**ECPLF 2024  
11th European Conference on Precision Livestock Farming**

**Author instructions for final copy of paper**

*Authors are required to follow instructions for preparing the final copy of their paper as laid out below. The final copy of the paper will be checked by the Editor to ensure that reviewer requirements on the first draft have been fully met. He will also check formatting, spelling and English construction. The Editor and Organising Committee reserve the right to reject papers that do not substantially meet the instructions below or where the spelling/grammar/English construction would require considerable work by the Editor to bring the paper up to the standards required for the Proceedings. Authors should note that their final copy needs to be ‘camera-ready’ for passing to the publisher.*

**General points**

1. The paper must be supplied as a Microsoft Word file. If your abstract is

accepted, you will get an invitation by e-mail to write a paper. That e-mail

includes a link for submitting paper. Follow that link and upload the file.

2. Authors who are not native English speakers are strongly advised to have their

papers checked/corrected by a native English speaker before submitting the

paper.

3. There is no flexibility on the date for manuscripts to be sent to the publisher by

the Organising Committee. Authors must therefore keep to the deadlines

indicated to them.

4. Colour figures can be included in the paper. The hardcopy of the proceedings

will be printed in B/W.

5. Maximum 8 pages

6. Maximum 5MB

**Format & structure**

Font: 12 pt Times New Roman

Line spacing: single

No line or page numbers. No headers or footers (other than footnotes).

Do not include paper ID number.

Margins: 30mm all sides.

Section titles – main sections: left adjusted, bold, sentence case; sub-sections: left

adjusted, regular, sentence case, under scored.

One blank line before and after main section titles.

One blank line before sub-section titles.

Paragraphs should be fully justified.

The structure of the paper must be:

• Title – bold, left adjusted, sentence case

• Authors – regular, left adjusted, sentence case

• Institutions and Addresses – italics, left adjusted, sentence case

• Email address of corresponding author - regular, left adjusted, sentence case

• Abstract – approximately 250 words

• Keywords - 6 maximum

• Introduction

• Material and Methods

• Results and Discussion

• Conclusions

• Acknowledgements

• References

**Figures**

1. Figures should be embedded in the paper close to where they are referenced in

the text.

2. Figures should preferably be placed at the top or bottom of a page.

3. All figures must have a figure number and a legend placed underneath the

figure.

4. All axes should have legends with units (where appropriate).

5. All captions/legends on a figure must be clearly legible – note that the A4 pages

will be reduced to about three quarters in each direction when printed in the

Proceedings.

6. All maps must have a length scale.

7. There should be no overall frame to a figure.

8. The proceedings will be printed in B/W. Therefore, authors should check for

clarity/quality of colour figures converted to B/W or gray scale to include in

their paper.

**Tables**

1. Tables should be placed close to where they are referenced in the text.

2. A table number and legend should be placed above each table.

3. The number of vertical and horizontal lines in a table must be kept to a

minimum. Generally, there should be no vertical lines and no horizontal lines

within the body of a table.

4. Values in a table should be in regular font.

**Equations**

1. Preferable, equations should be written in Microsoft Equation Editor.

2. Equations should normally be placed on separate lines from the text.

3. Equations should be numbered sequentially, the number appearing to the right of

the equation and in round parentheses ().

**References**

1. Literature quoted in the text should be indicated by author and publication year –

one author (Smith, 2000); two authors (Smith & Jones, 2000); more than two

authors (Smith et al, 2000).

2. References must be listed in alphabetical order of 1st author (then 2nd author etc).

Names of all authors must be included.

3. The reference must contain – author(s) name(s), year, title (sentence case),

journal name in full (or ‘In: proceedings of….’ or book publisher), volume

number, issue, page range.

4. Non-English titles should be followed by English translation of the title in

parentheses.

5. Proceedings (or collected works) editors should be named.

6. Only published works and those accepted for publication may be included.

Submitted but not yet accepted papers may not be included.

**Frequency analysis for real-time recognition of sick pigs and disease monitoring in pig houses**

Blank line

V. Exadaktylos1, M. Silva2, J.-M. Aerts2, C. J. Taylor1 and D. Berckmans2  
1*Engineering Department, Lancaster University, LA1 4YR Lancaster, United Kingdom*  
2*Department of Biosystems, Division M3-BIORES: Measure, Model & Manage Bioresponses, Catholic University of Leuven, Kasteelpark Arenberg 30, 3001 Heverlee, Belgium*Daniel.Berckmans@biw.kuleuven.be

Blank line

Times New

Roman 12 pt

# Abstract

Blank line

This paper extends existing cough identification methods and proposes a real-time version for identifying sick pig cough sounds. The analysis and classification is based on the frequency domain characteristics of the signal, while an improved procedure to extract the reference is presented. This technique evaluates fuzzy c-means clustering to parts of the training signals that mirror the cough characteristics. The identification process can be implemented for real-time applications that would improve and speed up the treatment procedure in pig houses.

Blank line

**Keywords**: real-time recognition, cough analysis, spectral analysis, signal processing

Blank line

# Introduction

Blank line

Paragraphs justified left and right

Cough is a sudden air explosion from the airways followed by a characteristic sound (Korpáš *et al*., 1996). Being one of the body's defence mechanisms against respiratory infections, it can be a sign of disorder or infection of the respiratory system. It has been used as an index for over 100 diseases and an experienced physician can identify an infection based on the cough sound. This fact has led researchers to further study cough recording and analysis methods (e.g. Subburaj *et al*., 1996) and to develop automated identification techniques (e.g. Matos *et al*., 2006)….

# Material and methods

Blank line

Blank line

## Experimental data

The data, both pathologic and healthy coughs, used for the analysis are cough sounds recorded in laboratory conditions. The healthy coughs were induced in an inhalation chamber by injecting an irritating substance namely 0.8 moles per litre of citric acid…

Blank line

## Signal analysis

The frequency characteristics of the signal on which the identification process is based, is the Power Spectral Density (PSD). In Figure 1, for example, …



Figure 1: Time-signal (left column) and frequency content (right column) for a sick cough (top row), a grunt (middle row) and a scream (bottom row)

Blank line

## Power Spectral Density of the training set

SI units only

To define a reference, ten sick cough signals with average duration  and five scream signals with average duration  were used. Each signal was split into parts of length  (or ) with a 50% overlap to each other allowing…

Blank line

## Extraction of signal characteristics

In this work, the Discrete Fourier Transform (DFT) that is widely used in signal processing (Oppenheim *et al*., 1999), is used to extract the spectrum of the signals. For completeness, its main properties are described below.

Consider a discrete signal ,  sampled at frequency . The N-point DFT of this signal is defined as

,  (1)

Blank line

where  is the imaginary unit and  is in general a complex number. The DFT reveals the frequency content of the sampled signal up to the Nyquist frequency .

Blank line

# Results and Discussion

Blank line

Each individual sound is processed using the proposed algorithm and is either identified as *sick* cough or not. Table 2 presents the total number of each sound and the number of them identified as *sick* cough when running the algorithm for a total of 656 sounds.

Blank line

Table 2: Identification results of the proposed algorithm

|  |  |  |  |
| --- | --- | --- | --- |
| Sound | Number of sounds | Number of sounds identified as cough | Percentage (%) |
| Healthy cough | 231 | 31 | 13.4 |
| Sick Cough | 281 | 231 | 82.2 |
| Scream | 13 | 1 | 7.6 |
| Sneeze | 19 | 2 | 10.5 |
| Grunt | 31 | 2 | 6.4 |
| Metal | 81 | 9 | 11.1 |

# Conclusions

Blank line

Blank line

This paper proposed a real-time algorithm for online identification of sick pig cough sounds.

Blank line

# Acknowledgements

Blank line

This project was funded by …

Blank line

# References

Blank line

Bezdek, J.C. 1981. *Pattern recognition with fuzzy objective function algorithms*. Plenum Press, New York.

Marx, G., Horn, T., Thielebein, J., Knubel, B., and von Borell, E. 2003. Analysis of pain-related vocalization in young pigs. *Journal of Sound and Vibration* **266**(3) 687-398.

10 mm hanging indent

Van Hirtum, A., and Berckmans, D. 2001. The fundamental frequency of cough by autocorrelation analysis. In: *Proc. EUROSPEECH: 7th European Conference on Speech Communication and Technology* Aalborg, Denmark, 2435-2438.