

Review of Doctoral Thesis

1. PhD candidate
Houssam Mahmoud / mahmoud@fme.vutbr.cz
2. Name of PhD programme
Design and Process Engineering
3. Title of PhD thesis
Diagnosis of Pneumatic Cylinders Using Acoustic Emission Methods
4. Principal supervisor
doc. Ing. Pavel Mazal, CSc. / mazal@fme.vutbr.cz
5. Co-supervisor
doc. Ing. Michal Černý, CSc. / michalc@mendelu.cz
6. Reviewer
Dipl. Ing. Ireneusz Baran, Ph.D. / ireneusz.baran@udt.gov.pl
Urząd Dozoru Technicznego, Oddział UDT w Krakowie, Kraków
7. Overview of the scope of PhD thesis¹
Excellent
The dissertation is of a theoretical and mainly experimental nature and consists of 74 pages. The main part of the work, including literature and own author publications, are on 66 pages. The remaining pages are "List of symbols and abbreviations", "List of figures and tables", as well as an Appendix with "The code of the MATLAB program". Summing up this point of the review, I find that the adopted layout and the way of organizing the content is logical and clear. The editorial page of the work does not raise any serious reservations, and the selection of the literature items is correct and sufficient. The reviewed doctoral dissertation contains all relevant and necessary elements.
8. Significance of the topic and clarity of problem statement
Very good
The subject of the dissertation undertaken by the doctoral student and the goals formulated in it are actual and important from a scientific and practical point of view. The main goal is to investigate the possibilities of implementing AE system for pneumatic cylinder leakages detection. The reviewed doctoral dissertation is in line of the current research trends (monitoring and in-service testing) in the field of AE. For the positive

¹ Overview of the scope of PhD thesis is a short description of objectives of PhD thesis's research and summary of main findings and scientific achievements.

feature of the dissertation should recognize the goal set by the author to be solved, mainly on the experimental, as well theoretical way.

9. Knowledge of existing literature

Very good

The selection of the literature is correct and sufficient. Author made good and correct review, as well analysis and evaluation of ref. literature in field of AE. Positive is, that author made review of works and researches done (presented in literature) in aspect of his job and used this knowledge in own work.

10. Choice of methods and technical soundness

Excellent

The author chose a number of methodologies and types of experiments. He carried out first of all measurements and experiments on samples (pneumatic cylinders), which from a technical point of view were in good technical condition (operational - no failures). Then he logically planned experiments with the simulation of various failures that could occur in the case of pneumatic cylinders. From a technical point of view, the work was done reliably and correctly, as well as it took in to account many aspects of failures and experiment configurations.

11. Quality, originality and significance of the results

Excellent

The author found the possibility and direction of action, aimed at solving the problem presented in the work in an innovative and original way. The proposed in work solutions and methodologies are interesting both in the scientific and practical aspect. I evaluate the quality of this work highly.

12. Quality of attached papers

Very good

Attached publications of author of the dissertation are connected mainly with subject of the dissertation. There are presented it different stages of work in wider range. This is showing that author conducted research successively, analysing obtained results next used it and modifying subsequent experiments.

13. Overall assessment, strengths and weaknesses (based upon the above evaluation categories 8–12)

Very good

The reviewed doctoral thesis of Ing. Houssam Mahmoud solves the original scientific task regarding the diagnostics of pneumatic cylinders using AE methods. I state that the goal set in this doctoral thesis has been achieved. The author proved that he knew the current state of art in the area covered by the subject of work, he showed up planning skills, programming and conducting scientific experiments.

14. Questions and comments

Main doubts, questions and remarks are presented here. In work are not used actual terminology which is defined in standard EN 1330-9:2017-09. There is not anything about standard PN-EN ISO 18081:2016-08,



that described AE leak testing. Why? In work are used many times shorthand, that are sometimes caused unclear sentence and its mean. I recommend to explain some used terms if are using first time in the text of work. In the definition of AE phenomena in chapter 1 in 10 row is used modified text which is correct for work but not general AE field. For example in next sentence "The main factors of the propagation velocity of the elastic stress wave are the wave type, the wave frequency, and the properties of the material" is used shorthand and the sentence is not clear. Chapter 2.1 row 2: I guessed that "envelope" is in mean "shell". Next in 10 row "The received signal is highly amplified and transmitted to the monitor where the number of events, the event rate and changes in the event rate are observed.", again shorthand. As mentioned on the begining I suggested used one time full measurement chain, where described the way since AE wave, through sensor, changed for AE signal, next is amplify in preamp. etc.. In chapter 2.1.2 editorial faults in row 10. In chapter 2.1.3 in row 3, what is mean "inlet pressure" -> difference of pressures or ref. to atmospheric pressure? In row 4 is used term "continuous" but need explanation (eg. EN 1330-9), next sentence inform that two parameters are used to describe leakage. What parameters? In chapter 2.2 editorial in row 1. In chapter 3 since row 8, where is Reynolds number described. I suggest include information that it is depends on fluid and literature giving different ranges. In literature number 9 and 19 are the same. I suggest included in literature EN 1330-9.

15. Conclusion

PhD thesis is an independent scientific work that presents a novel solution to a significant problem in the research area and demonstrates the candidate's ability to conduct independent research.

YES

16. Date and signature

Date: 1.07.2019

Please note

- A. Evaluate categories 7 to 13 very good, excellent. The quality of the research in your field is 3% of the research in your field.
- B. E-mail the completed form to

Review of Doctoral Thesis

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6. Reviewer
Dr. Serge Dos Santos / serge.dossantos@insa-cvl.fr
INSA Centre Val de Loire
7. Overview of the scope of PhD thesis¹
Good
The scope of the thesis is presented in a good way. The thesis intends to progress beyond the state of the art by developing suitable techniques and technology solutions for investigating the possibilities of implementing AE system for pneumatic cylinder leakages detection. The concept of the development of innovative techniques and models for use in the AE community is very positive and has the potential to improve leakage detection in pneumatic cylinders.
8. Significance of the topic and clarity of problem statement
Satisfactory
Significance of the topic and clarity of problem statement are presented in a satisfactory way.
9. Knowledge of existing literature
Satisfactory

¹ Overview of the scope of PhD thesis is a short description of objectives of PhD thesis's research and summary of main findings and scientific achievements.



Existing literature has been taken into account in a satisfactory way.

10. Choice of methods and technical soundness

Very good

Choice of methods and technical soundness have been oriented in a very good way. Signal processing methods used were relevant and produced results perfectly adapted to pneumatic cylinder leakages detection. The choice of methods addresses crucial research question and knowledge gap, and has a significant impact for testing leakage. The technical ideas are original and innovative, competitive and cutting-edge nationally. The proposed solution is scientifically motivated, the hypotheses and research objectives are very well addressed.

11. Quality, originality and significance of the results

Excellent

Quality, originality and significance of results are excellent

12. Quality of attached papers

Good

Attached papers quality is good since they have been published in several conference proceedings (13) (5 international and 8 national) where Mr MAHMOUD is the first author for 8 conference proceedings. Results of the PhD thesis have been published in one (1) impacted journal where Mr MAHMOUD is the first author. Two other papers are under review.

13. Overall assessment, strengths and weaknesses (based upon the above evaluation categories 8–12)

Very good

Overall assessment, strength and weakness of the Thesis is very good.

14. Questions and comments

15. Conclusion

PhD thesis is an independent scientific work that presents a novel solution to a significant problem in the research area and demonstrates the candidate's ability to conduct independent research.

YES

16. Date and signature



INSTITUTE OF MACHINE
AND INDUSTRIAL DESIGN



Faculty of Mechanical Engineering
Brno University of Technology

30/06/2019

Please note

- A. Evaluate categories 7 to 13 using the following scale: unacceptable, acceptable, satisfactory, good, very good, excellent. The qualification of 'excellent' should only be given for a PhD Thesis in the top 3% of the research in your field of expertise.
- B. E-mail the completed form to: Klara.Javorcekova@vut.cz

Principal supervisor's final report on the PhD study

1. PhD candidate
Ing. Mahmoud Houssam / mahmoud@fme.vutbr.cz
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3. Title of PhD thesis
Diagnosis of pneumatic cylinders using acoustic emission methods
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5. Co-supervisor
Doc. Ing. Michal Černý, CSc. / michal.cerny.utad@mendelu.cz
6. Stays at other institutions (min. 7 days)
Dakel Praha / Czech Republic / 06/06/2016 / 17/06/2016 (application of software DaeShow, DaeMon, IPL...)
7. Teaching activities
3-CD-A and 3-CD (CAD), 4 KC-A and 4KC (Design and CAD), ZKP (Team project) / 6 hours per week, 26 weeks, 3 years (2015, 2016 and 2017) – app. 470 hours
8. List of main publications
Total issued 20 publications (magazines, conferences, technical reports, methodology, functional sample) MAHMOUD, H.; VLAŠIČ, F.; MAZAL, P.; JÁNA, M. Leakage Analysis of Pneumatic Cylinders Using Acoustic Emission. <i>INSIGHT</i> , 2017, vol. 59, no. 9, p. 500-505. ISSN: 1354-2575. Impact 0,754. MAHMOUD, H.; VLAŠIČ, F.; MAZAL, P. Application of Acoustic Emission Method to Diagnose Damage in Pneumatic Cylinders. In <i>First World Congress on Condition Monitoring</i> . 1st. UK, Northampton: BINDT, 2017. p. 858-868. ISBN: 9781510844759. MAHMOUD, H.; VLAŠIČ, F.; MAZAL, P.; NOHÁL, L.; KRATOCHVÍLOVÁ, V. Analysis of pneumatic cylinder damage by acoustic emission method. In <i>Defektoskopie 2017 (NDE for Safety)</i> . první. Brno: VUT v Brně ve spolupráci s ČNDT, 2017. p. 151-161. ISBN: 978-80-214-5554-2. MAZAL, P.; VLAŠIČ, F.; MAHMOUD, H.; JANA, M. The Use of Acoustic Emission Method for Diagnosis of Damage of Pneumatic Cylinders. In <i>19th WCNDT 2016 - World Conference on NDT</i> . Munchen, Germany: German Society for NDT, 2016. p. 1-10. ISBN: 978-3-940283-78-8.



MAZAL, P.; MAHMOUD, H.; VLAŠIČ, F. Condition monitoring of pneumatic cylinders by acoustic emission. In *Application of contemporary non-destructive testing in engineering*. Ljubljana, Slovenija: University of Ljubljana, 2017. p. 231-238. ISBN: 978-961-93537-3-8.

MAZAL, P.; VLAŠIČ, F.; MAHMOUD, H.; NOHÁL, L.: VUT AE pneutest 2017; Stanice pro zkoušky pneumatických válců VUT UK 1. Vysoké učení technické v Brně, Fakulta strojního inženýrství, budova A3/111, Technická 2896/2, 61669 Brno. URL: <http://www.uk.fme.vutbr.cz/projekty/seznam/>. (funkční vzorek)

MAZAL, P.; VLAŠIČ, F.; MAHMOUD, H.; BUKÁČEK, V.: Testy pneuválců akustickou emisí; Hodnocení provozního stavu přímočarých pneumatik pomocí metody akustické emise. Vysoké učení technické v Brně, Fakulta strojního inženýrství, Ústav konstruování, Technická 2, Brno Poličské strojírny a.s., Bořiny 1145, 57201 Polička. (metodika certifikovaná uplatněná)

RICHTER, V.; MAHMOUD, H.; MAZAL, P.; SKŘIVÁNKOVÁ, V. *The Parameters of Acoustic Emission Signal Proposed to Identification of Damaged and Undamaged Cylinders*. European Conference on Acoustic Emission (EWGAE) 2018. Senlis, France: CETIM, 2018. p. 1-13.

The other two publications are actually accepted for publication in impacted journals.

9. Assessment of the supervision process

Very good

In accordance with the study plan the student passed all required exams in specialized subjects and English by the end of June 2016. The state doctoral examination successfully passed in June 2017. Specialization doctoral studies were concerned to the development of diagnostics of pneumatic cylinders using modern methods of non-destructive testing.

10. Assessment of the candidate's ability to work independently

Very good

The basic aim was to find suitable characteristics and then develop procedures for monitoring of these cylinders in production and also for their operation, which has so far been realized only to a very limited extent. To solve the problem, a series of experimental measurements of real cylinders with selected types of defects was carried out in order to optimize the measurement and subsequent data processing. The result of the dissertation thesis is verification of measurement repeatability, design of evaluated parameters of AE signals, determination of values of new coefficients and creation of basic measurement methodology. These results have already been successfully verified in the production practice of Poličské strojírny a.s.. Ph.D. student solved independently all tasks related to the topic of the dissertation work, he accomplished his doctoral degree assignments with a high level of commitment. Ing. Houssam Mahmoud has demonstrated the ability to independently solve complex research tasks.

11. Assessment of the contribution that the research makes to knowledge in the field

Very good

The results are beneficial for the further development of the field and can be used immediately to significantly improve the manufacturing and operational diagnostics of pneumatic cylinders. The work can



be considered the basis of a new application of the acoustic emission method. The special diagnostic devices are now being developed based on the dissertation results.

12. Other comments

Ing. Houssam Mahmoud started his doctoral studies in the specialization D-KPI Design and Process Engineering at the Institute of Mechanical and Industrial Design at FME BUT in 2014. His original topic was focused on the spot welding diagnostics by acoustic emission (AE). Given the currently investigated projects were the subject immediately after the onset of Mr. Houssam Mahmoud and with the consent of the school management, changed the actual topic. During his PhD studies he worked on several projects of TA CR and MIT CR, which were focused on application of acoustic emission method.

13. Conclusion

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YES

14. Date and signature

03/07/2019

Pavel Mazal

Please note

- A. Evaluate categories 9 to 11 using the following criteria: *very good, excellent.*
- B. In each category 9 to 11 explain reasons for evaluation using between 100-200 words.
- C. E-mail the completed form to: Klara.Javorcekova@vut.cz