

ULTRASONIC VERIFICATION OF COMPOSITE MATERIALS

C. Schoemaker, R. Sprik

INTRODUCTION

- Past decades increased use of composites.
- Aerospace sector; A350, B787 and F35
- Automotive sector; BMW i3 & i8, sports cars
- Energy sector & civil engineering; pipelines, bridges
- Composite maintenance didn't grow at same pace

INTRODUCTION

- *Significance:*

MRO should be cost-effective & increase life-cycle

- *Main problem:*

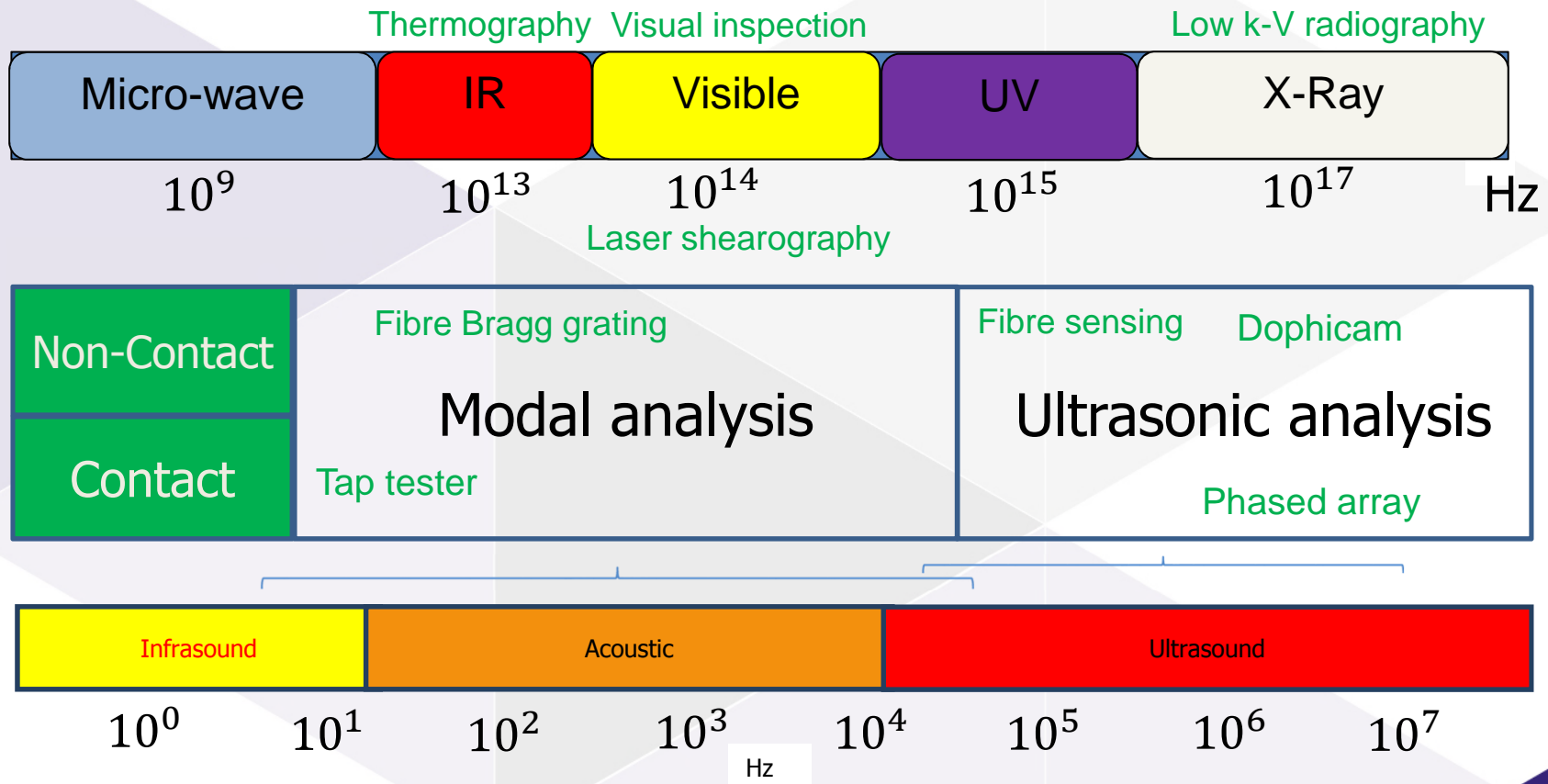
Anisotropy & heterogeneity, risk of delamination, bvid..

- *Objective:*

Detect different sorts of damage within short time span on large surface areas.

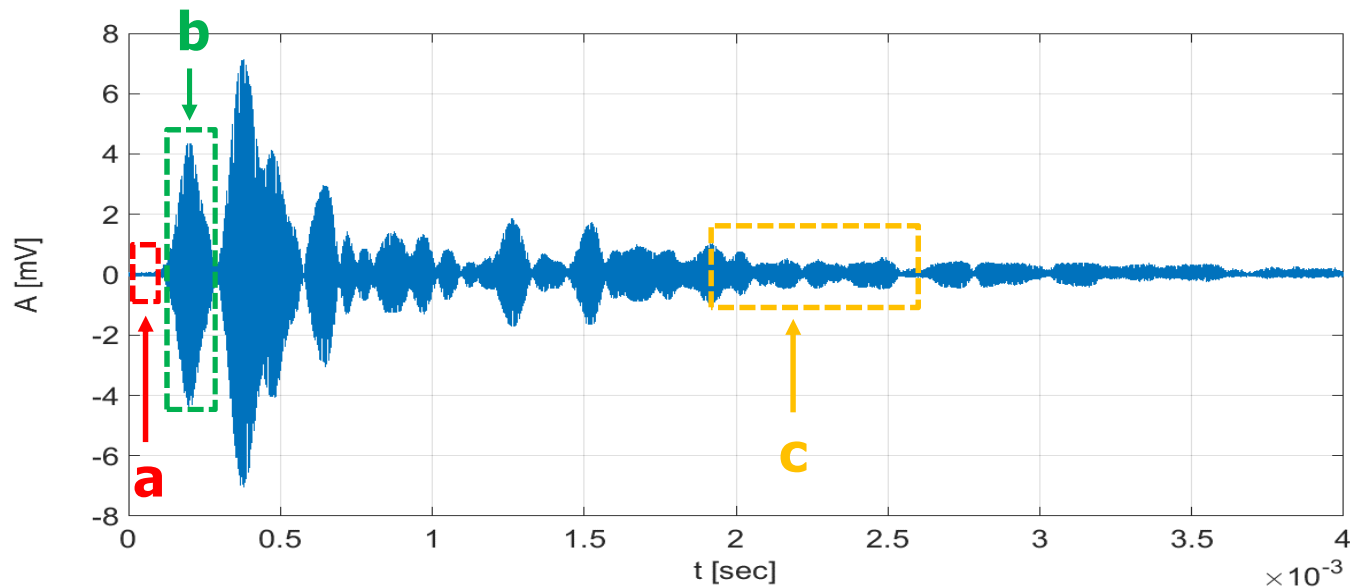
CURRENT MONITORING METHODS

- A wide variety of NDT methods exist.



ULTRASONIC PROPAGATION TECHNIQUES

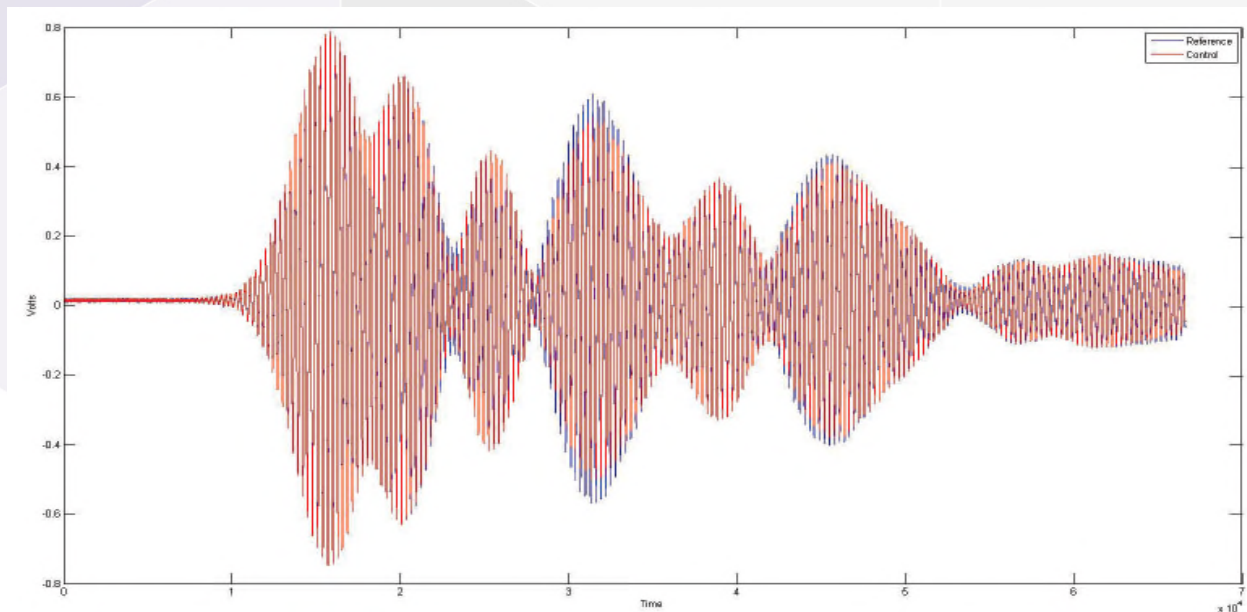
- Wave length $\frac{d}{\lambda} < 1$, Lamb wave occur
- **a** Trace signal background noise
- **b** First arrival Gaussian pulse
- **c** Reverberated signal



ULTRASONIC PROPAGATION TECHNIQUES

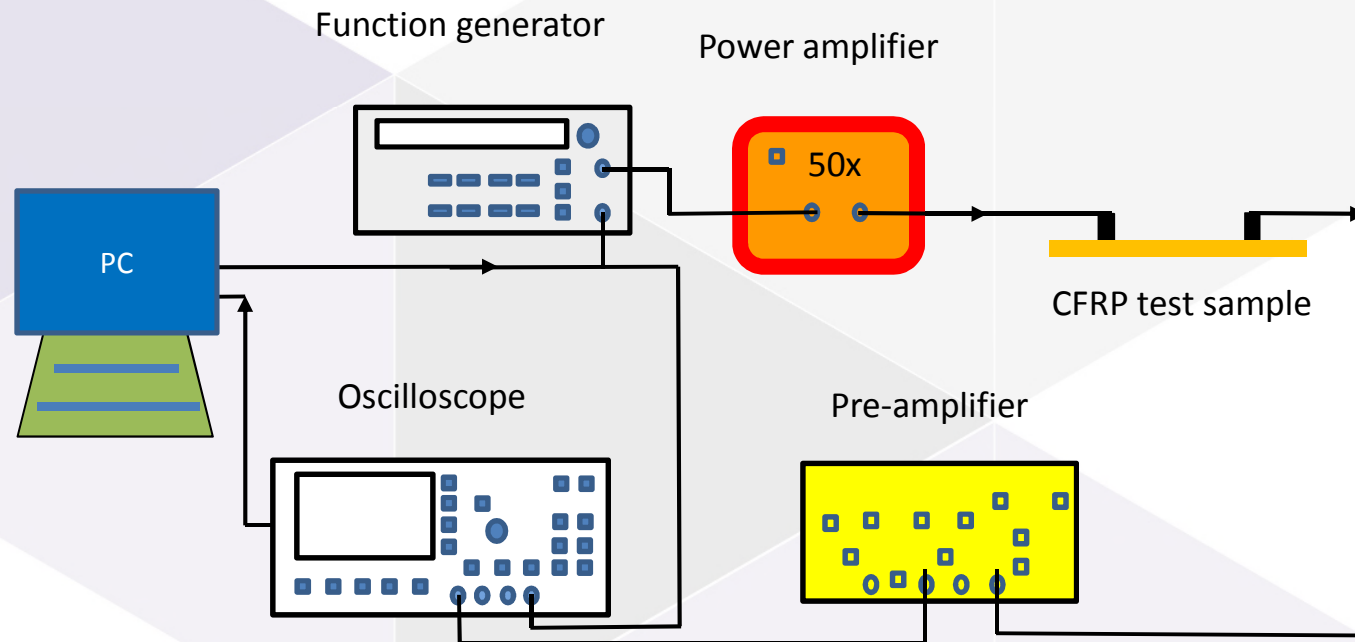
- Current focus on first arrival, 2nd part of signal (reverberation) also contains information
- Comparison 2 signals, damaged vs undamaged

$$\eta = \frac{V_1(\tau) \otimes V_2(\tau)}{\sqrt{(V_1(\tau) \otimes V_1(\tau))(V_2(\tau) \otimes V_2(\tau))}}$$



ULTRASONIC PROPAGATION TECHNIQUES

- Schematic description USV setup



MAINTENANCE REPAIR & OVERHAUL 2.0

- Integration of multiple sensors & different techniques
- SHM from 0 (quality control) to 4 (safe life estimate).
- From experienced based repair towards sensor based repair & post damage quality check → self healing

CONCLUSION

- Already wide variety of sensor systems.
- Focus on reverberation vs first arrival, gives new info
- Lamb wave combined with USV technique open possibility to analyse large surface areas
- Pre and post damage quality checks become possibility