



**AUN/SEED-Net**



# 8<sup>th</sup> **AUN/SEED-Net** REGIONAL CONFERENCE ON ELECTRICAL AND ELECTRONICS ENGINEERING

Envision, Enable, and Empower  
Smarter and Resilient Societies

*co-located with*

# 11<sup>th</sup> **ERDT Conference** on Semiconductor and Electronics, Information and Communications Technology and Energy

**16-17 November 2015**  
**Metro Manila, Philippines**



**Proceedings of the 8<sup>th</sup> AUN/SEED-Net RCEEE 2015 and 11<sup>th</sup> ERDT Conference  
on Semiconductor and Electronics, Information and Communications Technology, and Energy**

Editors:

Dr. Joel Joseph S. Marciano Jr.

Dr. Jhoanna Rhodette I. Pedrasa

Dr. Rhandley D. Cajote

© Copyright 2015 by the Electrical and Electronics Engineering Institute, College of Engineering, University of the Philippines Diliman, Engineering Research and Development for Technology, and ASEAN University Network/Southeast Asia Engineering Education Development Network (AUN/SEED-Net).

All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form without the consent of the editors of the Proceedings of the 8<sup>th</sup> AUN/SEED-Net RCEEE 2015 and 11<sup>th</sup> ERDT Conference on Semiconductor and Electronics, Information and Communications Technology, and Energy.

ISBN: 978-616-406-075-3

Published by: ASEAN University Network / Southeast Asia Engineering Education Development Network  
(AUN/SEED-Net) JICA Project  
Faculty of Engineering, Bldg. 2  
Chulalongkorn University, Bangkok  
Thailand 10330

Printed in the Philippines by: ERZALAN PRINTING PRESS  
45 Cotabato Street, Luzviminda Village, Batasan Hills, Quezon City, Philippines

# **8<sup>th</sup> AUN/SEED-Net Regional Conference on Electrical and Electronics Engineering 2015**

co-located with

## **11<sup>th</sup> ERDT Conference on Semiconductor and Electronics, Information and Communications Technology, and Energy**

# Envision, Enable and Empower Smarter and Resilient Societies

Published by: ASEAN University Network / Southeast Asia Engineering Education  
Development Network (AUN/SEED-Net) in partnership with Engineering Research and  
Development for Technology (ERDT) and University of the Philippines Diliman.

© Copyright 2015

No part of this publication may be reproduced without the consent of the editors of the  
Proceedings of the 8<sup>th</sup> AUN/SEED-Net Regional Conference on Electrical and Electronics  
Engineering 2015 and 11<sup>th</sup> ERDT Conference on Semiconductor and Electronics, Information  
and Communications Technology, and Energy.

ISBN: 978-616-406-075-3

## PORTABLE A-SCAN MEASURING UNIT USING 3 AXIS ULTRASONIC TRANSDUCER FOR COMPOSITE LAMINATE MATERIAL APPLICATION

Elmi Abu Bakar<sup>1\*</sup>, M. N. Mohamed<sup>2</sup>, M. F. Mahmud<sup>2,3</sup>, and A.R. Ramzi<sup>2</sup>

<sup>1</sup>School of Aerospace Engineering, Universiti Sains Malaysia,  
Nibong Tebal, Pulau Pinang, MALAYSIA

<sup>2</sup>School of Mechanical Engineering, Universiti Sains Malaysia,  
Nibong Tebal, Pulau Pinang, MALAYSIA

<sup>3</sup>Faculty of Mechanical Engineering and Manufacturing, Universiti Tun Hussein Onn Malaysia,  
Parit Raja, Batu Pahat, Johor, MALAYSIA

\*E-mail: meelmi@usm.my

### ABSTRACT

Ultrasonic Non-Destructive Test (NDT) has been widely applied in many industrial application as non-invasive techniques that use to determine the integrity of material, component or structure and without damage the sample. However, the use of ultrasonic pulse-echo scanning technique for composite laminates are dominated by huge company as the cost are high. Therefore, this technique has not yet to reach the desired maturity level for small research and development laboratory scale inspection purpose. Our work is purposely to enhance current problem of an Ultrasonic A-scan prototype with appropriate scanning envelop size, affordable cost with reliability of detect detection result. The mechanism of this machine is achieved by using 3 units of NEMA 17 bipolar stepper motors for the movement of every axis. Arduino microcontroller with help from GUI developed by Visual Studio is used to control the linear motions. The technique using a pulse receiver and UT Instrument software is used to acquire A-scan signal form 2.25MHz transducer before further analyzed by MATLAB. The signal-to-noise ratio (SNR) of the transducer used before and after filter is 29.64 percent and increase to 32.43 percent. The resolution of transducer used is 1mm. Our scanning speed of this prototype is up to 8mm/s while the scanning envelope size is (400mm x 200 x 100mm). As compared with current products, this prototype is more practical for research and education purpose where some features like type of sensor and scanning path design may changeable due to experimental needs.

**Keywords:** NDT, Composites Laminates, Ultrasonic A-Scan, Arduino Micro Controller, Scanning Path Design.

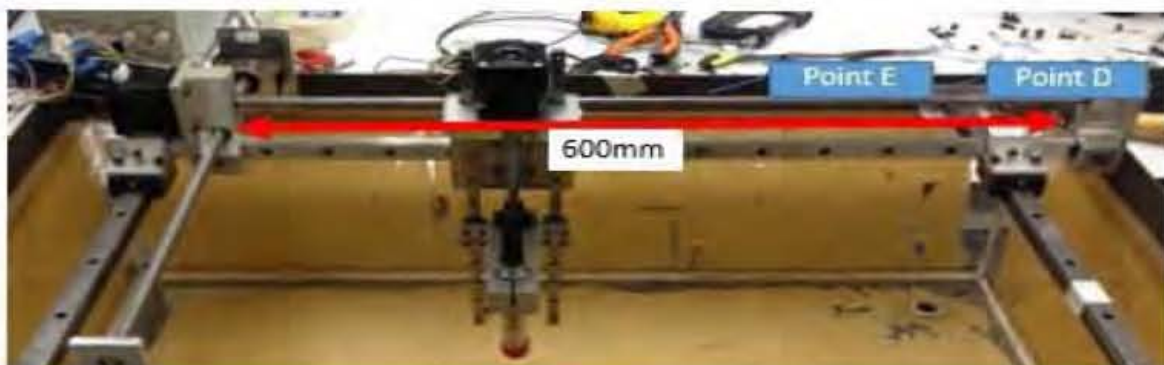


Figure 1. Example graph for the extended abstract.

Table 1. Properties of Y- Axis

Motors	Weight(N)	Length(m)	Diameter(m)	Yield Strength (N/m <sup>2</sup> )
Y-Axis	9.04	0.60	0.008	172

## Acknowledgment

The authors would like to express appreciation for the support of the sponsors [Project Number = ERGS 203/PAERO/6730118 and FRGS 203/PMEKANIK/6071296] under Ministry of Education Malaysia (MOE). Also to express appreciation to Universiti Sains Malaysia for Innovation Seed Grant under *Dana Inovasi* 1001/PAERO/AUP100236.

## References

- A. El Kouche and H. S. Hassanein, "Ultrasonic non-destructive testing (NDT) using wireless sensor networks," *Procedia Comput. Sci.*, vol. 10, pp. 136–143, 2012.
- P. Cawley and R. D. Adams, "Defect types and non-destructive testing techniques for composites and bonded joints," *Mater. Sci. Technol.*, vol. 5, no. 4, pp. 413–425, 1989.
- I. G. Scott and C. M. Scala, "A review of non-destructive testing of composite materials," *NDT Int.*, vol. 15, no. April, pp. 75–86, 1982.
- M. F. Mahmud, M. Z. M. Pauzi, and E. A. Bakar, "Flatbed Scanner Image and Single Ultrasonic Defect Detection," no. November, pp. 26–27, 2013.
- S. R. Doctor, T. E. Hall, and L. D. Reid, "SAFT —the evolution of a signal processing technology for ultrasonic testing," *NDT Int.*, vol. 19, no. 3, pp. 163–167, 1986.
- P. Gaudenzi, M. Bernabei, E. Dati, G. De Angelis, M. Marrone, and L. Lampani, "On the evaluation of impact damage on composite materials by comparing different NDI techniques," *Compos. Struct.*, vol. 118, pp. 257–266, 2014.
- B. Djordjevic, "Nondestructive test technology for the composites," ... *Slov. Soc. non-destructive Test.*, pp. 259–265, 2009.
- B. Ren and C. J. Lissenden, "Ultrasonic guided wave inspection of adhesive bonds between composite laminates," *Int. J. Adhes. Adhes.*, vol. 45, pp. 59–68, 2013.