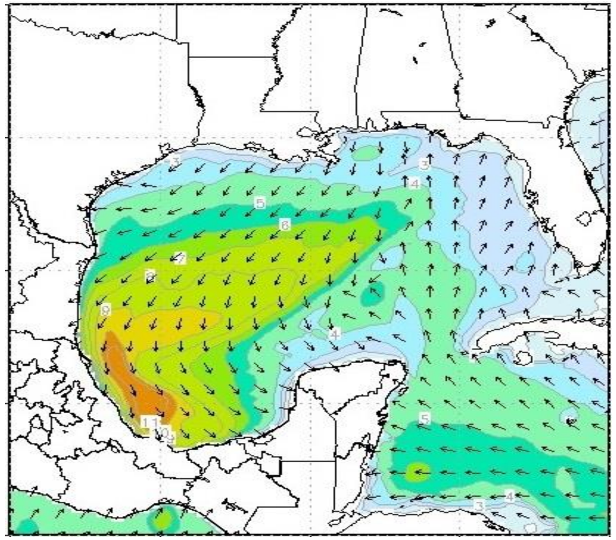
Wind type	# of images loaded
North	1,738
South	1,094
Normal	953

Loss measures the level of learning of a model when predicting the correct classification of a given set of samples. A good sampling should aim for zero.



Results

- Once the model was trained, the recognition performed by the ANN was tested with a batch of 300 images from different days and with different phenomena; with adequate results greater than 80%.
- A higher error rate was observed in situations where the maps of the phenomena converge in areas of the southern basin of Veracruz, that is, towards the coordinates with latitude 20^{o}N and longitude 96^{o}W.
- When detailing the images we find that the phenomena differ by the wind direction that originates them in previous days; resulting in classification errors.
- classification of meteorological phenomena as hurricanes



Conclusions

- number of training images in similar quantities and achieving a balanced learning.
- wind direction variable to eliminate ambiguities in the decision
- decisions memory that were made about the events in previous time (t-n)
- occurrence of other meteorological phenomena

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