21st International Conference on Condition Monitoring and Asset Management – CM 2025
Edinburgh, UK, September 2025
DOI: 10.1784/cm2025.5e3

Wave Velocity Analysis and Repeatability of Artificial Acoustic Emission in Homogeneous Materials: Steel and Aluminium plates

Zahra Faridi, Isidro Durazo Cardenas, David Ayre
Cranfield University
Cranfield, Bedfordshire, MK43 0AL, United Kingdom
Tel: +44 1234 758468
Zahra.Faridi@cranfield.ac.uk

Abstract

In this study, wave velocity calculations and the repeatability of the Pencil Lead Break (PLB) test were examined through two use-cases involving homogeneous materials: a 5 mm aluminium plate and a 2 mm steel plate. The PLB test is a widely used and straightforward method for generating artificial acoustic emissions. Ensuring its repeatability is essential for reliable signal processing in acoustic emission (AE)-based analysis. PLB tests were repeated under controlled conditions, and the resulting AE waveforms were analysed using Fast Fourier Transform (FFT) and Continuous Wavelet Transform (CWT). Time-of-arrival (TOA) values were extracted to calculate wave velocities using known distances between the source and sensors. The measured velocities—approximately 5100 m/s for aluminium and 5700 m/s for steel—were consistent with expected Lamb wave mode behaviour. The research emphasises the importance of applying consistent PLB force to produce clear waveform characteristics and valid TOA-based velocity estimates. These findings support the validity of TOA-based wave velocity measurement methods for thin homogeneous plates and establish a foundation for extending similar methodologies to more complex materials and acoustic emission scenarios.

1. Introduction

Acoustic Emission (AE) testing inherently deals with transient elastic waves to identify and locate damage. In thin plates, where Lamb waves dominate, precise wave velocity estimation is fundamental to ensuring the accuracy of AE-based structural diagnostics. Localised energy release produces these guided waves, which include mode-specific information crucial for material assessment and source localisation [1]. Accurate wave velocity estimation is an essential step in AE-based source localisation. In plate-like structures, dispersive guided waves, primarily Lamb waves, propagate with mode-dependent velocities[2]. To extract meaningful velocity information, signal processing methods—particularly time-of-arrival (TOA) analysis and time-frequency methods such as the Continuous Wavelet Transform (CWT)—are often necessary [3], [4]. Some studies have demonstrated that using mode-specific features from Lamb waves, such as the A_0 and S_0 modes, enables more precise group and phase velocity measurements, even under noise-prone or dispersive conditions [5], [6], [7].

Among various AE testing methods, the PLB test is a widely used method for generating artificial acoustic emissions due to its simplicity, reproducibility, and ability to simulate transient signals that closely resemble real damage sources such as crack formation or corrosion-induced emissions [8], [9]. Waveform quality can be greatly impacted by variations in lead length, break force, and angle, which can therefore have an effect on the

Published by BINDT. This is the Author Accepted Manuscript issued with: Creative Commons Attribution License (CC:BY 4.0).
The final published version (version of record) is available online at DOI:10.1784/cm2025.5e3. Please refer to any applicable publisher terms of use.

accuracy of TOA extraction and velocity calculations. The significance of standardising PLB execution for experimental reproducibility is highlighted by some studies that have reported significant dispersion in wave velocity measurements using PLB sources [10].
This study focuses on two objectives: (1) estimating wave velocities in homogeneous thin aluminium and steel plates using a TOA-based method, and (2) discussing the influence of PLB consistency on AE signal quality. Although a second method for wave velocity calculation—based on CWT and Lamb mode separation—is discussed conceptually, the present study focuses on TOA-based velocity measurements. The results establish baseline velocities in homogeneous plates and highlight the role of PLB consistency in ensuring reliable AE-based analysis.
This paper is organised as follows: In the next section, the experimental procedures, including PLB testing on aluminium and steel plates, as well as the signal analysis and wave velocity calculation methods, will be outlined. The results are presented and discussed in Section 3, and the key conclusions are reported in Section 4.

2. Methodology

2.1 Pencil Lead Break (PLB) Test

Pencil Lead Break (PLB) is a widely used technique for simulating acoustic emission (AE) signals within a material. The test involves breaking a mechanical pencil lead on the test surface to generate reproducible acoustic signals. The test parameters of the PLB test herein follow ASTM E976-15 standard, as given in **Table *1***

Table 1. Key characteristics of PLB testing (ASTM E976-15)[11]

Characteristics	Standard Value
Pencil lead type	0.3 mm, 2H lead
Lead length before break	2.5 ± 0.5 mm
Break angle	30°
The Nielsen Shoe	Polytetrafluoroethylene (PTFE) guide ring

2.2 PLB in Al plate

The PLB tests were conducted on an aluminium plate with dimensions 600 × 600 mm² and a thickness of 5 mm. The Al plate has a Young's modulus of 71 GPa, a density of 2700 kg/m³, and a Poisson's ratio of 0.33. The experimental setup involved 10 acoustic emission (AE) sensor configurations, using a total of 4 AE sensors arranged in different layouts to evaluate signal consistency and wave propagation characteristics. Each PLB test was repeated at least five times to ensure both accuracy—consistency with previously observed signal characteristics—and repeatability, meaning stable results across multiple trials. Repeatability is crucial because it demonstrates that the test can reliably produce the same results under the same conditions, thereby confirming the stability and reliability of the measurements [11], [12]. Figure 1 and Table ***1*** 2 show the specimen and the sensors configurations and locations accordingly.

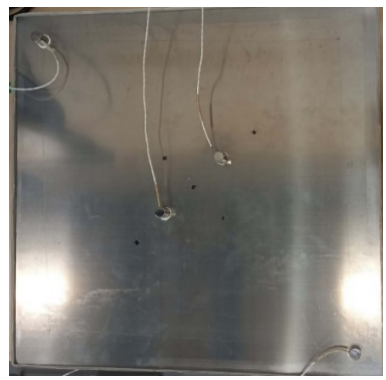
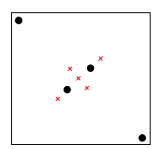
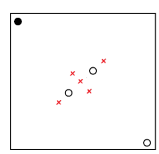
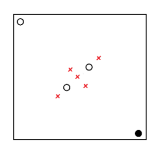
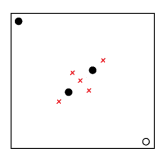
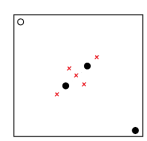
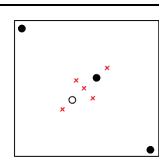
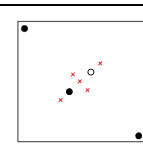
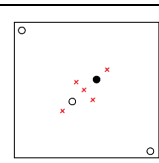
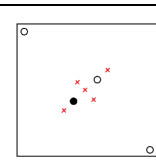
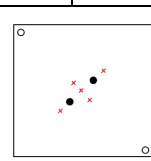


Figure 1. Al plate with four-sensor configuration

Table 2. Schematic overview of the sensor arrangement (10 AE sensors) and PLB source locations. Red points indicate PLB locations; filled circles represent active sensors during tests; hollow circles indicate inactive ones

Test Group Number	Sensor Setup & PLB Locations	
1		
2,3		
4,5		
6,7		
8,9		
10		

For each sensor arrangement, Pencil Lead Break (PLB) tests were conducted at five locations to ensure comprehensive data collection. The tests were divided into two categories: Group A (without edge treatment) and Group B (with vacuum bagging sealant tape applied along the plate edges). A total of 100 experiments were performed—50 per

group.The reason for the application of damping tape on Group B was specifically aimed at minimizing edge reflections, which can interfere with the clarity of AE signals. These reflections could distort the waveforms, making it difficult to obtain clean signals. With the use of sealant tape, it was anticipated that edge reflections would be reduced, improving signal clarity. Group B results, utilising this tape, were expected to show more consistent rise and count values, improved signal-to-noise ratios, and reduced waveform distortion, facilitating more precise measurements.

2.3 PLB in steel plate

The PLB tests were performed on a mild steel plate with dimensions of 650 × 500 mm² and a thickness of 2 mm. The steel plate has a Young's modulus of 215 GPa, a density of 8050 kg/m³, and a Poisson's ratio of 0.31. Figure 2 and Figure 3 provide a visual representation of the steel plate setup and PLB locations. Figure 2 depicts the experimental setup for the steel plate, while Figure 3 illustrates the PLB positions along the diagonal and vertical directions. The distances from Sensor 1 (S1) to the PLB points along both directions are 15 cm, 25 cm, 26 cm, 30 cm, 40 cm, 45 cm, and 55 cm, corresponding to PLB locations 1, 2, 7, 3, 4, 5, and 6, respectively.

The PLB test positions were distributed along two directions: vertical and diagonal relative to the sensor. Each direction included seven source-to-sensor distances ranging from 15 cm to 55 cm. This configuration enabled the evaluation of wave propagation effects over varying distances.

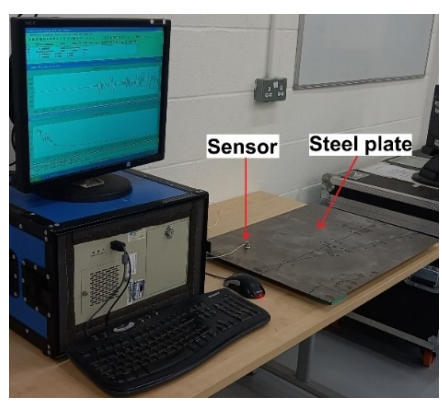


Figure 2. Experimental setup for PLB testing on steel plate with AE system and sensor placement

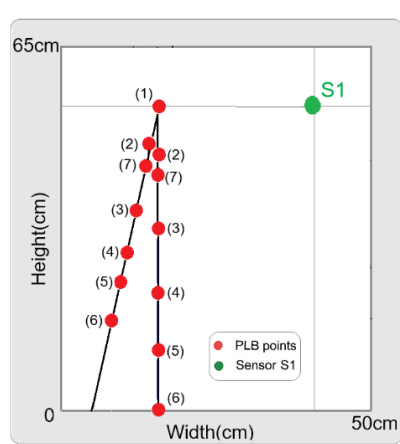


Figure 3. PLB locations on the steel plate. Red dots indicate test positions distributed along diagonal and vertical lines relative to Sensor S1 (green)

2.4 Acoustic Signal Analysis

2.4.1 ***Time-Domain Waveform Analysis***

PLB tests typically generate burst-type signals, as these transient waveforms are well-suited for evaluating acoustic emission (AE) characteristics in materials. A burst signal in Acoustic Emission (AE) refers to a short, transient emission of ultrasonic energy generated by discrete events such as crack growth or sudden stress releases [12]. The Acoustic Emission (AE) signals recorded during the Pencil Lead Break (PLB) tests on aluminium and steel plates were examined, and it was observed that they consistently exhibited these transient waveforms.

By contrast, continuous AE signals, typically produced by sustained processes such as plastic deformation or grinding, appear as prolonged, overlapping waveforms and often require RMS or frequency-domain analysis for interpretation. While not observed in this study, understanding the distinction reinforces the suitability of burst-type signals generated by PLB for high-precision AE characterisation [13].

2.4.2 ***Time-Frequency (Wavelet) Analysis***

The time-frequency properties of AE signals were investigated using the Continuous Wavelet Transform (CWT), which was implemented using MATLAB R2022a with the Morlet Wavelet. This method is effective for evaluating repeatability because it captures signal variation arising from inconsistencies in PLB force and material properties. The typical frequency range for AE signals generated by PLB tests extends from tens of kHz to several hundred kHz (approximately 20 kHz to 500 kHz) [16].

2.5 Wave Velocity Calculations

In this study, wave velocity in aluminium and steel plates are primarily determined in time domain using the Time-of-Arrival (TOA) Method. This method is a time domain method for wave velocity calculation.

1) Time Domain Method

Time-of-Arrival (TOA) Method is based on measuring the time difference between the arrivals of acoustic waves at different sensor locations. Given a known distance between the source and the sensors, the wave velocity (V) can be calculated using the fundamental relationship:

$$V = \frac{Distance}{TOA\ difference} \tag{1}$$

The distance parameter in this study is considered in three ways: (a) the distance difference between PLB and sensor for 2 sensor locations[13], (b) the direct distance between the sensor and the PLB location, and (c) the distance between two sensors. The TOA values are obtained from the waveforms recorded using AEWin software. This method has been frequently used in AE literature to estimate wave speeds in various materials[14], [15]. Although TOA values are commonly associated with p-waves—the fastest type of elastic waves generated by sudden energy release within a material, also known as primary waves—they can also be applied to other wave types in various AE applications. For example, in bulk wave studies[16], TOA values can be used for Lamb waves, provided the wave mode is correctly identified. In this study, TOA is specifically analysed for Lamb

waves, which dominate wave propagation in plate-like structures.

It is worth mentioning that frequency methods can give us more comprehensive analyses, as AE signals contain various frequency components, while the Time-of-Arrival (TOA) Method solely works with time domain. For this purpose, a well-known method of wave velocity calculation in frequency domain named the Lamb Wave Mode Separation Method is discussed as an alternative approach for wave velocity measurements. This method is a widely used approach in acoustic emission studies and provides a more comprehensive means of estimating wave propagation speed in plate-like structures [4], [5], [6].

2) Lamb Wave Mode Separation Method

In thin plates, AE signals tend to propagate as Lamb waves, which consist of two fundamental modes: the symmetric (S0) mode and the asymmetric (A0) mode. Each mode exhibits distinct propagation characteristics and can be identified based on its velocity and dominant frequency content. The general wave velocity equation for dispersive media is given by:

$$c = \lambda . \mathrm{f} \tag{2}$$

where c represents wave velocity, λ is wavelength, and f is frequency. In this method, mode identification is instrumental because a single mode can manifest at various frequencies, and different modes can appear at the same frequency.
In this method, to refine the velocity estimation, a trial-and-error approach will be implemented. Given that the PLB locations are known, the estimated distances can be compared to the measured distances, and adjustments to the assumed velocity values can be made accordingly. The distance can be obtained by,

$$D = \frac{t_1 - t_2}{\frac{1}{c_1} - \frac{1}{c_2}} \tag{3}$$

where t_1 and t_2 denote the arrival times of the lower velocity wave mode and higher velocity wave mode at the AE sensor, respectively. c_1 and c_2 represent the velocities of the lower velocity wave mode and higher velocity wave mode, respectively. These four parameters are unknown in the formulation and need to be identified.

To extract the TOA values for different wave modes, the Continuous Wavelet Transform (CWT) is applied to the AE signals obtained from PLB tests [8]. The dominant frequencies are first identified using CWT, and the absolute wavelet transform coefficient graphs for these dominant frequencies are then analysed to determine the TOA values for each mode [17]. These TOA values can also be cross-referenced with the waveform data from the acoustic emission acquisition system to ensure consistency [2], [18].

The corresponding velocities of the S0 and A0 modes are estimated using classical plate wave theory. The theoretical expressions for symmetrical (cs) and asymmetrical (ca) wave velocities in a dispersive medium are given by [19]:

$$c_s = \left[\frac{E}{\rho(1-\upsilon^2)}\right]^{\frac{1}{2}} \tag{4}$$

$$c_a = \left[\frac{E\mathrm{t}^2}{12\rho(1-\upsilon^2)}\right]^{\frac{1}{4}} \omega^{\frac{1}{2}} \tag{5}$$

Where E is the Young's modulus, t is the plate thickness, ρ is density, and ν is Poisson's ratio, and ω is the frequency of the wave (the dominant frequencies obtained by CWT).
Using known material properties, approximate wave velocities for thin plates are calculated [20]. The significant task here is to understand which one of these modes are associated

with the lower-frequency wave mode c_1 in Equation (3) and which one is associated with the higher-frequency wave mode c_2 in Equation (3). A key finding from previous research [19] highlights that in PLB experiments, higher-frequency wave modes tend to arrive earlier than lower-frequency ones. This trend is crucial for accurate mode identification and velocity estimation.

Another approach for determining wave velocities of c_1 and c_2 in Equation (3) is based on dispersion curves, which provide frequency-dependent group velocities for different Lamb wave modes. Instead of relying solely on theoretical calculations, velocity values, c_1 and c_2, can be directly extracted from experimentally validated dispersion relations. As mentioned earlier, known PLB locations allow for comparing estimated and measured distances, which enables adjustments to the assumed velocity values. By iteratively modifying the lower-velocity wave mode c_1, which is correlated to A0 mode, the calculated distances are fine-tuned until they match the actual PLB locations and getting acceptable resolution for the calculated distance $D_T - D_M$. This iterative approach ensures that the estimated wave velocities remain physically meaningful and consistent with experimental observations.

Although the TOA technique is the central method used in this research for the calculation of wave velocity, it is crucial to consider the supplementary information from frequency-based techniques like the Lamb wave method. The TOA approach allows for direct wave speed computation from measured arrival times, while wavelet transform analysis allows for mode identification by correlating dominant frequencies with particular wave modes. Additionally, dispersion curve evaluation provides theoretical validation for the experimentally obtained velocities [2], [14], [18], [20-24].
Wave propagation in thin plates requires a more precise estimate of wave velocity, which can be obtained by combining these approaches. The accuracy and applicability of wave velocity estimations in AE-based studies could be improved by future research investigating the application of these techniques to various materials and conditions.

3. Results and Discussion

This section presents and discusses the results of the experimental tests. For the aluminium plate, 100 test sets were analysed for signal characteristics, with 40 sets used for wave velocity measurements. For the steel plate, 17 test sets were analyzed for signal analysis, with 4 sets used for wave velocity calculations using TOA method.

3.1 Time-Domain Waveform Analysis: Aluminium vs Steel plate

The representative time-domain signals for aluminium and steel (Figures 4 and 5) demonstrate well-defined bursts with distinguishable first arrivals.

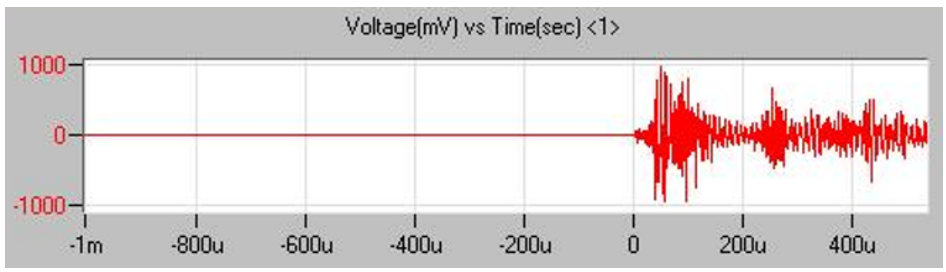


Figure 4. Representative AE waveform from PLB test on aluminium plate showing clear burst and ringing

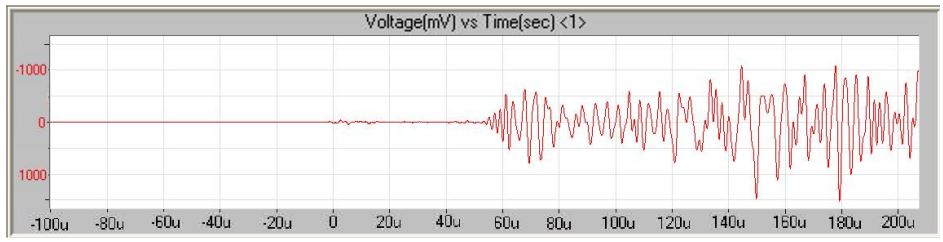


Figure 5. Representative AE waveform from PLB test on steel plate showing clear burst and ringing

Signal quality in the aluminium plate was more susceptible to edge reflections, especially in the absence of damping tape applied around the edges, sometimes leading to waveform distortion and complicating TOA identification. The application of damping tape appeared to improve signal consistency. In steel plate, on the other hand, generated signals without the need for damping that were clearer and more consistent. Aluminium may be more susceptible to boundary effects potentially because of its lower stiffness compared to steel.

3.2 Time-Frequency (Wavelet) Analysis: Aluminium vs Steel plate

The time-frequency properties of AE signals were investigated using the Continuous Wavelet Transform (CWT), which was implemented using MATLAB R2022a with the Morlet Wavelet. For steel and aluminium plates, scalograms (Figures 6 and 7) show how the dominant frequency components change over time. Scalograms show time (x-axis), frequency (y-axis), and the magnitude of Continuous Wavelet Transform (CWT) coefficients (color intensity).

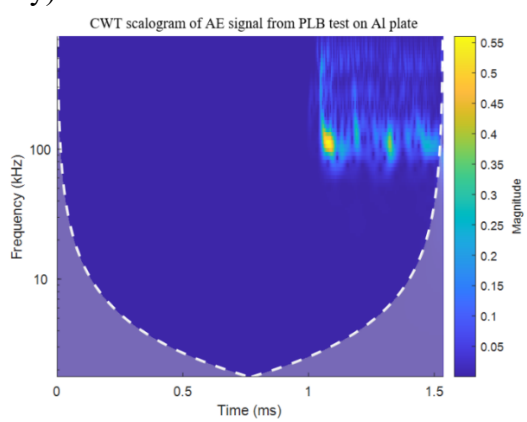


Figure 6. CWT scalogram of AE signal from PLB test on the Al plate, illustrating time-frequency characteristics and spectral evolution

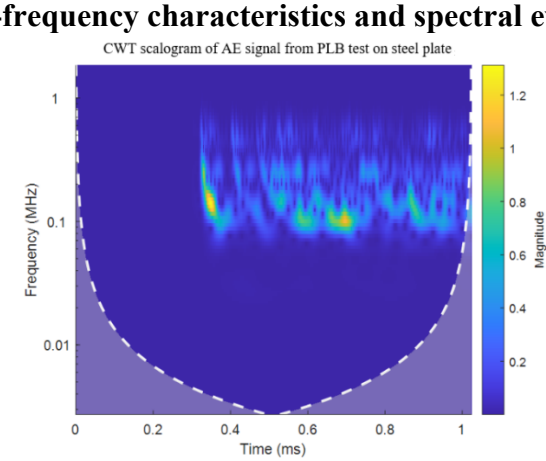


Figure 7. CWT scalogram of AE signal from PLB test on the steel plate, illustrating time-frequency characteristics and spectral evolution

The aluminium plate's consistent acoustic response— most likely due to reduced edge reflections achieved by using damping tape—was evident in the CWT scalogram, which showed a single dominating frequency component at roughly 100 kHz. The steel plate, on the other hand, showed two different dominating frequency bands, roughly 100KHz and 150KHz, most likely as a result of modal interactions between Lamb wave modes and increased material damping compared to aluminium. This discrepancy emphasises how material parameters, namely stiffness, dispersion behaviour, affect the characteristics of AE signals and how crucial it is to take frequency content into account when evaluating source behaviour and test repeatability.

3.3 Aluminium Plate: Velocity Estimation Results

Pencil Lead Break (PLB) tests on the 5 mm-thick aluminium plate demonstrated consistent wave propagation behaviour, as expected for a homogeneous isotropic material. The average wave velocity calculated using the Time-of-Arrival (TOA) method was approximately 5100 m/s, which corresponds to the expected velocity of the fundamental symmetric Lamb wave mode (S_0) in aluminium plates at 90–150 kHz (Figure 8). This range is well-supported by previous studies, which report S_0 mode velocities between 5100–6400 m/s in comparable conditions[2], [23].

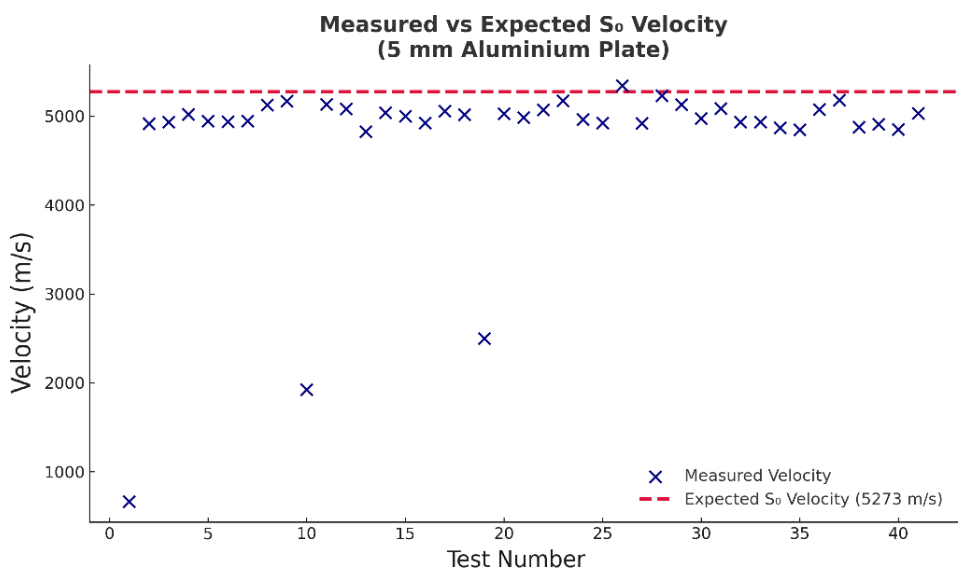


Figure 8. Wave velocity measured in the Al plate using PLB AE signals and TOA method

Some outliers with unusually low velocities were initially observed, primarily due to small TOA differences between sensors placed at similar distances and the fine resolution of time measurements (in microseconds) compared to millimeter-level spatial resolution. These can be removed using defined thresholds on TOA and plausible velocity ranges to ensure data consistency.

Using aluminium properties (E=71 GPa, $\rho = 2700$ kg/m³, $\nu = 0.33$, t=5 mm), the theoretical velocities served to validate experimental findings using Equations 4 and 5. The Continuous Wavelet Transform (CWT) analysis confirmed dominant frequency content between 90 and 150 kHz, which supports the identification of the S_0 mode as the principal propagating wave. For more detail, Table 3 summarises the characteristic parameters of fundamental modes S0 and A0 in the 5 mm aluminium plate, and Figure 9 illustrates the dispersion curves of Lamb modes for the 5 mm thick aluminium plate.

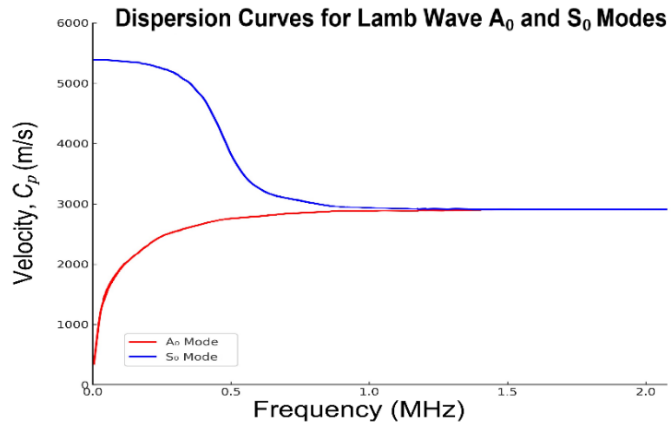


Figure 9. The dispersion curves of Lamb modes for the 5 mm thick aluminium plate[25]

Table 3. The characteristic parameters of fundamental modes S0 in the 5 mm aluminium plate[25]

Freq. (kHz)	S_0 Velocity. (m/s)	Freq. (kHz)	S_0 Velocity. (m/s)
100	5335	140	5273
120	5307	160	5231

3.4 Steel Plate: Velocity Estimation Results

The wave velocity analysis (Figure 10) for the steel plate shows generally higher values compared to the aluminium counterpart, as expected due to the higher stiffness and density of steel. In the case of the 2 mm-thick steel plate, the average wave velocity calculated from the TOA method was 5700 m/s. This value aligns with the expected range for the S_0 Lamb wave mode in thin steel plates, which is typically reported between 5300–6200 m/s [16][19]. While fewer PLB tests were conducted on the steel plate compared to aluminium, the measured wave velocities showed consistent values across the available tests. The early arrival times observed in the raw AE waveforms—combined with dominant CWT frequency content around 100–150 kHz—support the presence of the S_0 mode, which is known to propagate faster and with less dispersion at these frequencies in steel.

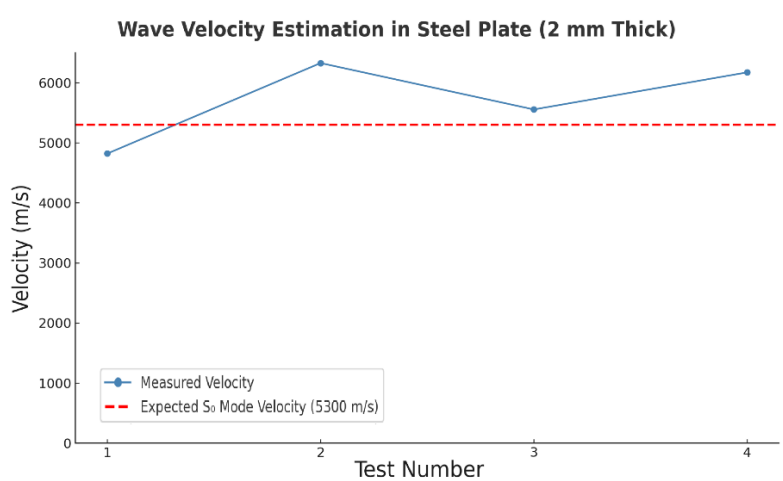


Figure 10. Wave velocity measured in the steel plate using PLB AE signals and TOA method

4. Conclusion

In this study, Time-of-arrival (TOA) data from Pencil Lead Break (PLB) tests were used to measure wave velocity in steel and aluminium plates. The findings were consistent with expected Lamb wave velocities: approximately 5100 m/s and 5700 m/s for the S_0 mode in aluminium and steel, respectively. The analysis showed that PLB consistency, particularly in applied force, directly influenced signal clarity and TOA precision. Trials with inadequate break force resulted in lower amplitude signals and greater TOA uncertainty, whereas consistently executed PLBs produced more stable waveforms suitable for velocity analysis.

Continuous Wavelet Transform (CWT) was applied to verify dominant frequency content and assist in wave interpretation. In both materials, the frequency-time energy distribution observed in the scalograms aligned with expected Lamb wave behaviour—lower-frequency content dominating in aluminium and higher-frequency components arriving earlier in steel. These trends provided support in the velocity estimations obtained through the TOA-based method.

These measurements provide a validated basis for wave propagation analysis in homogeneous materials and can support future steps such as AE source localisation.

Acknowledgements

The authors gratefully acknowledge the support from Cranfield University and the Centre for Life-cycle Engineering and Management, whose resources and guidance were essential for the completion of this research.

References

[1] Z. , Y. L. Su, “Fundamentals and Analysis of Lamb Waves,” in *Identification of Damage Using Lamb Waves*, vol. 48, London. : Springer, Lecture Notes in Applied and Computational Mechanics, 2009.

[2] J. L. Rose, *Ultrasonic guided waves in solid media*. Cambridge university press, 2014.

[3] S. Michael, “Source location in thin plates using cross correlation,” *Calhoun: The NPS Institutional Archive D Space Repository*, 1991, [Online]. Available: https://hdl.handle.net/10945/28552

[4] Z. Su, L. Ye, and Y. Lu, “Guided Lamb waves for identification of damage in composite structures: A review,” *J Sound Vib*, vol. 295, no. 3–5, pp. 753–780, Aug. 2006, doi: 10.1016/j.jsv.2006.01.020.

[5] F. Ciampa and M. Meo, “A new algorithm for acoustic emission localization and flexural group velocity determination in anisotropic structures,” *Compos Part A Appl Sci Manuf*, vol. 41, no. 12, pp. 1777–1786, Dec. 2010, doi: 10.1016/j.compositesa.2010.08.013.

[6] L. Zeng, X. Cao, L. Huang, and Z. Luo, “The measurement of Lamb wave phase velocity using analytic cross-correlation method,” *Mech Syst Signal Process*, vol. 151, Apr. 2021, doi: 10.1016/j.ymssp.2020.107387.

[7] O. Tumšys, “Experimental Method for Simultaneous Determination of the Lamb Wave A0 Modes Group and Phase Velocities,” *Materials*, vol. 15, no. 9, May 2022, doi: 10.3390/ma15092976.

[8] M. A. Hamstad, “On Determination Of Accurate Lamb-mode Group-velocity Arrival Times With Different Types Of Acoustic Emission Sensors,” in *Proceedings of Seventh International Conference on Acoustic Emission*, 2008. [Online]. Available: https://www.ndt.net/?id=14529

[9] M. et al Kaphle, “Identification of acoustic emission wave modes for accurate source location in plate-like structures,” *Struct Control Health Monit*, vol. 19.2, no. 1, pp. 187–198, Jul. 2012, doi: 10.1002/stc.4.

[10] B. Xu, J. Huang, and Y. Jie, “Application of the Lamb Wave Mode of Acoustic Emission for Monitoring Impact Damage in Plate Structures,” *Sensors (Basel)*, vol. 23, no. 20, Oct. 2023, doi: 10.3390/s23208611.

[11] “Guide for Determining the Reproducibility of Acoustic Emission Sensor Response,” Dec. 01, 2015, *ASTM International, West Conshohocken, PA*. doi: 10.1520/E0976-15.

[12] C. U. Grosse, M. Ohtsu, D. G. Aggelis, and T. Shiotani, *Acoustic Emission Testing Basics for Research-Applications in Engineering*, Second Edition. Springer Tracts in Civil Engineering. [Online]. Available: http://www.springer.com/series/15088

[13] S. Sikdar, D. Liu, and A. Kundu, “Acoustic emission data based deep learning approach for classification and detection of damage-sources in a composite panel,” *Compos B Eng*, vol. 228, Jan. 2022, doi: 10.1016/j.compositesb.2021.109450.

[14] T. Kundu, “Acoustic source localization,” Jan. 2014. doi: 10.1016/j.ultras.2013.06.009.

[15] M. R. Gorman, “Plate wave acoustic emission,” *Calhoun: The NPS Institutional Archive D Space Repository*, 1991, [Online]. Available: https://hdl.handle.net/10945/62206

[16] X. Shang, Y. Wang, and R. Miao, “Acoustic emission source location from P-wave arrival time corrected data and virtual field optimization method,” *Mech Syst Signal Process*, vol. 163, Jan. 2022, doi: 10.1016/j.ymssp.2021.108129.

[17] P. Roy, A. K. Datta, and P. Topdar, “A study on the efficacy of modal acoustic emission technique for health monitoring of structures with different geometries,” *Nondestructive Testing and Evaluation*, vol. 39, no. 4, pp. 846–885, 2024, doi: 10.1080/10589759.2023.2231611.

[18] M. G. Baxter, R. Pullin, K. M. Holford, and S. L. Evans, “Delta T source location for acoustic emission,” *Mech Syst Signal Process*, vol. 21, no. 3, pp. 1512–1520, Apr. 2007, doi: 10.1016/j.ymssp.2006.05.003.

[19] A. Mukherjee and A. Banerjee, “Analysis of Acoustic Emission Signal for Crack Detection and Distance Measurement on Steel Structure,” *Acoust Aust*, vol. 49, no. 1, pp. 133–149, Mar. 2021, doi: 10.1007/s40857-020-00208-z.

[20] Karl F. Graff, *Wave Motion in Elastic Solids*. Courier Corporation, 2012. Accessed: Apr. 02, 2025. [Online]. Available: https://books.google.co.uk/books?hl=en&lr=&id=jorRAgAAQBAJ&oi=fnd&pg=PP1&ots=Le3AqB6WRa&sig=DR40W-ZBmV6Emvu_rdcOdqgHcgk&redir_esc=y#v=onepage&q&f=false

[21] D. G. Aggelis and T. Shiotani, “Experimental study of surface wave propagation in strongly heterogeneous media,” *J Acoust Soc Am*, vol. 122, no. 5, pp. EL151–EL157, Nov. 2007, doi: 10.1121/1.2784151.

[22] Y. Suzuki and T. Matsuo, “Initial Arrival Time Identification Utilizing Wavelet Transform and Akaike Information Criterion for Locating Acoustic Emission Source in a Thin Plate,” *Mater Trans*, vol. 64, no. 1, pp. 205–211, 2023, doi: 10.2320/matertrans.MT-I2022003.

[23] A. Raghavan, “Guided-wave Structural Health Monitoring,” 2007.

[24] M. A. Hamstad, M. A. Hamstad, A. O’gallagher, and J. Gary, “A wavelet transform applied to acoustic emission signals: Part 1: Source identification,” *J. Acoustic Emission*, vol. 20, p. 39, 2002, [Online]. Available: https://www.researchgate.net/publication/253109356

[25] C. Han, G. Yang, J. Wang, and X. Guo, “The research on propagation characteristics of acoustic emission signals in stiffened plates based on the multipath propagation model,” *Ultrasonics*, vol. 108, Dec. 2020, doi: 10.1016/j.ultras.2020.106177.



https://dspace.org/

Wave velocity analysis and repeatability of artificial acoustic emission in homogeneous materials: steel and aluminium plates

Faridi, Zahra; Durazo-Cardenas, Isidro; Ayre, David

2025-09-11
British Institute of Non-Destructive Testing (BINDT)
https://doi.org/10.1784/cm2025.5e3
Faridi Z, Durazo-Cardenas I, Ayre D. (2025) Wave velocity analysis and repeatability of artificial acoustic emission in homogeneous materials: steel and aluminium plates. In: Proceedings of the International Conference on Condition Monitoring and Asset Management, 9-11 September 2025, Edinburgh, UK

Downloaded from a DSpace repository. https://dspace.org/