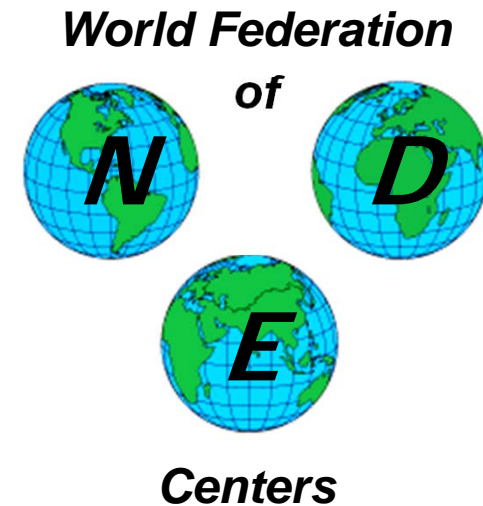


# 2011 ULTRASONIC GUIDED WAVE BENCHMARK



## **Benchmark Overview**

*Experimental tests were performed on a flat plate with an adhesively bonded stringer. The transmission of an  $S_0$  plate wave past the stringer at different angles were studied. The ultrasonic A-scans were recorded and placed in both an Excel file and a MATLAB .mat file format so that comparisons can be made with model predictions.*

*The A-scan data can be accessed from the Center for NDE, Iowa State University ftp site at <ftp.cnde.iastate.edu> . The data is located in the pub directory in a file named 2011 Guided Wave Benchmark. Please contact Prof. Schmerr ([Ischmerr@cnde.iastate.edu](mailto:Ischmerr@cnde.iastate.edu) ) for the username and password to the ftp site.*

*The experimental data for these studies have been obtained by Paul Wilcox from the University of Bristol . For detailed questions on these results or the setup parameters, please contact Paul ( [p.wilcox@bristol.ac.uk](mailto:p.wilcox@bristol.ac.uk) )*

# 2011 Guided Wave Benchmark

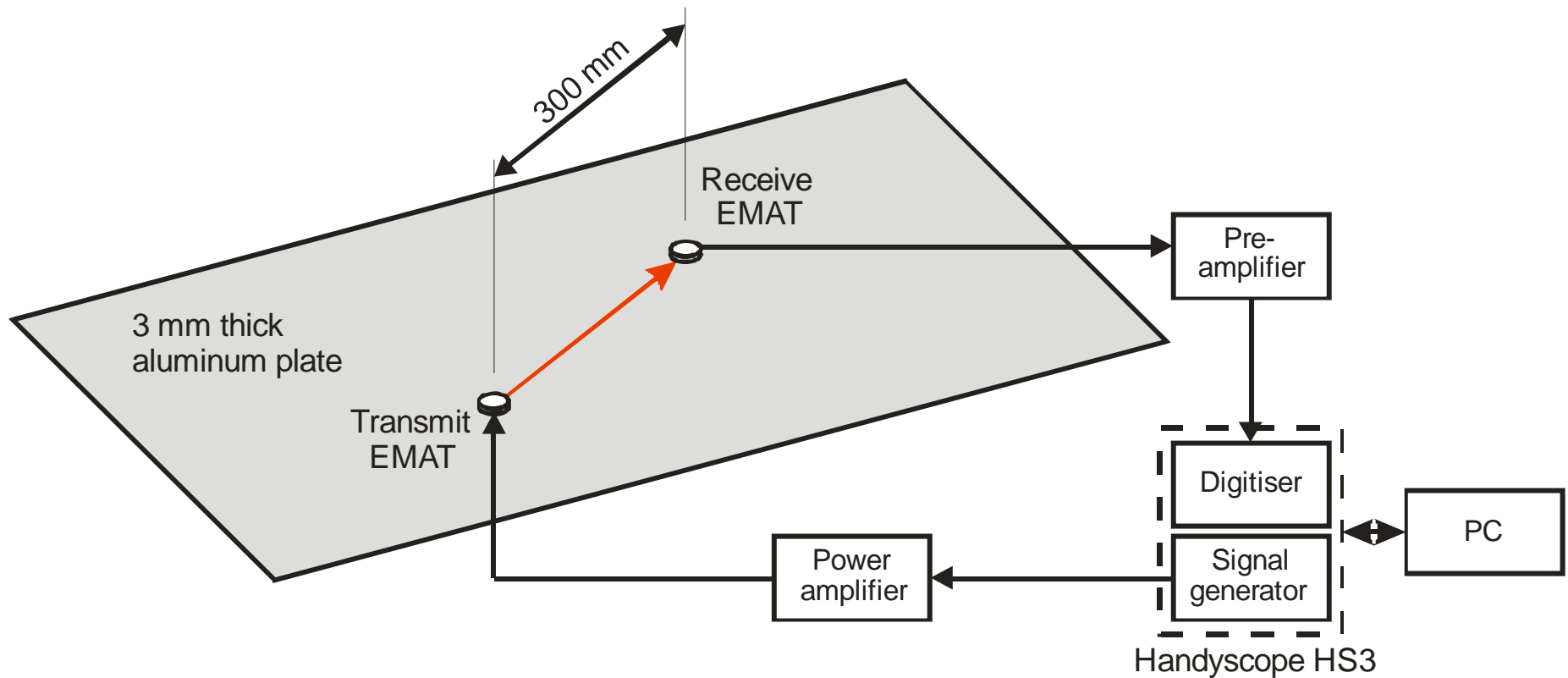
Oblique Incidence Transmission of  $S_0$   
Guided Wave Mode at Stringer

# Outline

- $S_0$  Lamb wave transmission past an adhesively-bonded, square-section stringer
  - 3 mm thick aluminum plate
  - Incident angles from  $0^\circ$  to  $70^\circ$  in  $5^\circ$  increments
  - Transmitted signal: 3-cycle, Hanning-windowed toneburst at 200 kHz center-frequency
  - Pancake coil EMATs used as transmitter and receiver
  - Reference measurement made under same conditions on identical plate without stringer

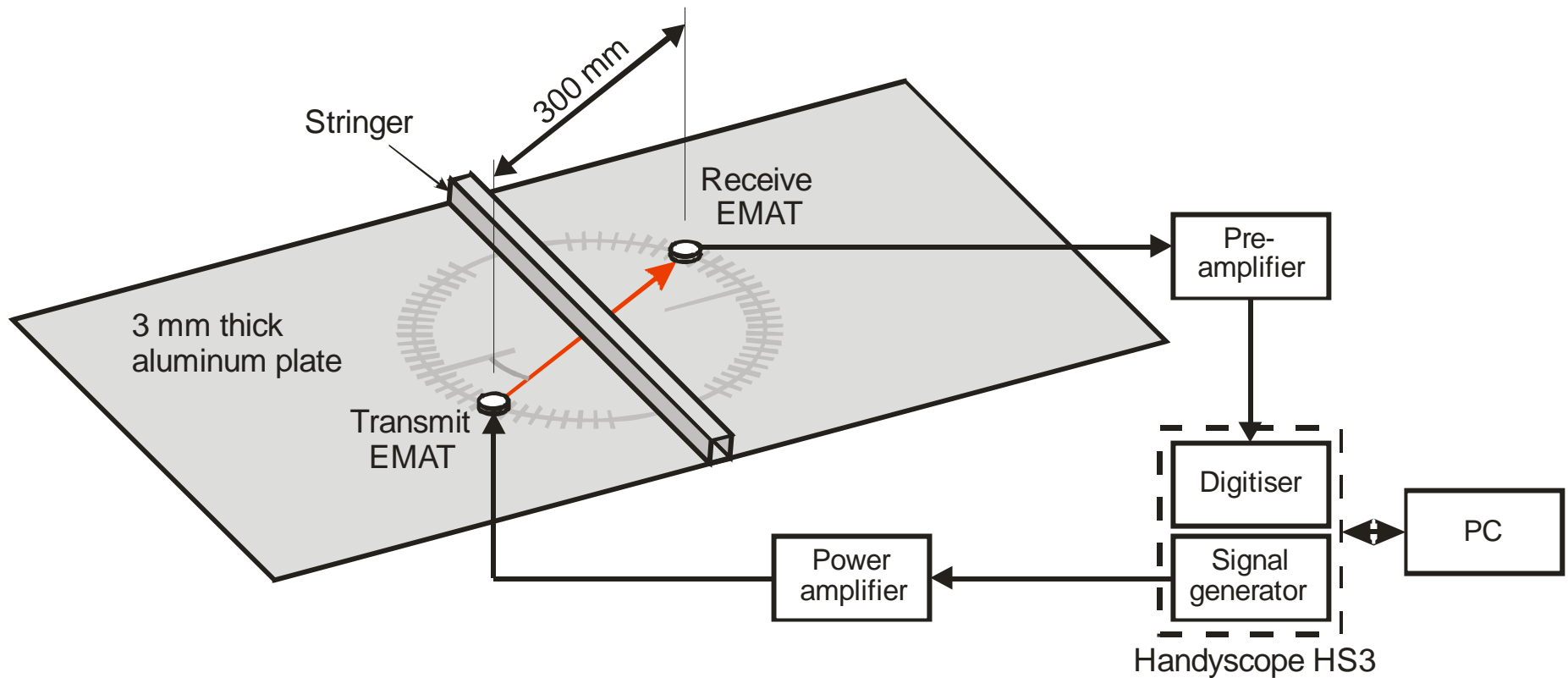
# Experimental configuration

- Reference measurement

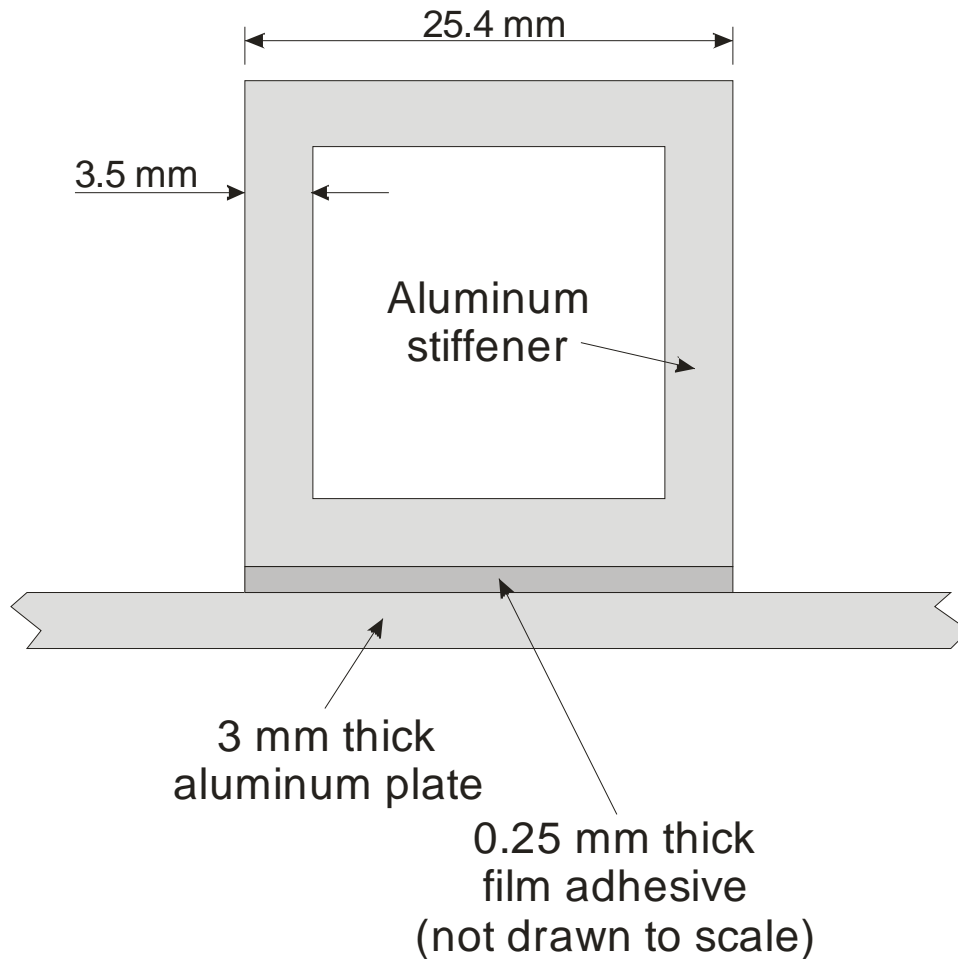


# Experimental configuration

- Transmission measurements

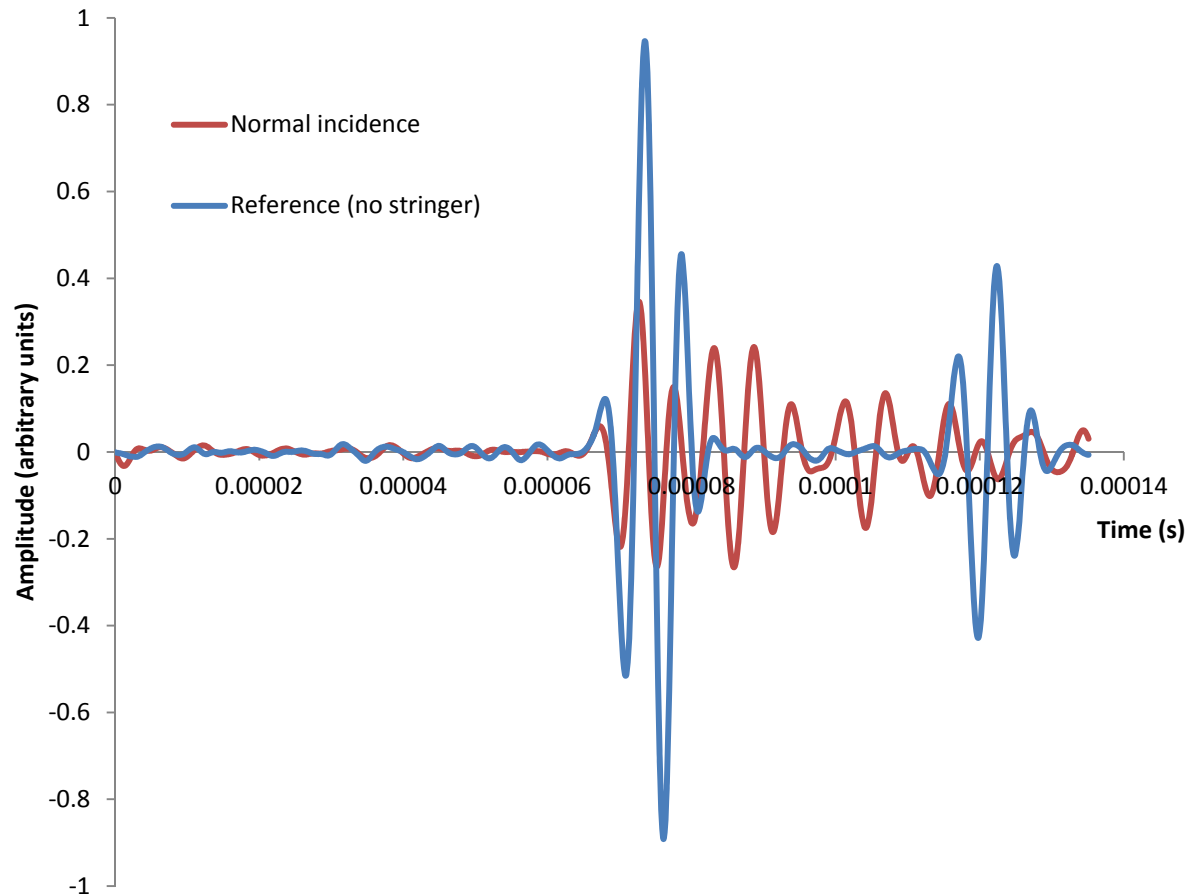


# Geometry and Material Properties



	Aluminum	Adhesive
Young's modulus (GPa)	70	2.64
Poisson's ratio	1/3	1/3
Density (kg m <sup>-3</sup> )	2700	1200

# Example experimental results



- Complete results available in
  - Excel spreadsheet: 2011 guided wave benchmark.xls
  - Matlab: 2011 guided wave benchmark.mat

# References

- Wilcox, P. D., Velichko, A., Drinkwater, B. W., Croxford, A. J. and Todd, M. D., "Scattering of Plane Guided Waves Obliquely Incident on a Straight Feature with Uniform Cross-section", *J. Acoust. Soc. Am.*, **128**(5), pp. 2715–2725, 2010
  - Development of semi-analytical finite element (SAFE) modelling technique for predicting guided wave reflection and transmission coefficients at oblique incidence, including comparison with these results
- Wilcox, P. D., Lowe, M. J. S. and Cawley, P., "The Excitation and Detection of Lamb Waves with Planar Coil Electromagnetic Acoustic Transducers", *IEEE Trans. Ultrason. Ferroelec. Freq. Contr.*, **52**(12), pp. 2370-2383, 2005.
  - Operation of pancake coil EMATs as used here for Lamb wave excitation and detection