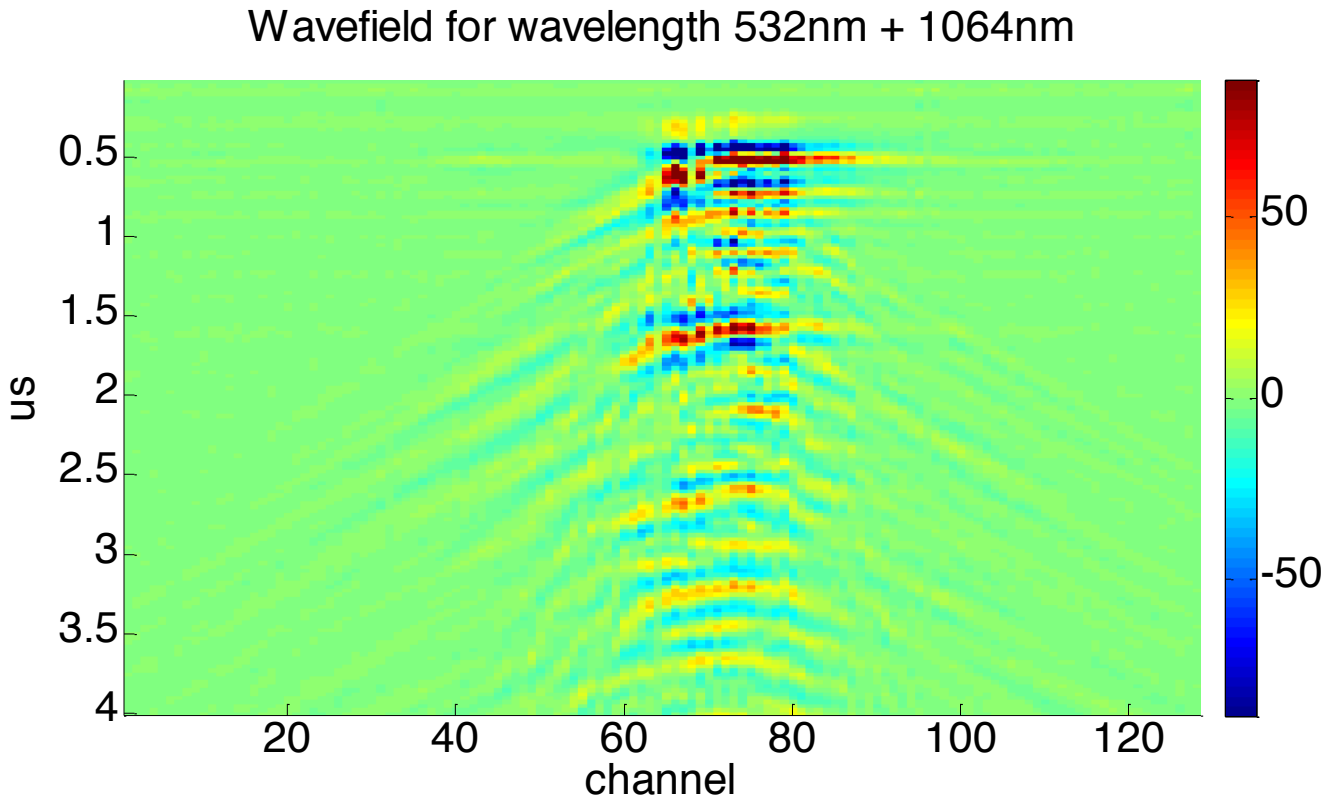
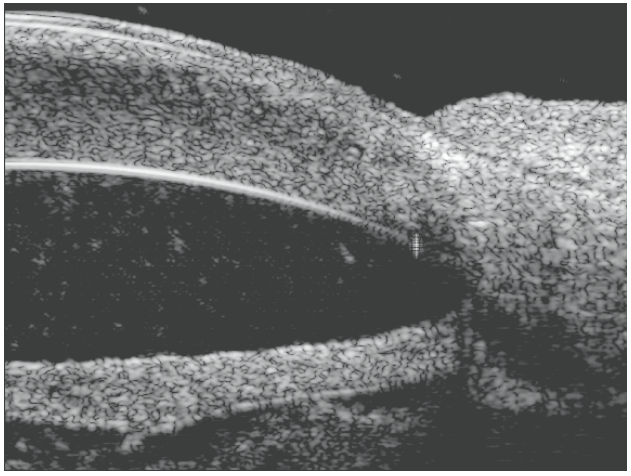
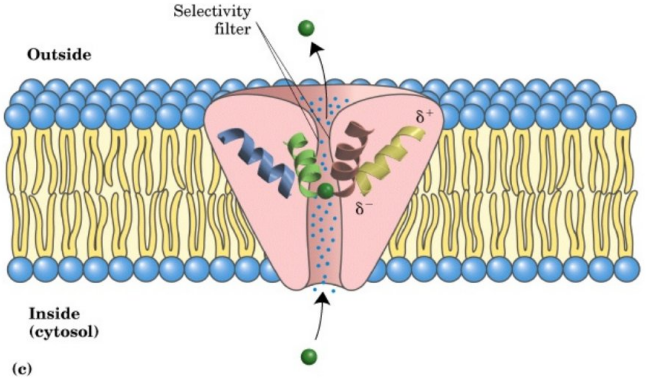
Future Composite Repair Systems: Disruptive Technologies for NDE

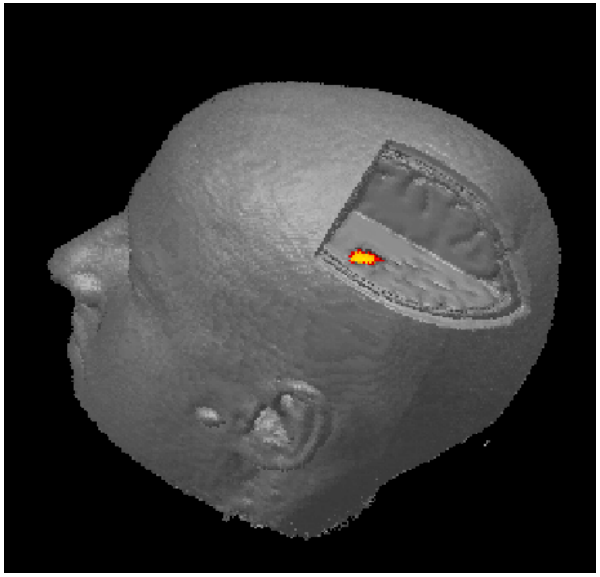


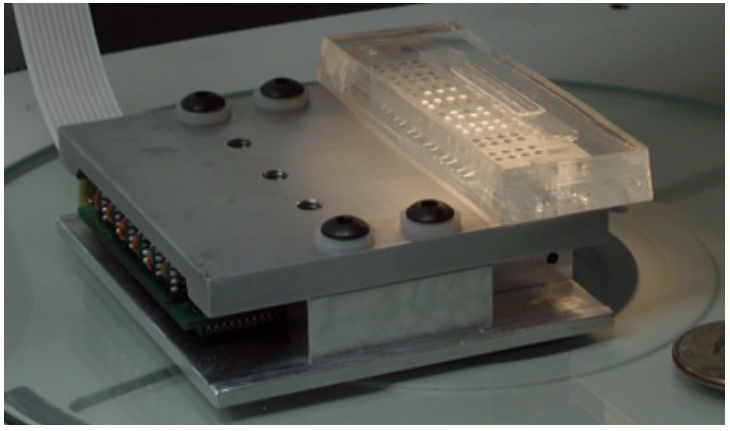
Matt O'Donnell, Chen-Wei Wei, Jinjun Xia
Bioengineering Department, UW

What do Biomedical Sensors have to do with NDE of Composites?





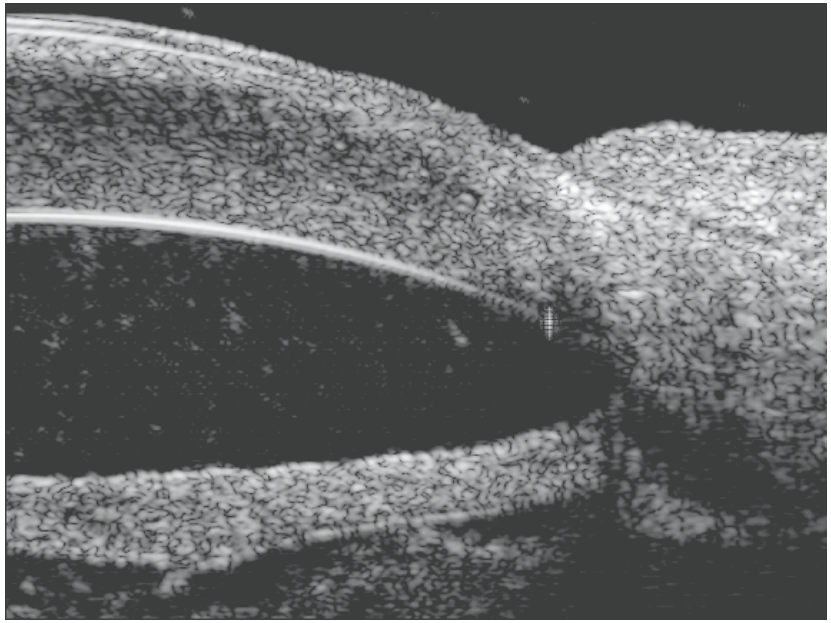


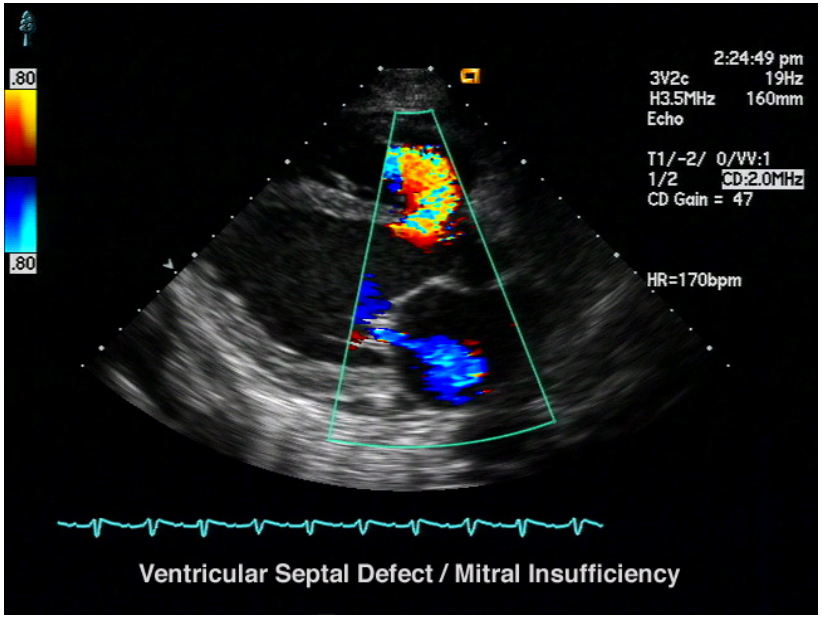


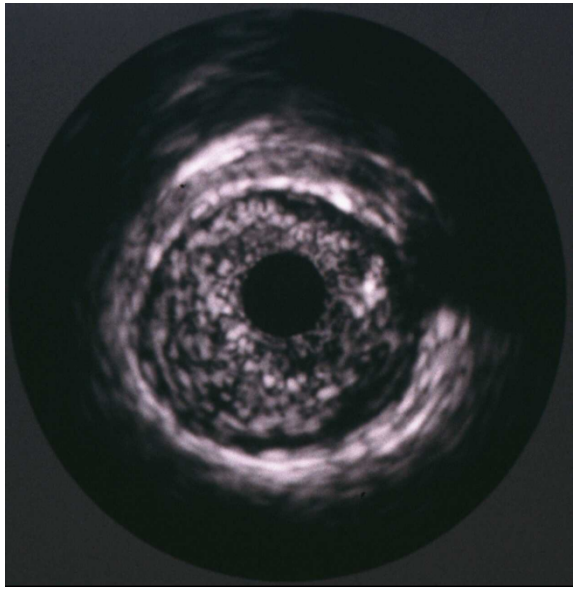
Biomedical Sensors since 2000

- Sensor sensitivity has increased enormously in the last decade
- Portable and low power devices now in operation
- Remote sensing/imaging sensitivity and simplicity greatly improved

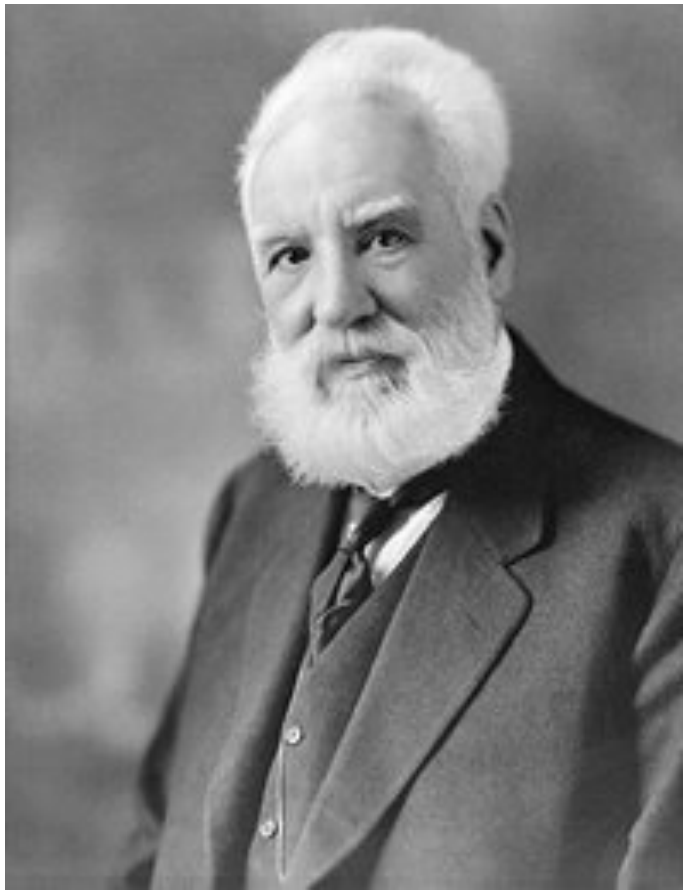
Ultrasound Imaging

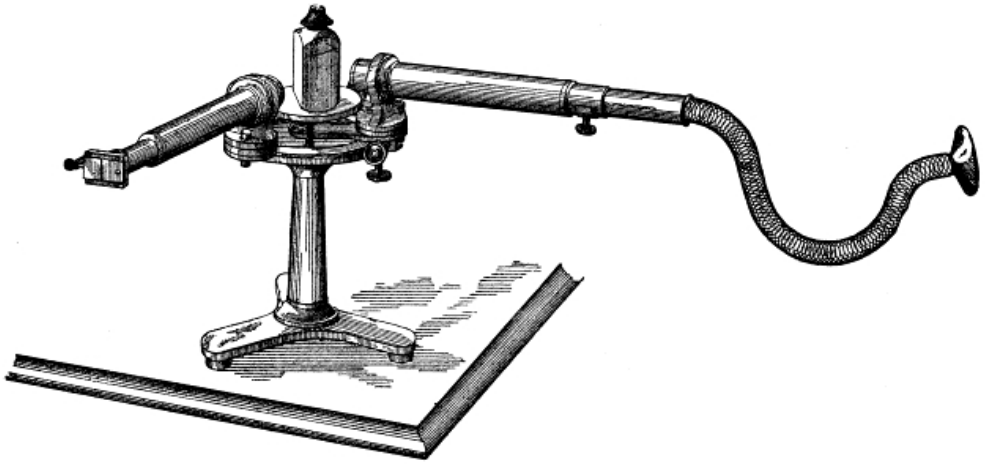






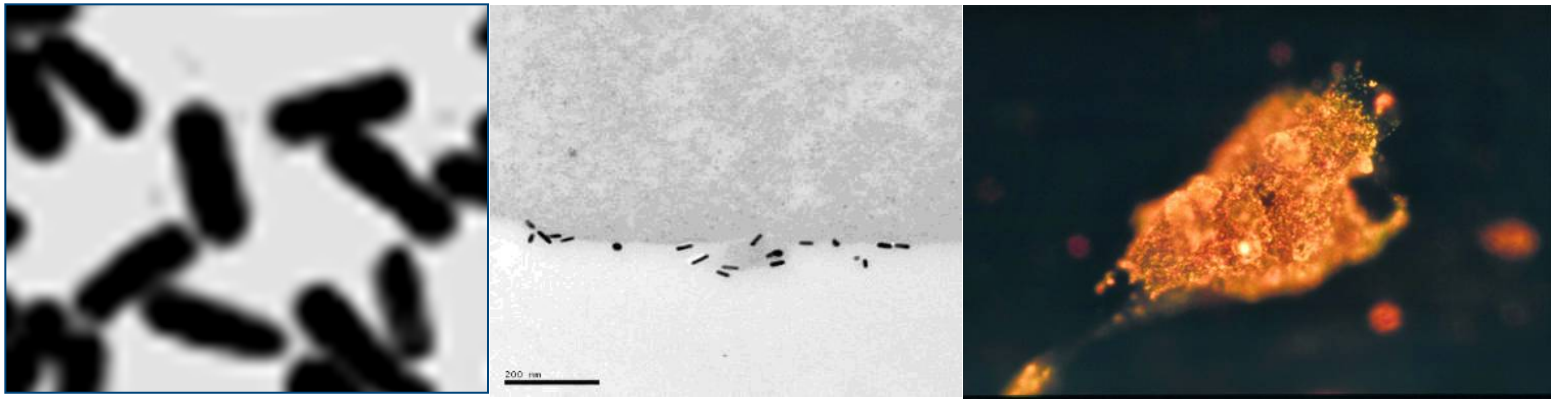
Photoacoustics (PA)

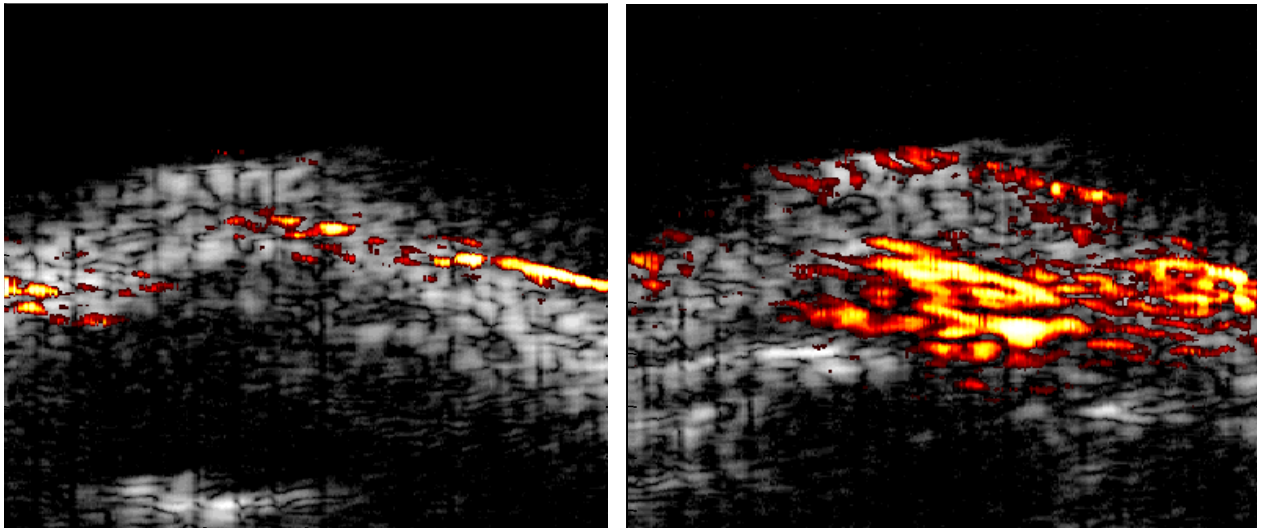




Alexander Graham Bell, “Production of Sound by Radiant Energy”, Journal of the Franklin Institute, Volume 111, Issue 6, pp. 401-426 (1881).

PA Molecular Imaging

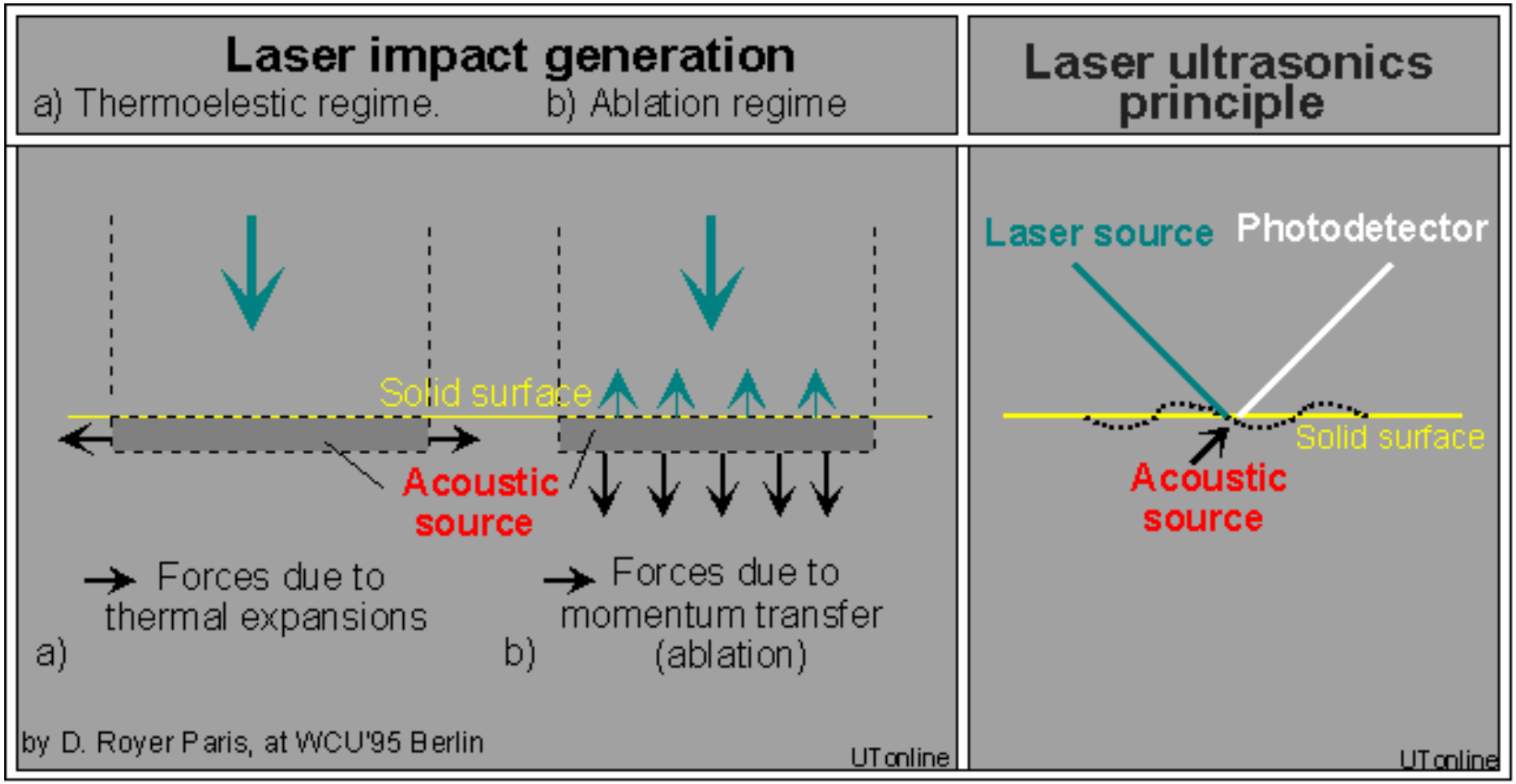




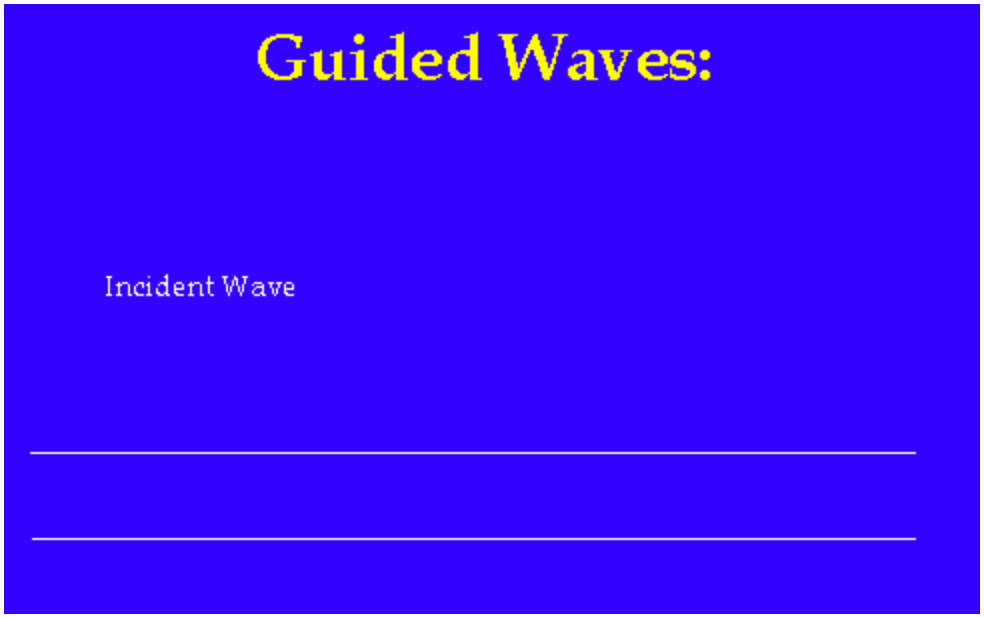
Before injection After injection

Pai-Chi Li, National Taiwan Univeristy

Photoacoustics in NDE



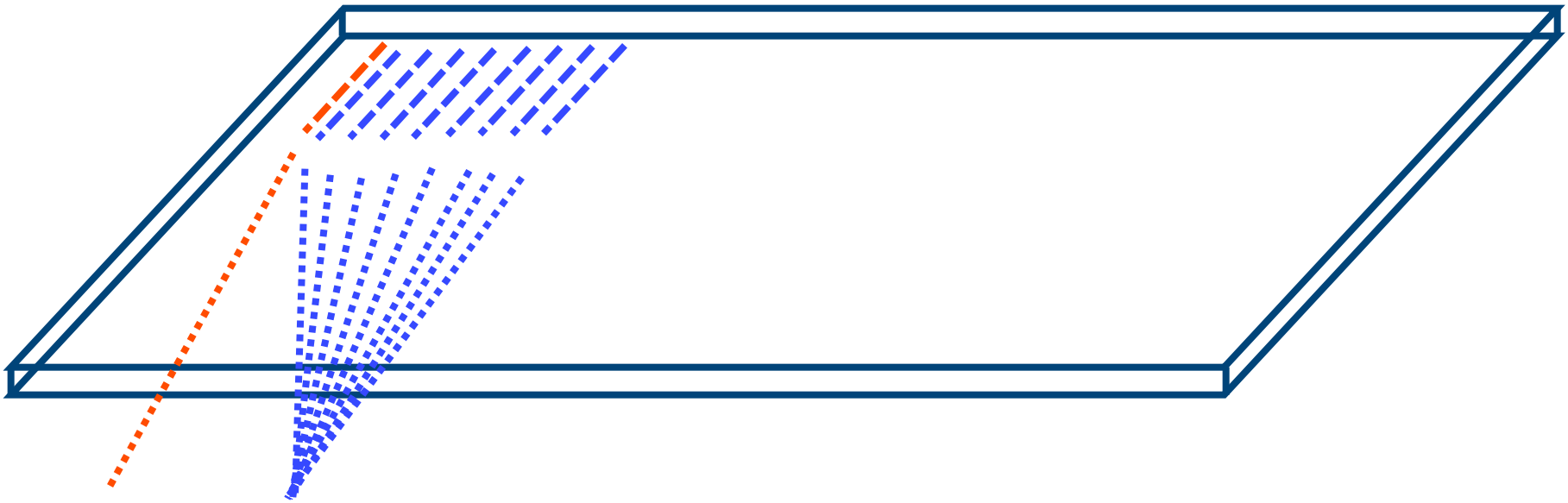
Ultrasonic NDE



Conventional Laser Ultrasonics: L-Wave and S-Wave Transducers

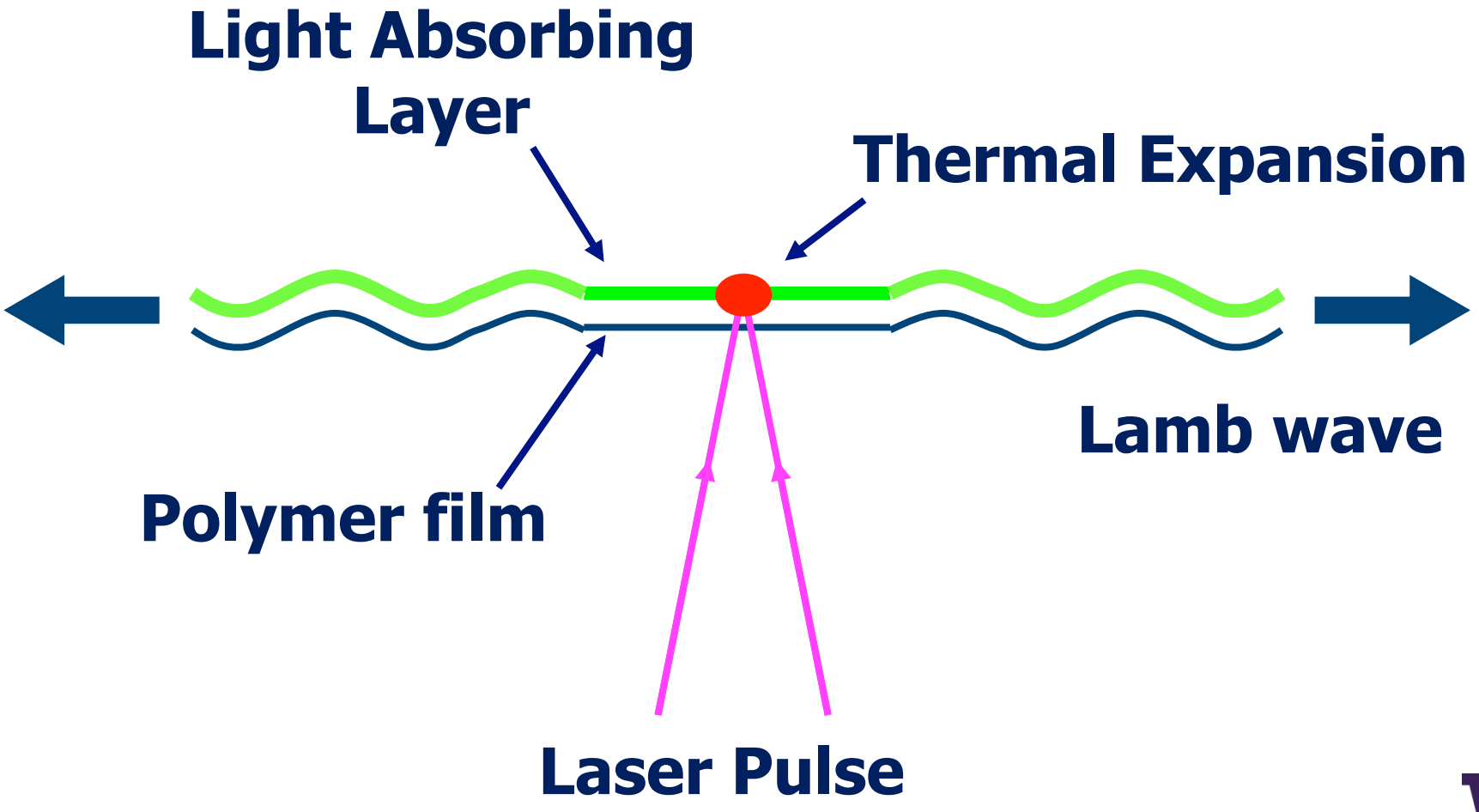
Scanned Dual Laser Pattern

Conventional Laser Ultrasonics: L-Wave and S-Wave Arrays

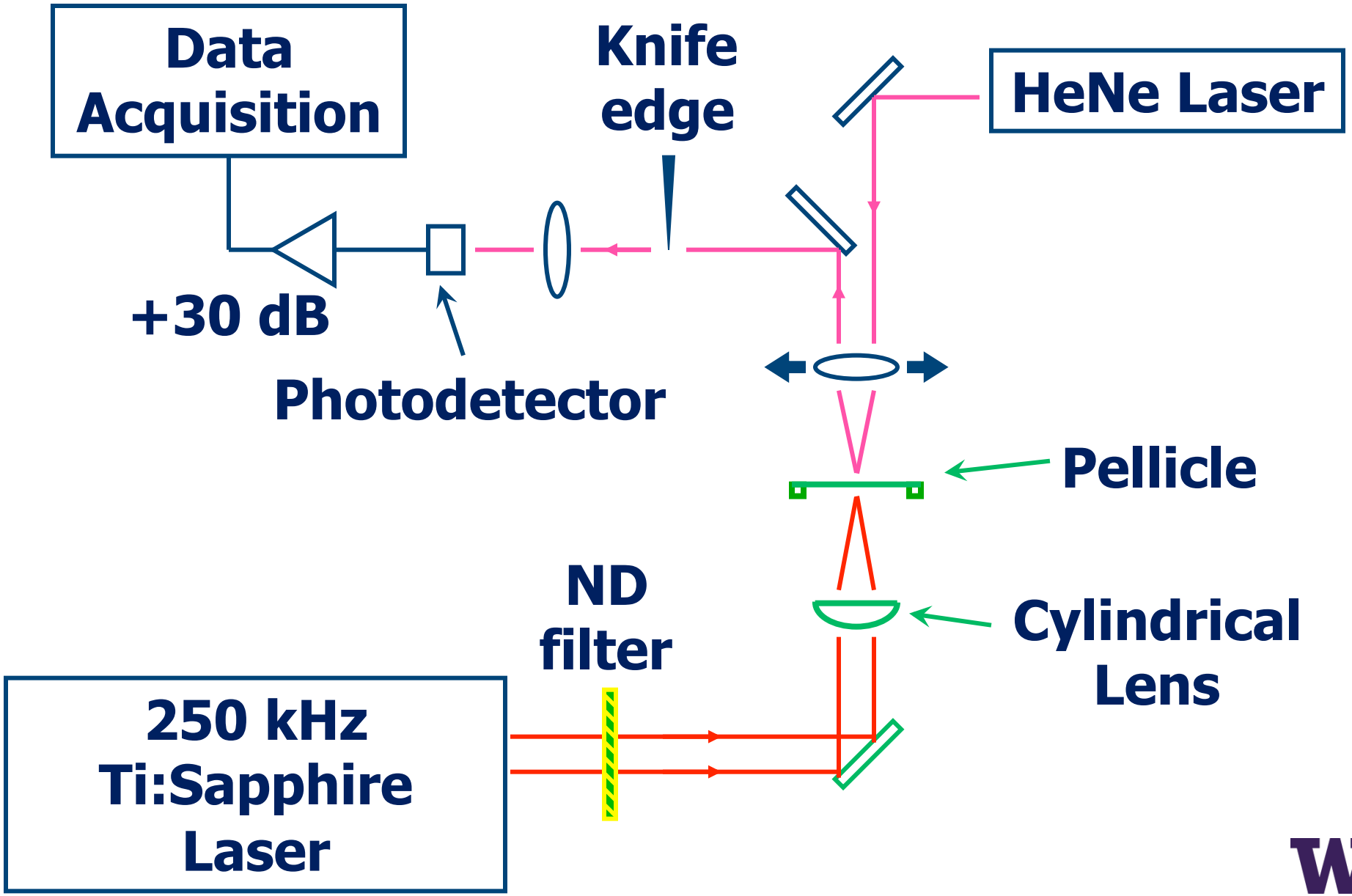


Scanned Dual Laser Pattern

Thermoelastic Generation of Guided Waves

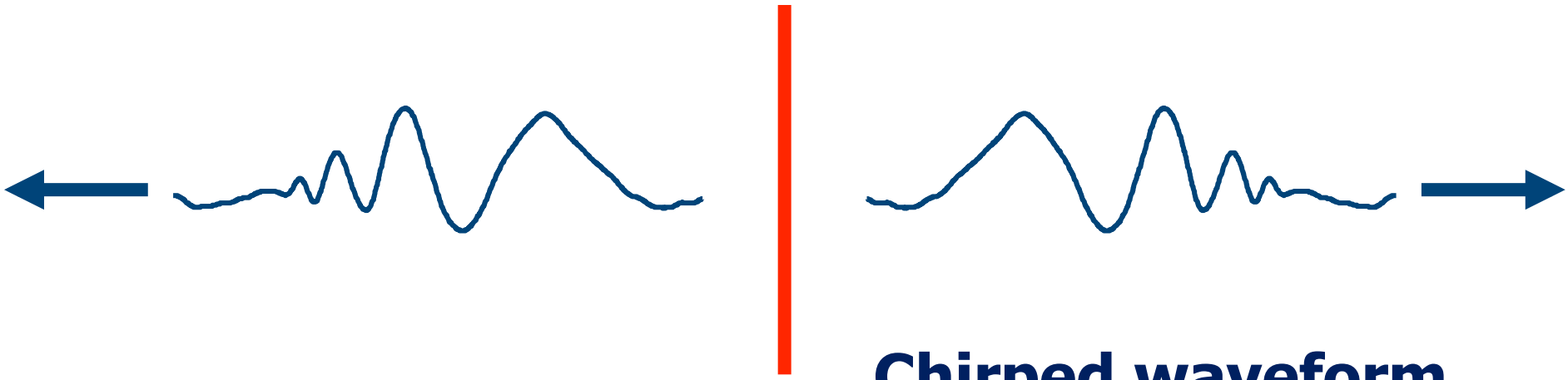


Experiment


Data Acquisition
Knife edge
HeNe Laser
+30 dB
Photodetector
Pellicle
ND filter
Cylindrical Lens
250 kHz Ti:Sapphire Laser

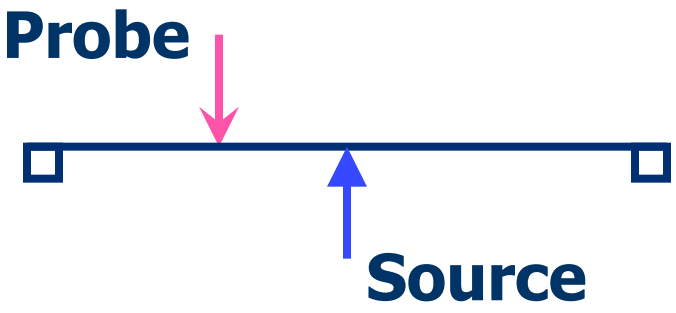
Broadband Excitation

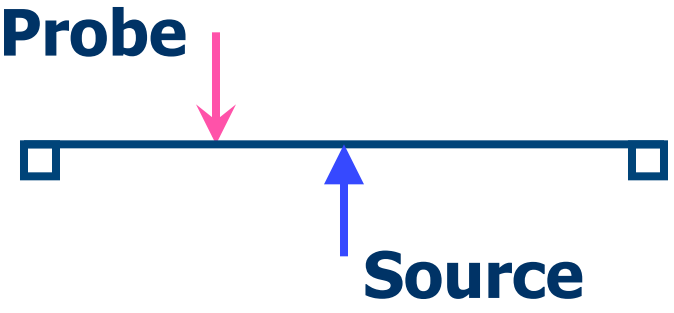
Single Line Source



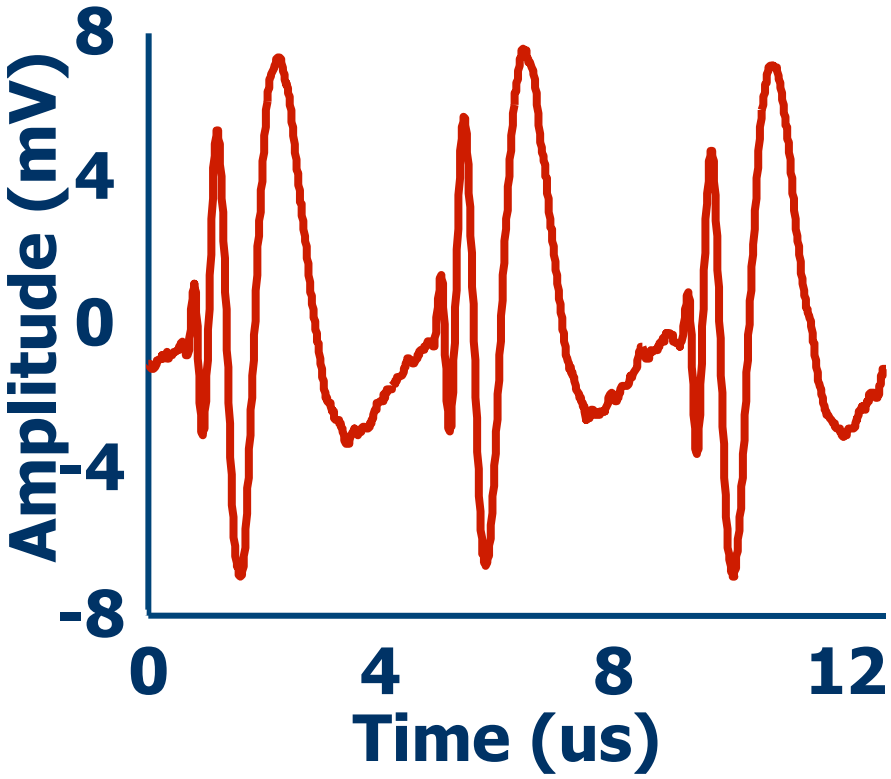
Chirped waveform

Single Line Source

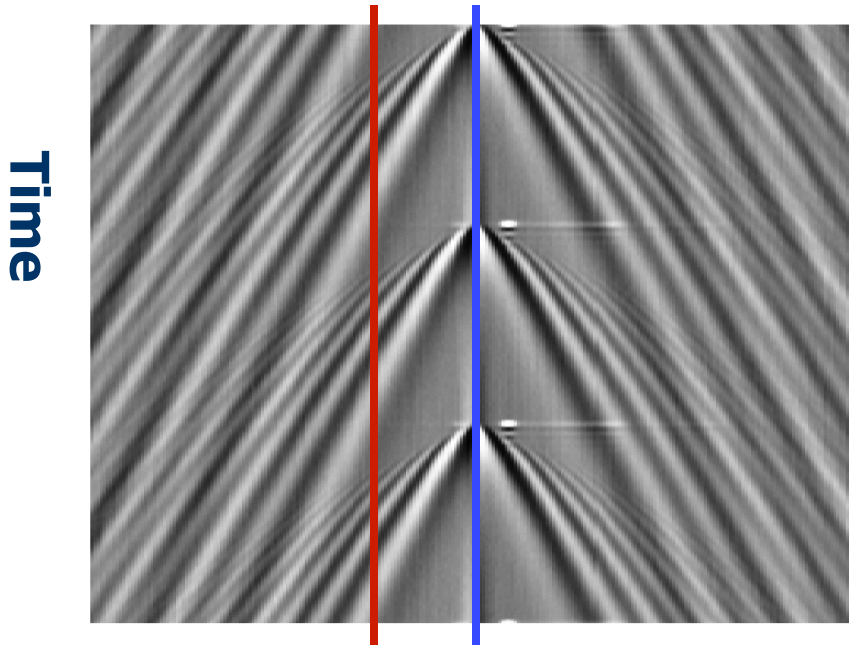




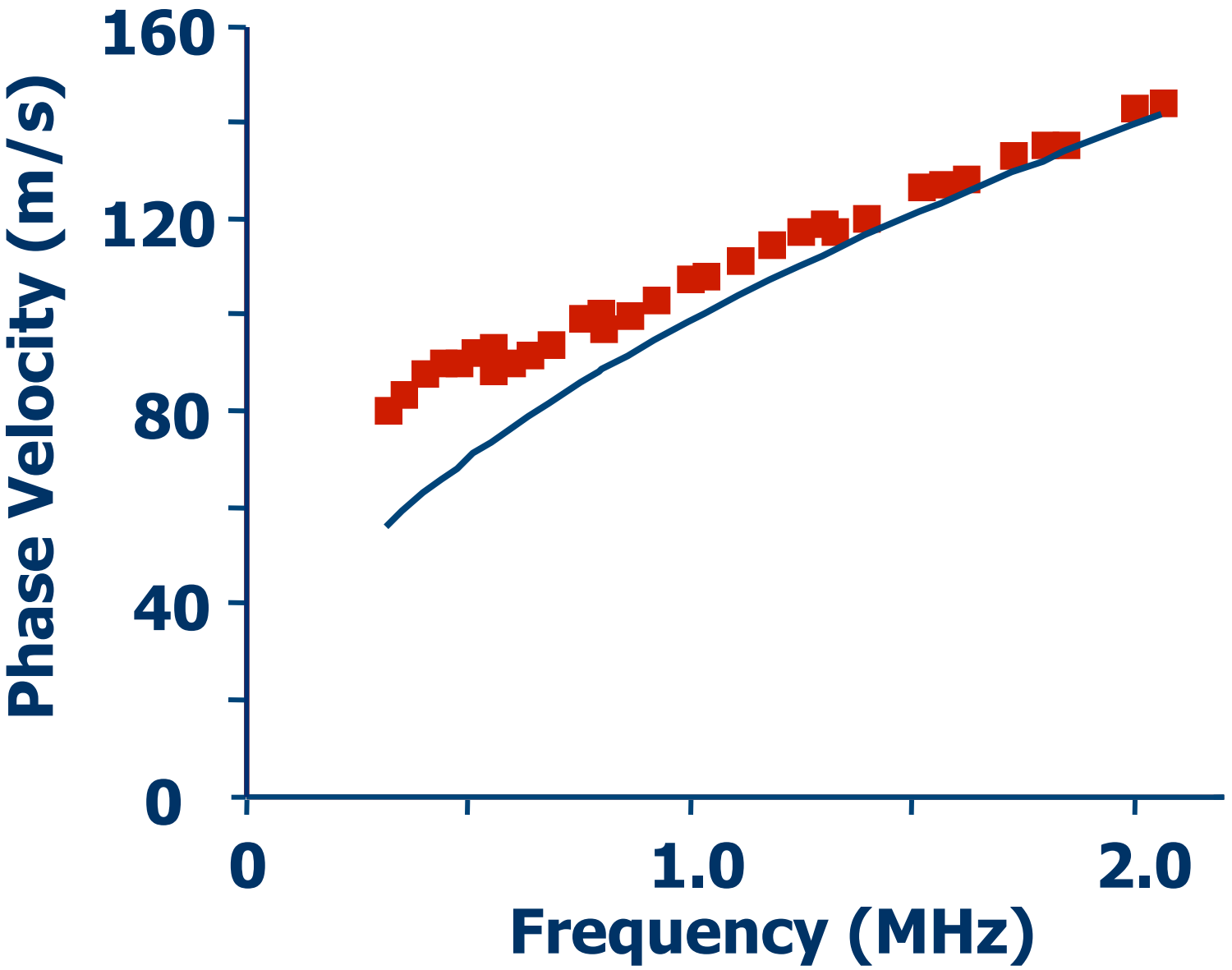
Chirped A-line



Wavefield plot

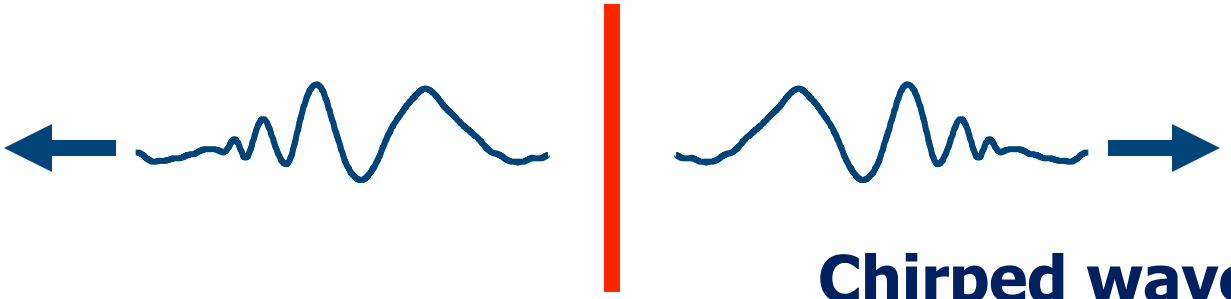


Dispersion Curve



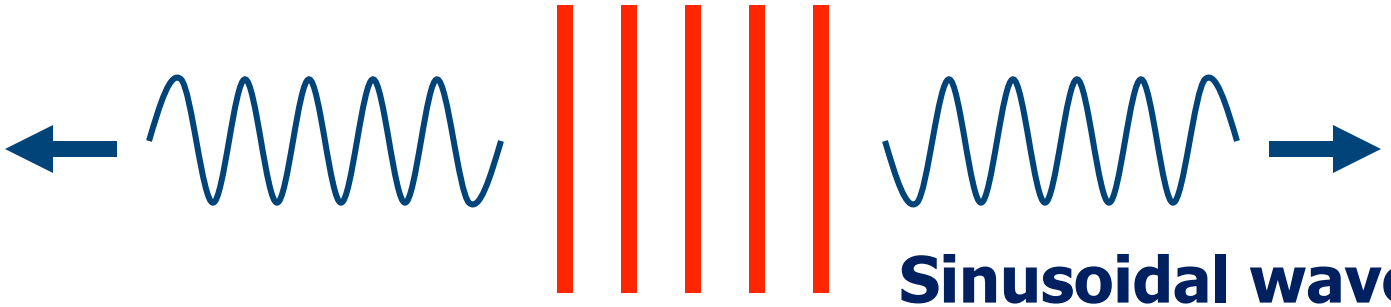
Narrowband Excitation

Single Line Source



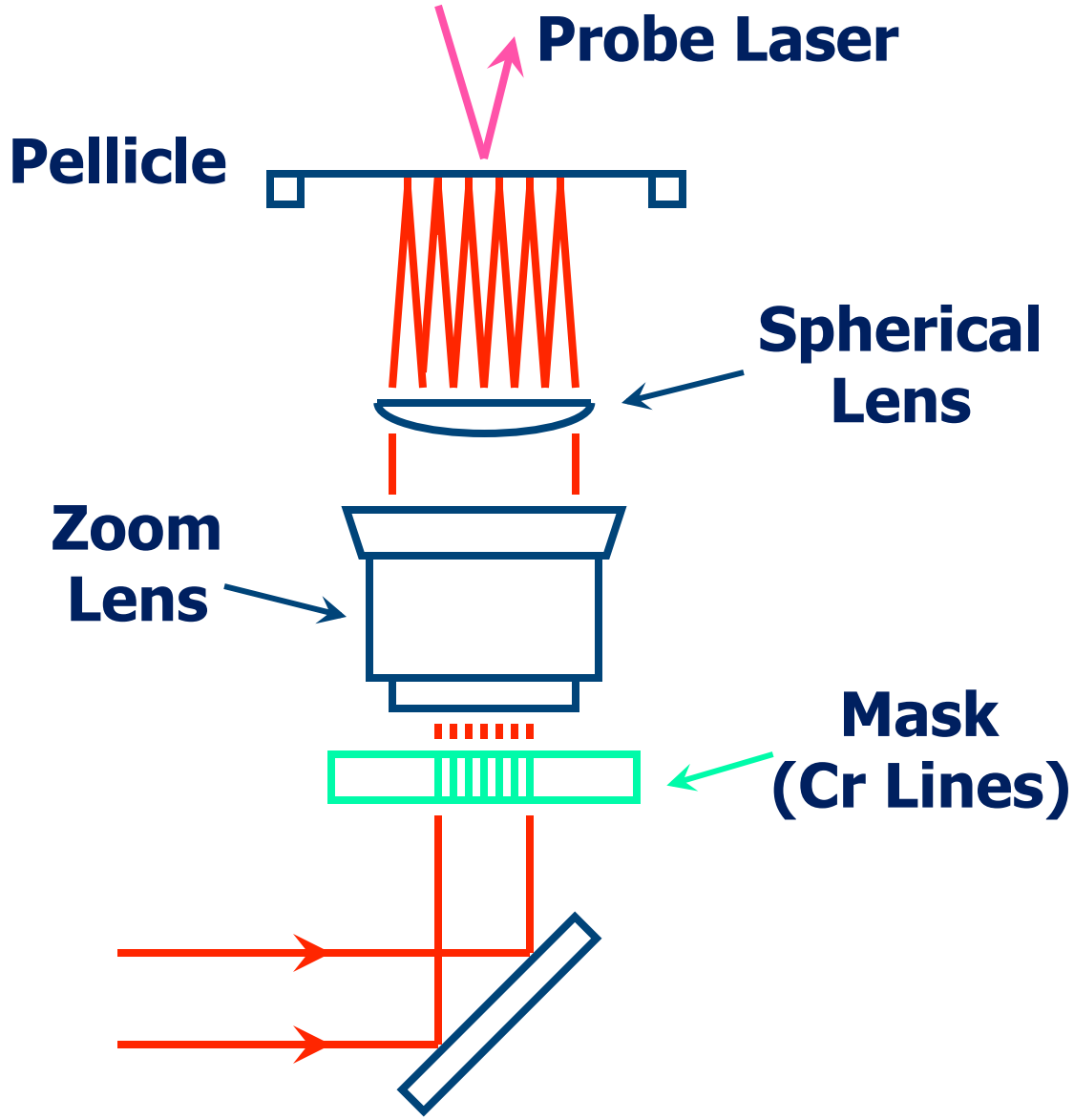
Chirped waveform

Multiple Line Source

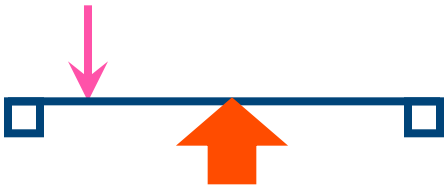


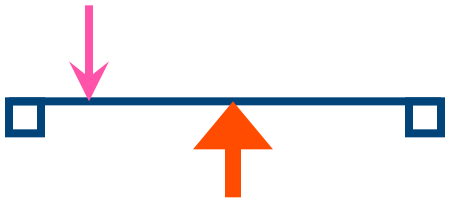
Sinusoidal waveform

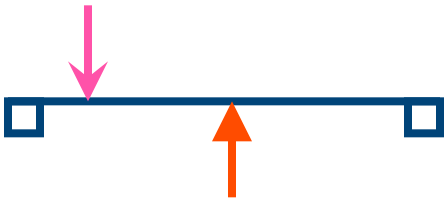
Multiple Line Source

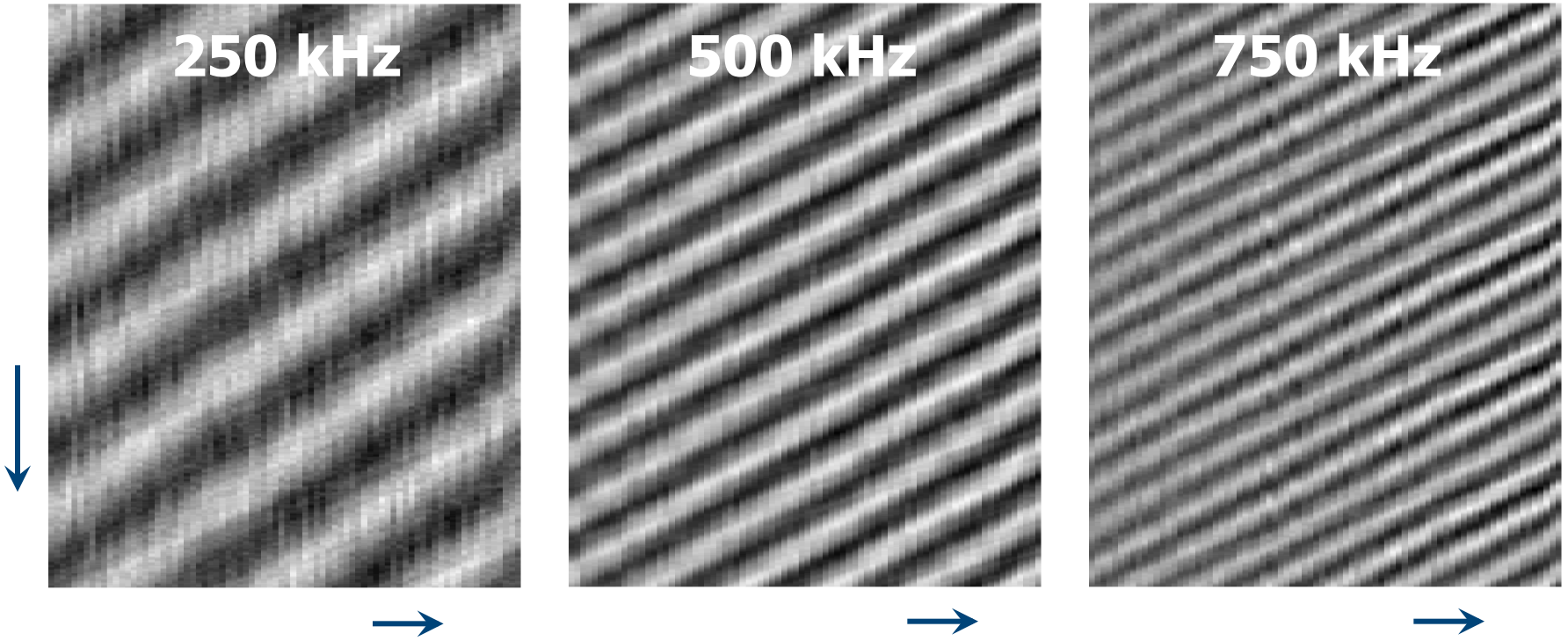


Wavefield Plots



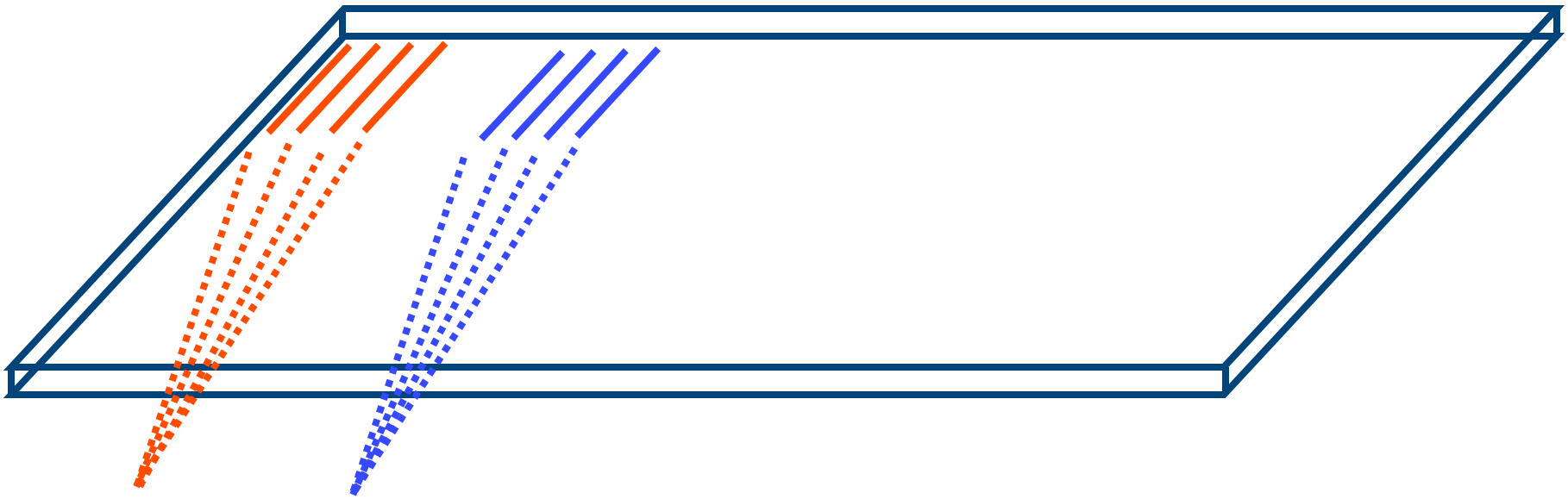






v = 80 m/s **v = 96 m/s** **v = 103 m/s**

Moving Lamb Wave Xducers: Guided-wave Evaluation



Scanned
Laser Pattern

Future

Can all optical narrow band lamb wave generation & detection applied in NDE?

Advantages:

- **Non-contact**
- **Flexible transmitting & receiving arrangement**
- **Flexible wave frequency control for detection mode choice**