

## ***Interactive comment on “Improved real-time bio-aerosol classification using Artificial Neural Networks” by Maciej Leśkiewicz et al.***

### **Anonymous Referee #3**

Received and published: 10 June 2018

In this paper the authors present a method for bio-aerosol classification using labelled laboratory data. The authors are correct in noting the need to improve and document such methods for improved bio-aerosol research. However before publication is considered, I feel the following points should be addressed. Presently it is unclear how anyone might replicate these results.

Minor points:

The formatting of references is wrong? Please check with the Copernicus guidelines and change from (xx)(xx) format to (xx;xx;xx. . .)

There is a range of grammatical issues that need revising before publication. I have listed some below but would suggest the authors re-read the paper and change ac-

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cordingly, removing any vague descriptions that require support with numerics or information to enable replication of experimental conditions. E.g: Line 76: 'This paper focuses on the application of ANN for real time discrimination of bio-aerosols basing on single particle fluorescence characteristics.' Please change 'basing' to 'based' Line 108: 'The concentration of the aerosols was adjusted with vibration frequency of [the] vortex.' Line 176: 'In order to determine whether it is time to stop teaching,'. This is too informal. I would suggest re-writing in terms of the fitting process.

#### Specific Points:

In table 2 the authors use the term 'own collection'. I'm a little concerned this does not provide enough information to enable replication of results. Where was the sample obtained? How old? Also the terms 'regular shop' and 'pharmacy' raise similar concerns. Which Pharmaceutical brand?

Would it be possible to present size and shape information for each specie in a separate table?

Line 119: Please list the bands of florescence recorded. You have done so in Table 1 but you should reference this table in the text on this line to avoid confusion.

Line 127: 'An Important aspect of the data acquisition process was monitoring the rate of generation of aerosol, which should be stable (not too high or spontaneous). ' Please define how this is quantified. What is 'too high'? How would this experiment be repeated?

Line 130: 'It is important to note that fact because of its statistical value for the further analysis'. What statistical value?

Section 3.2.1.2: What comparisons have been made, if any, between the bespoke implementation of the ANN in this work with what should be identical performance in existing software packages? How do we know the implementation of the bespoke ANN is correct? Please provide evidence.

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Major points:

It is difficult to contextualise the input data being used. Please provide a visualisation of some example spectra.

To the best of the reviewers understanding, each particle will be classified at multiple levels of the decision tree. For example each particle will be classified as FM7, Rib, NT, LCB, or group 1 etc. and then should the particle be identified as group 1, the particle will then get classified again as UDP, PNP, group 4 etc. For example, should a particle from group 2 be misclassified and placed into group 1, which will happen about 12% of the time, how does this error propagate down the tree? Will it be evenly distributed amongst UDP, PNP, group 4 etc. or will it be heavily weighted towards one class?

With the exception of the level 0 ANN, I assume that each of the ANNs are trained only on a subsection of the data. This needs to be clarified. For example the ANN for group 1, is trained in absence of the data from group 2 etc.

On line 245 it is stated that it is impossible to produce a single neural network to perform classification of all 48 classes. Need to be clear whether this means that it is impossible because of the number of classes, or that it is possible to create a single neural network but the classification error is unreasonably high. Would it be possible to produce a contour confusion matrix plot for the full 48 classes, for a single ANN and for the approach suggested in the manuscript, or to provide adjusted rand score or percentage of particles correctly classified to demonstrate whether better classification can be attained using the tree of ANNs as opposed to a single ANN?

How was the decision tree created? I.e. how it was decided which individual classes would be placed into group 1 through 3?

The authors have indicated on line 203 that the hyper-parameters of the ANNs have been randomly selected until the desired/best result is reached. In terms of reproducibility, it would be helpful to specify the range of parameters which were tested and

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which of these options produced the best results. Also did each of the 22 networks utilise the same hyper parameters, or was this optimisation conducted for each of the 22 networks?

There is no discussion on either data or software availability. The authors need to consider the default Copernicus publishing rules and provide text that would allow others to request access to both the data and software. If this is restricted, it should be stated with the reasons why. [https://www.atmospheric-measurement-techniques.net/about/data\\_policy.html](https://www.atmospheric-measurement-techniques.net/about/data_policy.html)

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