EHDA closed loop control system based on real time non-visual spray mode classification
(Center, Bold, Times New Roman 14, maximum 15 words in english)

João P. M. Marques[1], **Luewton F. L. Agostinho**[2], **Antonio Carrasco**[3], **Fourth author**[4*]

[1,2] Study Program, Faculty, University Bogor, West Java, 16143, Indonesia
[3] Department of Computer Science, Faculty of Mathematics and Natural Science, Pakuan University, Bogor, West Java, 16143, Indonesia
[4] Department of Mathematical Sciences, Faculty of Science, Universiti Teknologi Malaysia, 81310 Johor Bahru, Johor, Malaysia

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Abstract

Electrohydrodynamic Atomization (EHDA) also known as Electrospray (ES), is a technology that uses a strong electric field (kV/cm) to manipulate liquid breakup into droplets. This technique allows the generation of droplets smaller than the nozzle diameter with a controlled droplet size, which means it can be used to produce uniformly sized particles in the micro/nanoscale range. This liquid spraying technique can generate different modes when both the liquid flow rate and the voltage vary with a narrow size dispersion. The most known mode is the cone-jet mode, because it can produce droplets in the micro and nanometric range with a narrow size dispersion.

The article presents a novel closed-loop control system for electrohydraulic actuators (EHDA) that utilizes real-time, non-visual spray mode classification to improve performance and efficiency. The system utilizes current data from the experiment to classify the spray mode dynamics in real-time and adjust the EHDA parameters, such as pump flowrate and power supply voltage, to reach the desired spray mode and stabilize it. The proposed control algorithm is able to achieve improved accuracy and reduced waste compared to previous methods. The results of the system are discussed and its potential applications in industrial settings are highlighted.

The beginning of EHDA researches started with Taylor. He noticed that using electric field in liquids small droplets could be created. That dynamics received his name as Taylor Cone jet. After that other scientists such as Willian Gilber, Prunet published about "Electric Modes". In the work of Sjaaks[?] he could classify the spraying dynamics using non-visual data. The data was being collected is the currrent data flowing throught the system. However, the automation of the experiment is not very well explored. This could bring better knowledge about the experiment since the variables are normally adjusted manually. This work is structured with the goal of .....

consists of objectives, methods, findings, and research contributions in 150 to 250 words which contains the main conclusions and provides important information and is accompanied by **5 keywords**. Furthermore, the determination of keywords needs to pay attention to important words contained in the title and abstract, separated by a semicolon. **The novelty** in this paper briefly explains why no one else has adequately researched the question. Then **the results** are made a list of the empirical findings and write the discussion in one or two sentences.

Keywords: *Keyword 1; keyword 2; keyword 3; keyword 4; keyword 5*

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*Corresponding author. E-mail address: author4@email.com

1.   Introduction (10pt, bold)

The introduction is about 400-600 words and provides background information, previous references related to the main topic, reason, purpose of the research, and the novelty of the research. Content should be relatively non-technical, but clear enough for a knowledgeable reader to understand the manuscript's contribution. Explain what the purpose of the research is and why the research was conducted the main body of the article should begin with an introduction, which provides further details on the purpose of the paper, motivation, research methods, and findings. For citations use numbering which must be used for reference titles, for example, citations for journals consisting of 1 article [1] or two articles [2], [3], while for writing citations of more than two articles [4] - [7].

In writing a bibliography using the IEEE style, the conditions are numbered, as follows: [1], in order from the first citation to the last. References with IEEE style use a numeric number placed in a square box for the reference taken and put it at the end of the sentence. The numeric numbers located in the square box are made the same as the bibliography on the final page of the scientific paper.

2.   Methods (10pt, bold)

The methods section describes the steps followed in the execution of the study and also provides a brief justification for the research methods used. A chronological explanation of the research, including research design, research procedures (in the form of algorithms, codes, or others), how the procedures are to obtain and test data [8] - [23]. The description of the research has been supported by references, so that the implementation can be accepted scientifically [6]. Figure are presented in the center, as shown below and are cited in the manuscript. An example of a membership function graph can be seen in Figure 1.
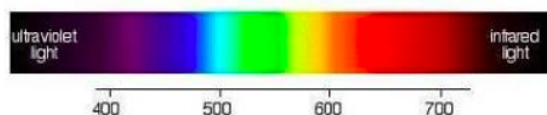

Figure 1. Font 10pt and center not bold for captions except for the words "Figure"

Each image (photos, graphs, and diagrams) in the article must be accompanied by a caption/image title and sequential image numbers, written below the image in the middle position. Images must be directly relevant to the article and are always referenced in the article referred to as Figur 1, where the capital letters are capitalized.

2.1.   Table (10pt, bold)

Writing tables are numbered followed by the title of the table above the table, centered, 1 spaced with a short and precise title. Consider the example in Table 1
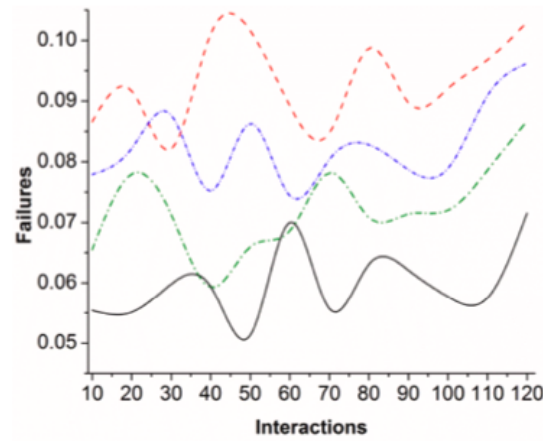
2.2.   Figure (10pt, bold)

Image writing techniques in scientific papers must also be symmetrical in the middle. So the settings are not aligned right or left, but in the center. This helps tidy up the position of the image or photo so that it appears side by side well with the description text as in Figure 2.

Table 1. Font 10pt and center not bold for captions except for the words "Table"

Characteristics	Description	Frequency	Percentage
Gender	Male	198	80.2%
	Female	49	19.8%
Entry	2018	54	21.9%
	2019	64	25.9%
	2020	59	23.9%
	2021	70	28.3%
MBKM	Yes	217	87.9%
	No	30	12.1%
	Total	247	100%

Figure 2. Font 10pt and center not bold for captions except for the words "Figure"

3.   Result and Discussion (10pt, bold)

The results obtained are data or facts obtained from research. Important data or facts that cannot be clearly narrated can be displayed in the form of tables or pictures or other illustrations. If the results are presented in the form of tables or figures, they do not need to be described at length. The discussion is a review of the results, explaining the meaning of the research results, conformity with the results or previous research, the role of the results in solving the problems mentioned in the introduction, and the possibility.

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3.1.   Equation (10pt, bold)

Mathematical equations must be numbered sequentially and starting with (1) until the end of the paper including the appendix. This numbering must begin and end with an opening and closing parenthesis and right align. Add one blank space above and below the Eq. 1.

$$\chi(L(\Gamma); \lambda) = (\lambda + 2)^{m-n} \chi(\Gamma; \lambda + 2 - k) \tag{1}$$

For example, from Eq. 2 it is derived again the next mathematical equation

$$\chi(L(\Gamma); \lambda) = \det(\lambda I_m - A_L) \tag{2}$$

Or there is the next mathematical Eq. 3 as below

$$\det(D_0 D_0^t) = \sum_{|U|=n-1} \det(D_U) \det(D_U^t)$$ (3)

3.2.   Therema (10pt, bold)

The schema for writing definitions, theorems, lemmas, and proofs conforms to and follows the template below.

Theorem 1 *Theorem is a statement about mathematics that still requires proof and the statement can be shown to have a truth value or is also true.*

3.2.1.   Lemma (10pt, bold)

Lemma 1 *An entry is a word or phrase entered in the dictionary beyond the definition given in the entry*

4.   Conclusion (10pt, bold)

The author presents brief conclusions from the results of research with suggestions for advanced researchers or general readers. A conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. Conclusions must identify the results obtained in a clear and unambiguous manner, the author should provide the answer to the question: is this a problem with error, method, validity, and or otherwise?

5.   Acknowledgement (if any)

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