Figure 1. ComPair Logo

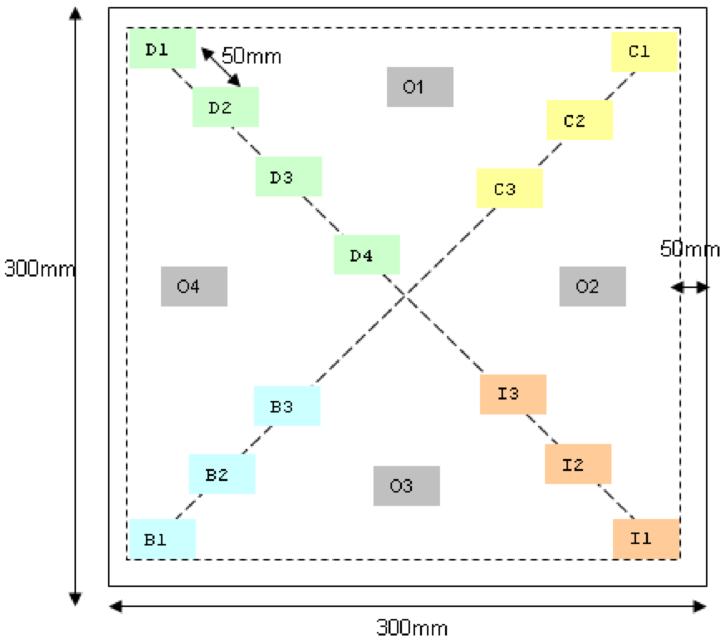


Figure 2. Stage 1 (300mmx300mm) CFRP & GFRP samples with defects - D: Delamination; I: Impact; C: Countersink; B: Burned drill hole; O: Secret defects

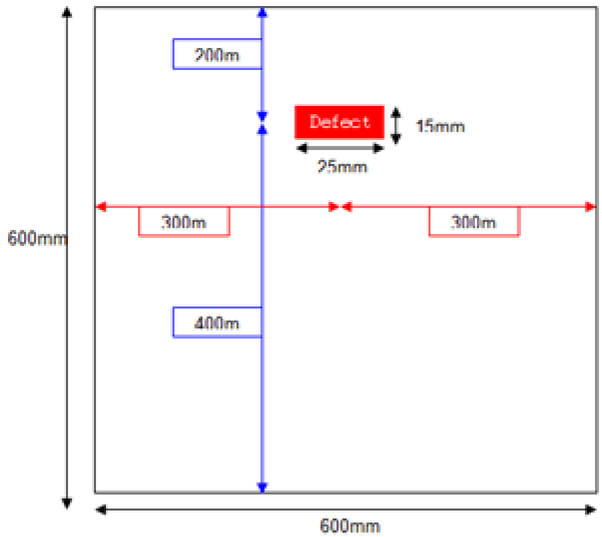


Figure 3: Stage 2 (600mmx600mm) CFRP & GFRP samples with 1 paper inclusion defect

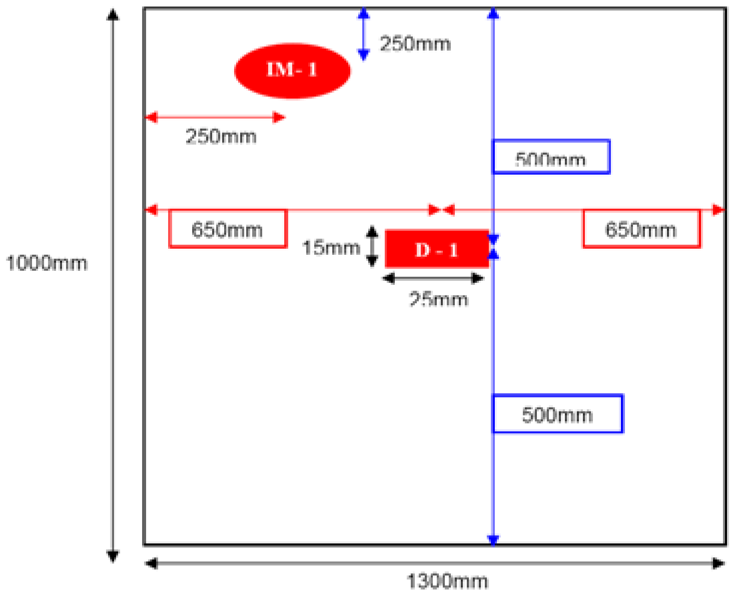


Figure 4: Stage 3 (1mx1.3m) CFRP & GFRP samples with impact damage and delamination (poly-insert)

Table 1: Elastic properties for CFRP and GFRP along the x-axis

Material	E_1, GPa	E_2, GPa	ν_{12}	ν_{23}	G_{12}, GPa	ρ, kg/m^3
CFRP (AS4/8552), thickness 6mm	141	10	0.32	0.487	5.3	1570
GFRP, thickness 8.4mm	42.5	10	0.26	0.4	4.3	1828

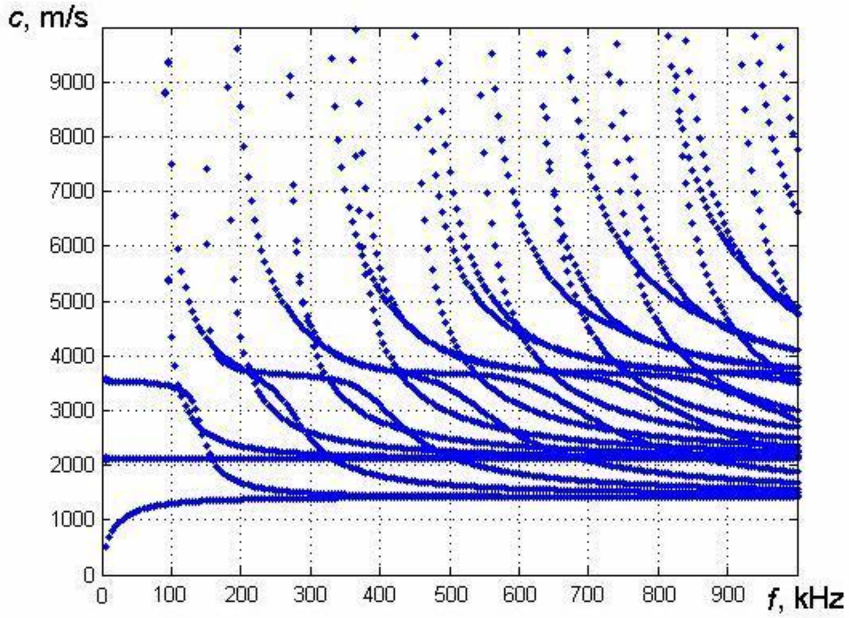


Figure 5. Dispersion curves for GFRP model with 8.4mm thickness using semi-analytic finite element method

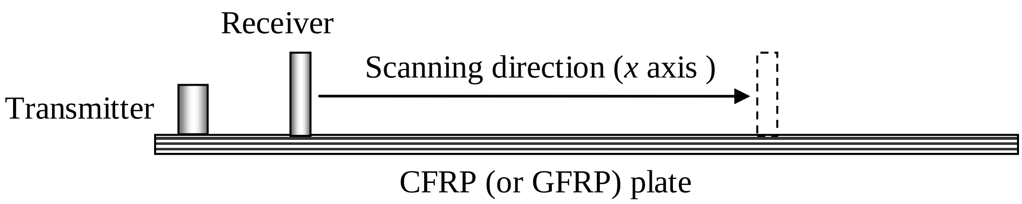


Figure 6. Experimental contact test-set up for composite sample

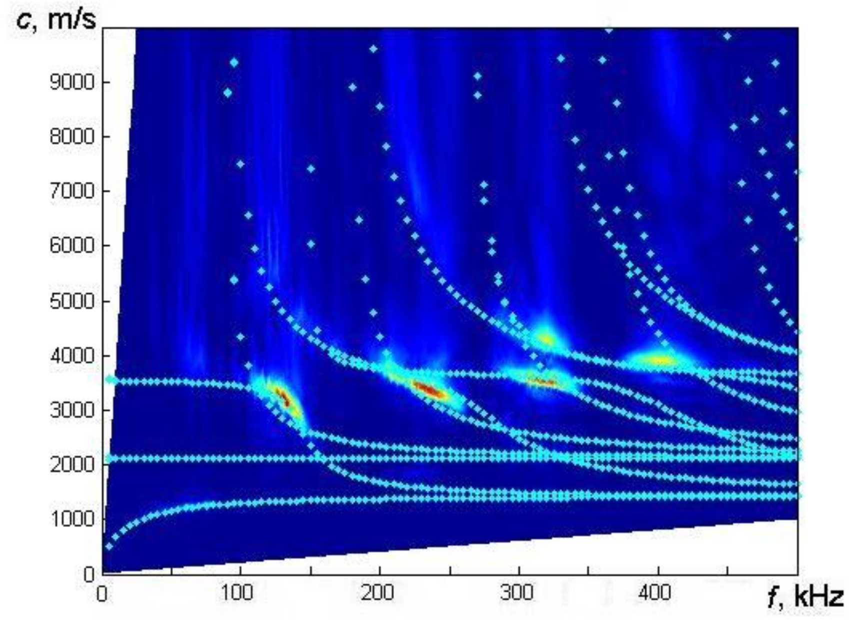


Figure 7. |Theoretical and experimental dispersion curves in 8.4mm thickness GFRP plate

Sensor type	Operating Frequency range (KHz)	Resonant frequency (KHz)	S/N
WDI	100 - 1000	125 [500]	AS.F2
R6	35 - 100	55 [90]	AS.H1
R6	35 - 100	55 [90]	AS.H2
PICO	200 - 750	250 [500]	AS.E1
Micro 30	100 - 600	125 [225]	AS.K1

Preamplifier type	Operating Frequency range (KHz)	Amplification (dB)	S/N
1220A	20 - 1200	40	AP.B1
1220A	20 -1200	40	AP.B4

Software	**Type**	**Version**
AE-Win for PCI-2	AE Acquisition software	E3.52
NOESIS [5]	AE data Analysis software	5.3.36

Figure8. AE sensors, hardware and software

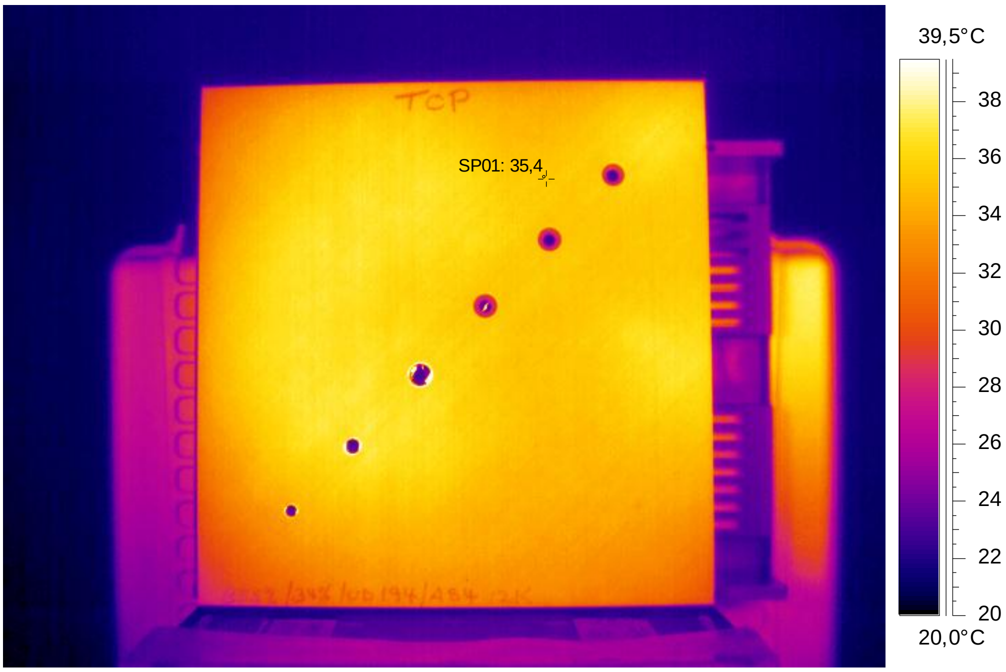
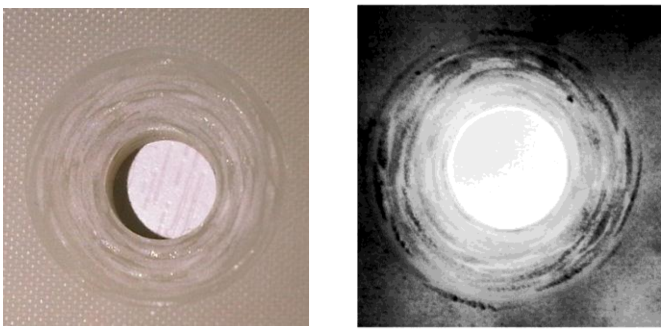
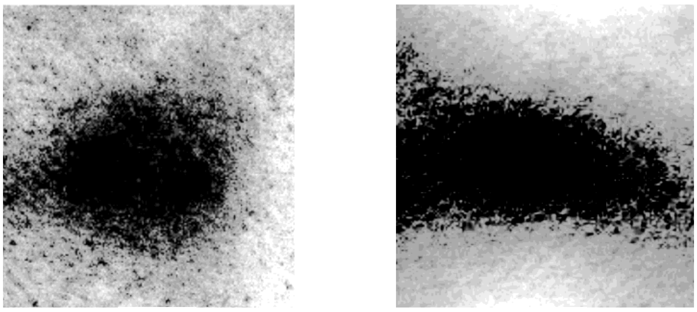


Figure 9. Individual thermal picture taken from the sequence using FLIR P640 on the 300mm x300mm CFRP sample



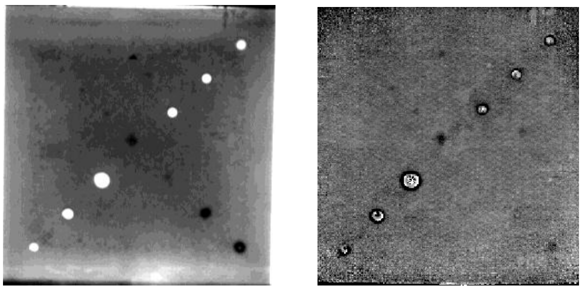
(a (b

Figure 10. Close-up image of a 6.35mm countersink defect, (a); Processed NIR image of countersunk defect, (b).



(a) (b)

Figure 11. Processed NIR image of a 5mmx5mm delamination defect, (a); Processed NIR image of the reverse side of the same delamination.



(a) (b)

Figure 12. Results by NIR vision, (a); thermography (processed using pulsed phase thermography), (b)

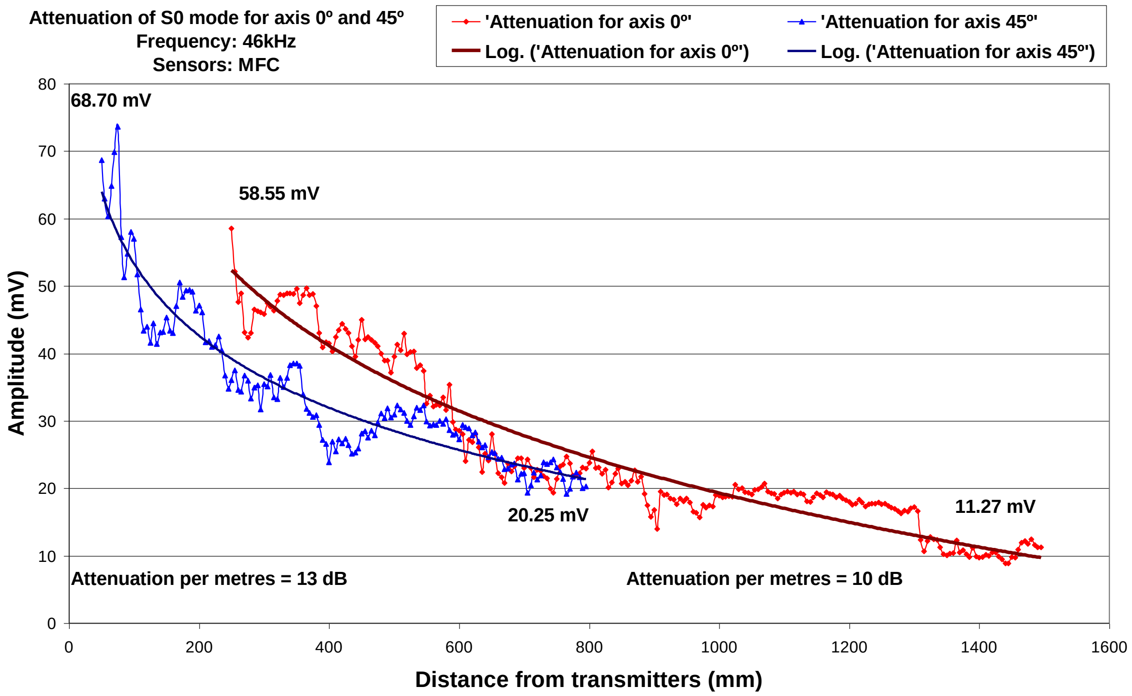


Figure 13. Attenuation characteristics of qausi-isotropic GFRP using MFC sensors as Tx and Rx

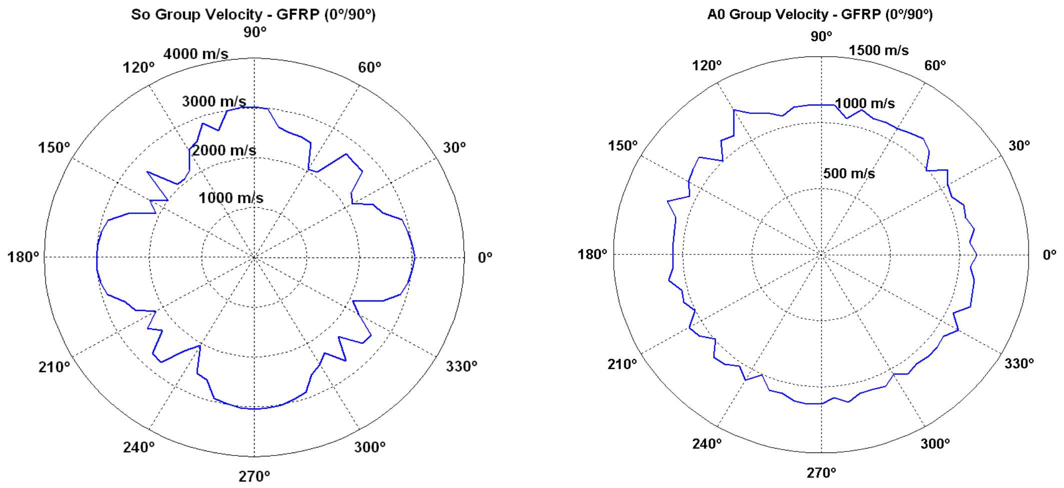


Figure14. Plot of S0 wave mode velocity, right; and A0 wave mode velocity, left, using the mode time of arrival from data collected using bi-directional GFRP

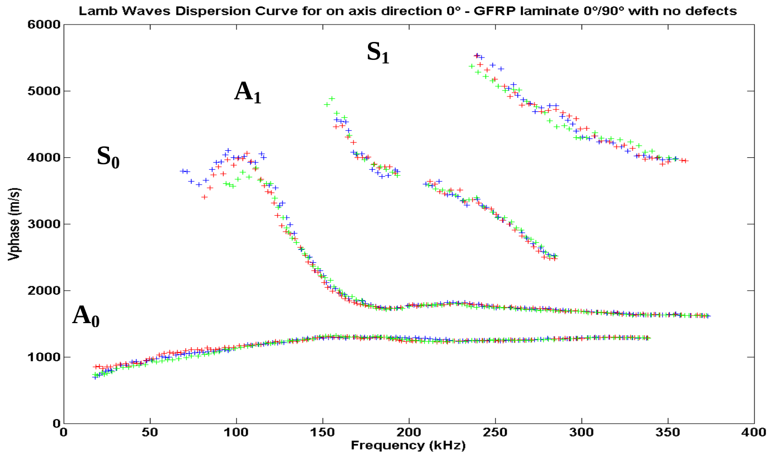


Figure 15. Normalised dispersion curves – bidirectional GFRP sample

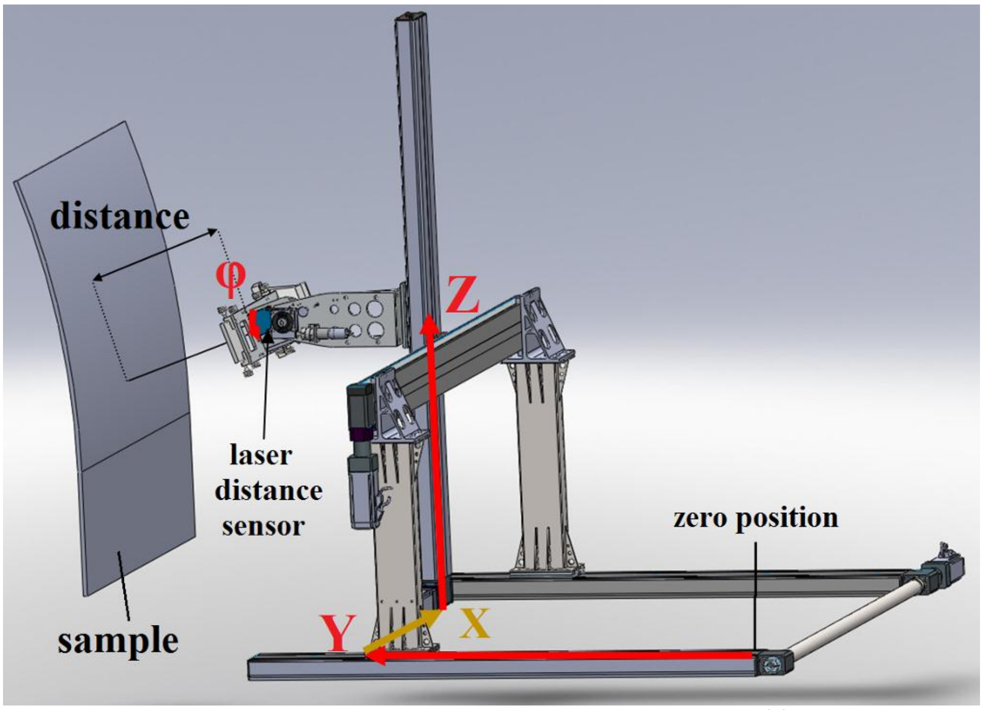


Figure 16. Pre-scanning measured parameters showing 4 degrees of freedom (X, Y, Z, φ)

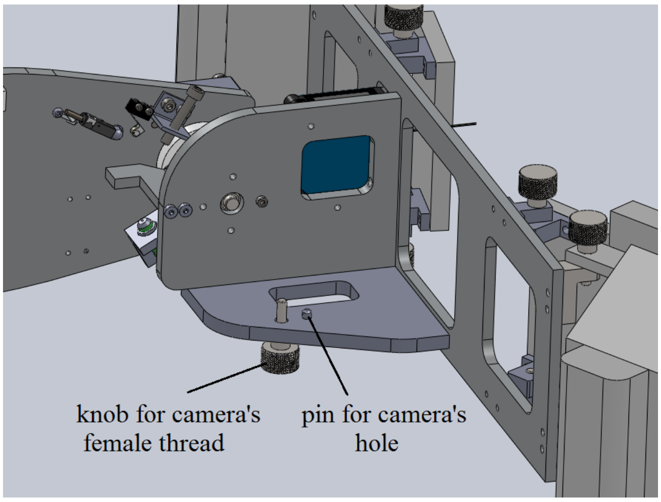


Figure 17. Mounting fixture on robotic scanner for transient thermography camera

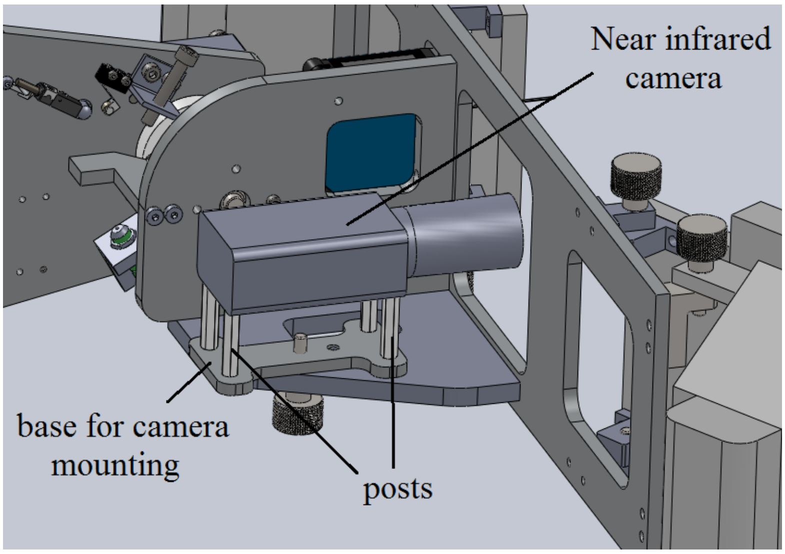


Figure 18. Mounting fixture on a robotic scanner for NIR camera

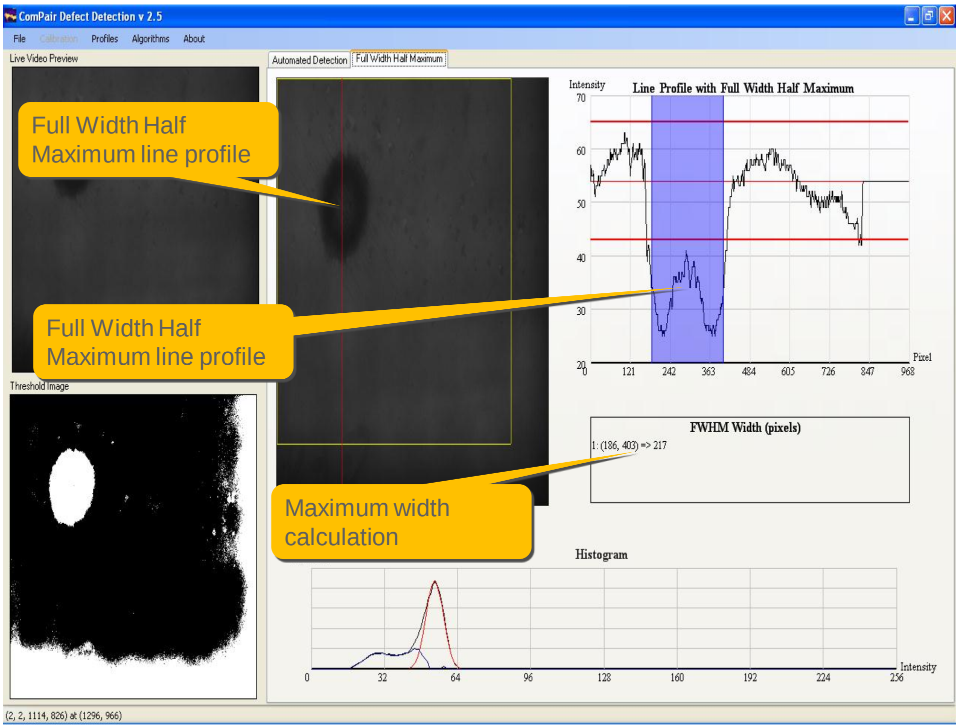


Figure 19. ComPair inspection software – Full Width Half Maximum (FWHM) implemented on impact related defect

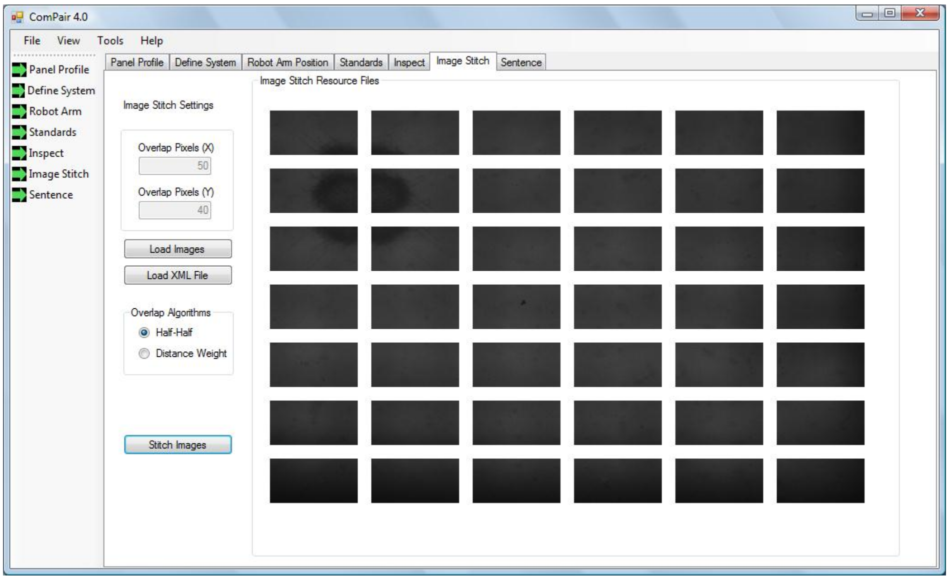


Figure 20. ComPair inspection software showing Image Stitching

Figure 21. ComPair Inspection procedure of the CFRP sample

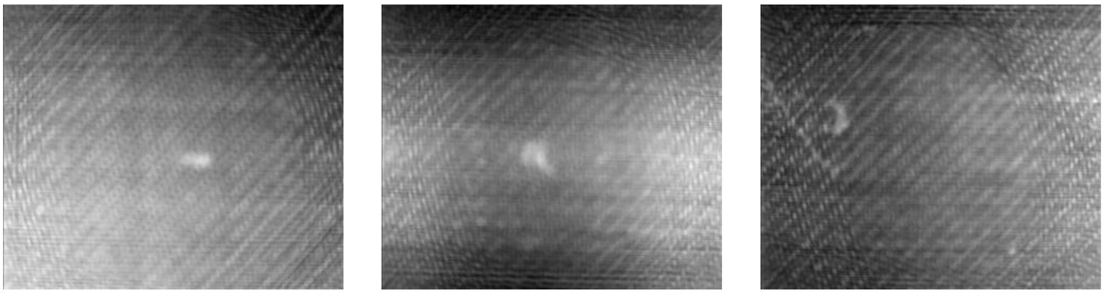


Figure 22. ComPair Inspection software identifies impact defects from the individual thermographic inspections

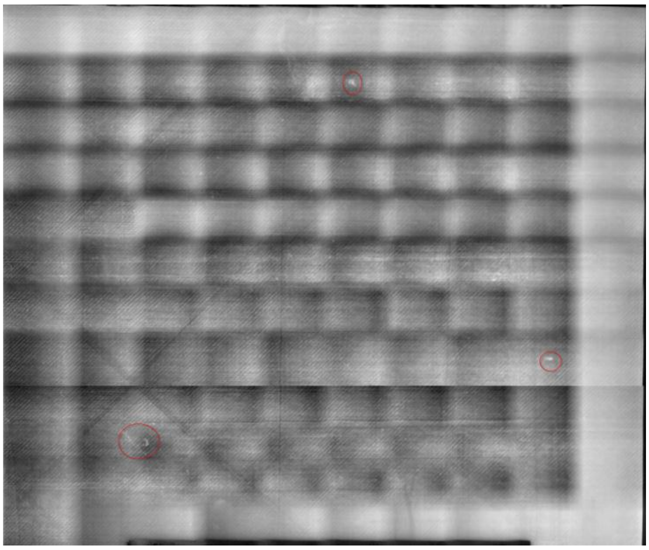


Figure 23. ComPair software complete stitched image of the individual thermographic results

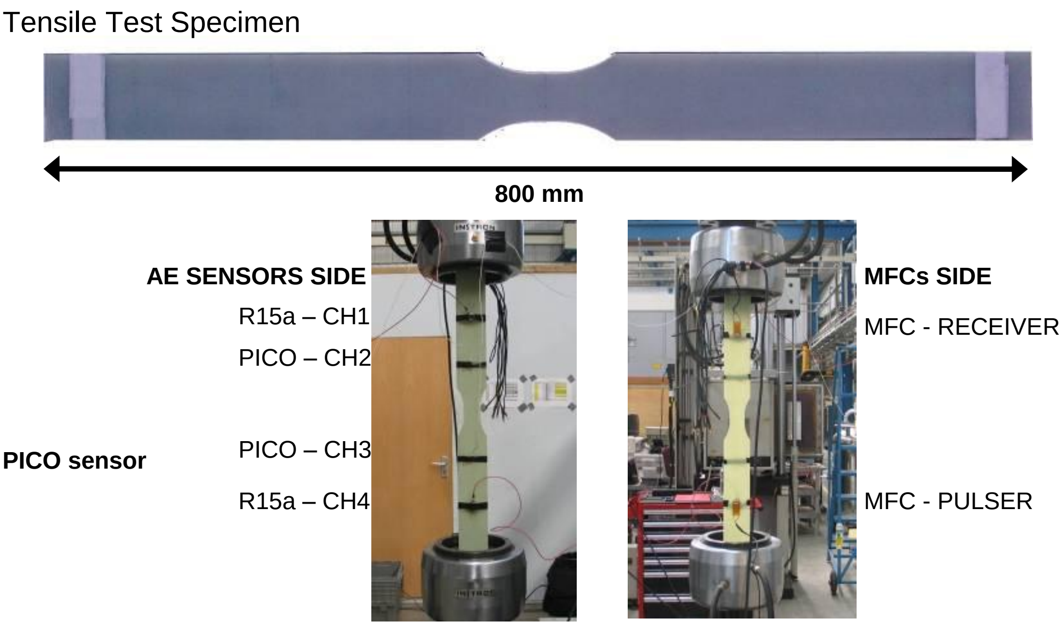


Figure 24. ComPair Monitoring AE/LRU system during a tensile test on 800mmx70mmx4mm GFRP coupon

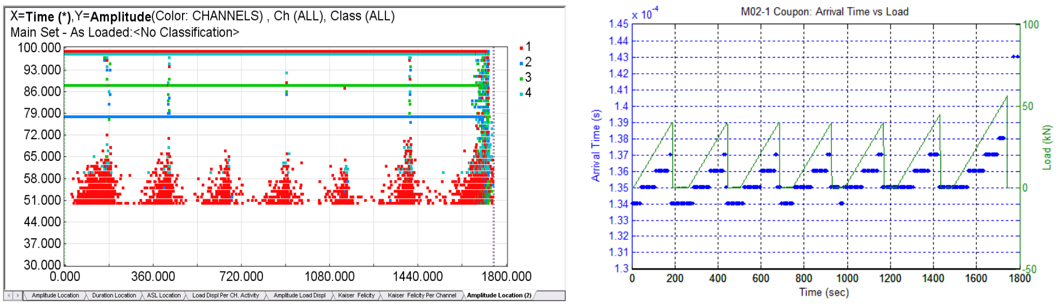


Figure 25. ComPair Monitoring system software showing detection of tensile loading cycle: AE activity to destruction, left; LRU GW activity to destruction, right

Strengths	Weaknesses
• The experience of the development team on similar projects (i.e. Research expertise & IT expertise) • Innovative content based on European R&D results • International applicability. • Global technical information and superior technology available • Realisation of sophisticated and innovative tool/s. • Sufficient financial resources for the prototype realisation • Important and very nourished potential users list and good relationship with some important customers • Unique approach to continuous inspection and maintenance • Experience of the development team on competent projects • The evaluation phases on prototypes performed by all partners • The final product of the project can be expanded into other applications, outside • Unique technology • The realisation of the prototype/s followed by a market response evaluation in all the participating members.	• Still under development • Absence of end users in the consortium • Requirement for constant updating of the technical content. • The ComPair project products are based on existing, well known technologies, which entails an increase in operating costs for the future updating • Slow and less flexible decision making process during the commercial phase of the project due to the involvement of many partners
Opportunities	**Threats**
• Development of European procedures as an integrated tool for NDT approaches manufacturing stage, real time monitoring and in service inspection of composites repairs in vehicles. Contribution to facilitate the way to implement the EU Directives especially the ones targeting directly for detection of defects of transport sector materials. • Composites transport materials market is expected to expand in the next future. This is a clear signal about the opportunities to identify new commercial opportunities in other sectors, for example: aerospace components as propellers, bicycle frames or storage tanks. A strategy will be produced in the next future • Opportunities for new employment, contribution to solving societal problems	• Influence of current economic crunch • Reduction in R&D budget • Bureaucratic process to exploit the results • Decreasing consumer spend • Other competing technologies • insufficient / incompetent knowledge (end users & manufacturers) • Fear of something new - resistance to change • A project based on a content that is presented for the first time and that introduces new services may not be easy to use by its potential users • Long process to perform project guide lines to European standards

interconnected with current unemployment situation in Europe • Increasing public awareness on "Probability of Detection" at a higher confidence level, reducing of accident rate and increasing of the safety level. (Positive contribution in accident rate) • The increasing competition amongst NDT researchers and professionals urges for additional and new skills in order for the professionals to keep themselves on the market. Thus the ability to produce innovative tools may be seen as a means to expand job opportunities. • Transport sector is one of Europe's strengths. Ensuring customer satisfaction and safety and improving all safety aspects through innovative real time monitoring services and in service inspection open the market potentialities and create opportunities for widespread licensing. • Requirement for real monitoring • Positive contribution to the maintenance and the repair time • Increasing power-to-weight ratio • Fast response to abnormalities on the composites, prevention of serious breakdowns. • Requirement for increased reliability and robustness • Build up stronger industrial contact database. • Reliability for both transport and composites. • Requirement for modern technology • Competitive advantage for the European transport industry. • Increased transportation safety • Improved service providence	

Figure 26: SWOT analysis for WinTur project