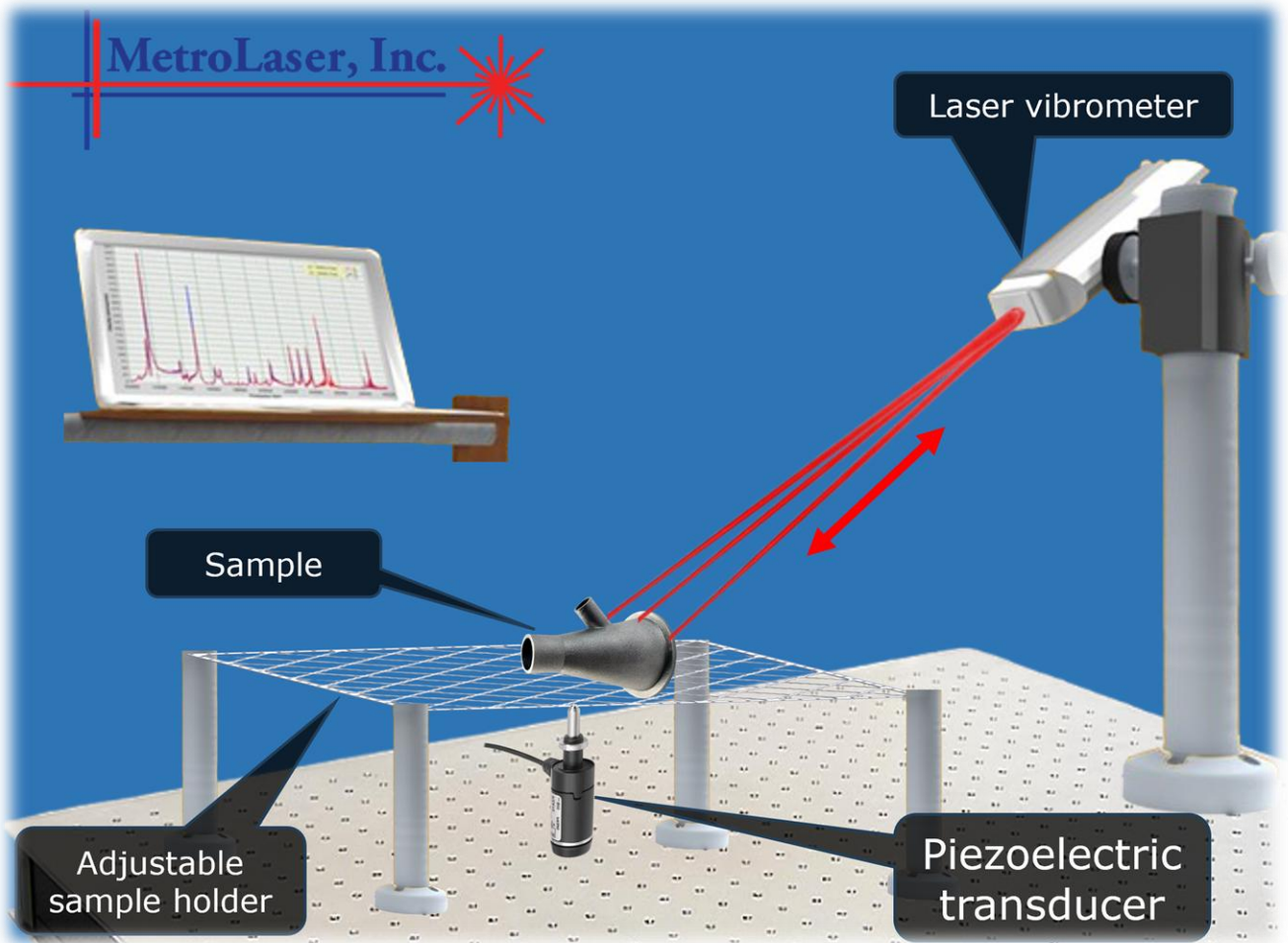


Laser Acoustic Resonance Spectroscopy (LARS)

Technical service available!

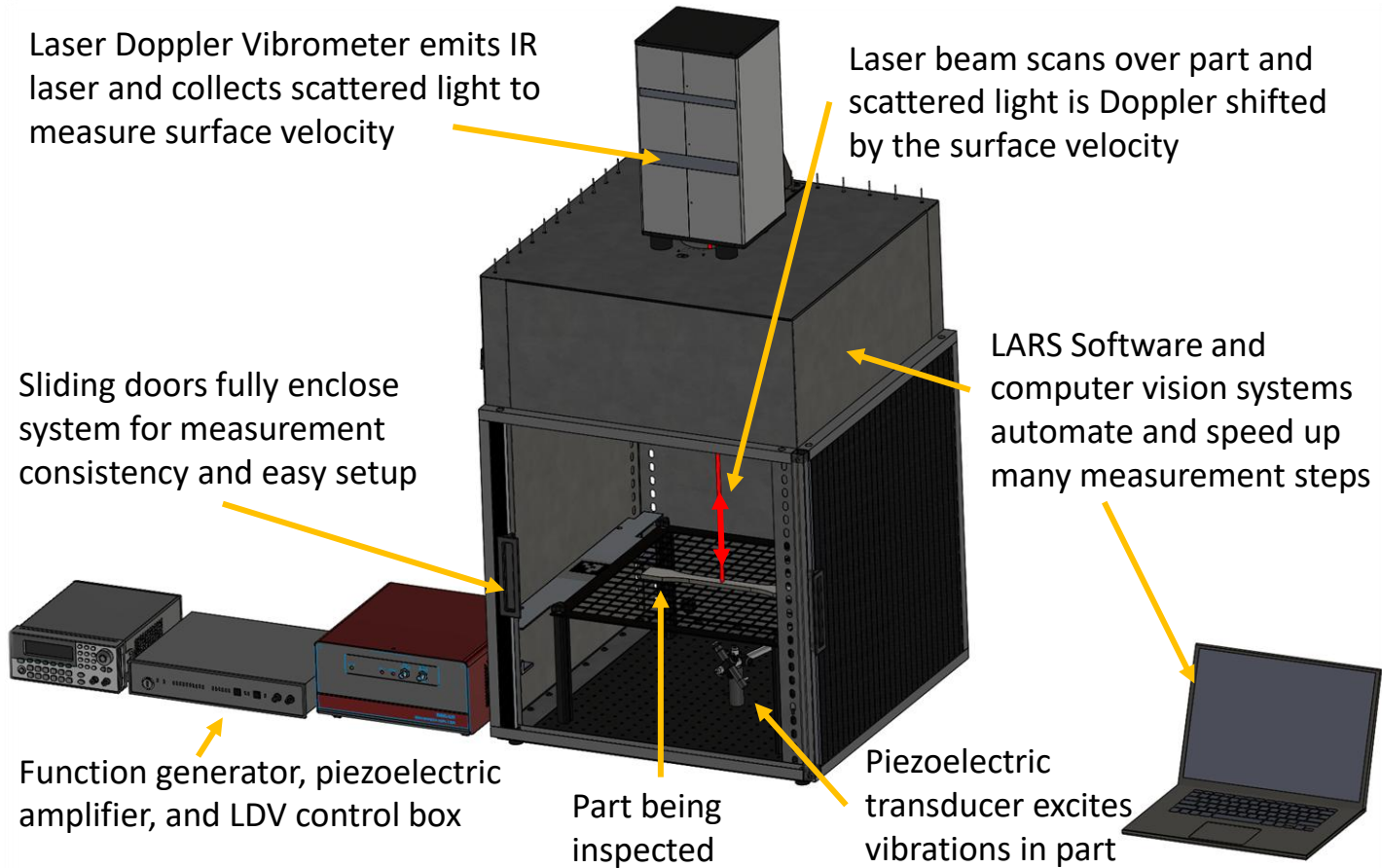


- Non-destructive evaluation
- Minimal sample preparation
- Digital rendering of vibrational modes
- Computational modeling

- Wide range of applicable materials
- High confidence
- Rapid testing
- Immediate evaluation

Laser Acoustic Resonance Spectroscopy (LARS)

The LARS Instrument



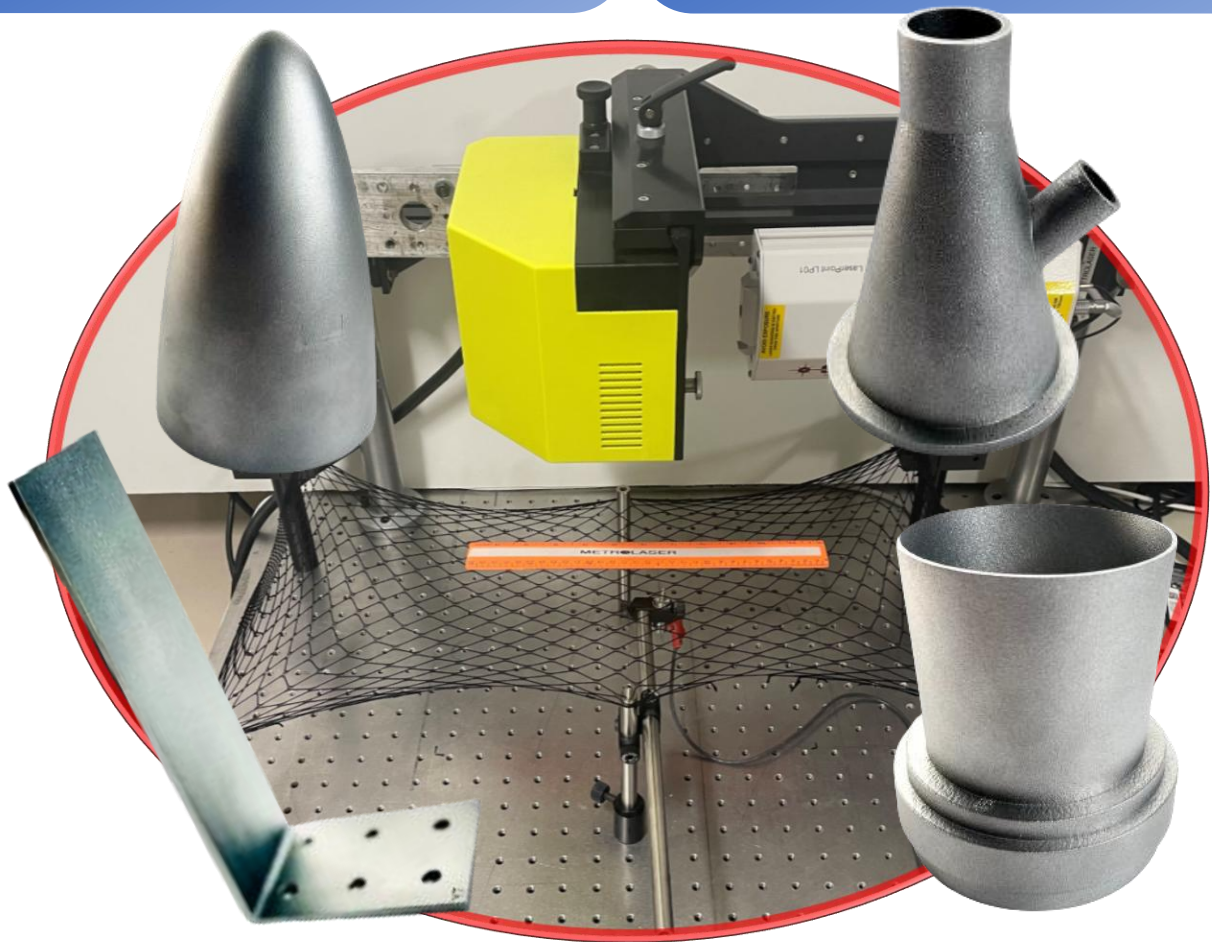
- ✓ Easy to use interface and automated measurements for rapid part evaluation
- ✓ Computer vision systems allow easy and precise choice of measurement locations
- ✓ Net and fully adjustable piezoelectric transducer positioning provide easy part setup
- ✓ Enclosure and lighting ensure consistency and reliability
- ✓ Vibration isolated from table and transducer to eliminate noise

Material compatibility:

- Metals, additively or traditionally manufactured
- Most ceramics

Applications/Uses:

- Identify defective or suspicious parts
- Authentication of parts or items



✓ Geometric complexity:

- Any

✓ Resonant Frequency range:

- 0 - 80 kHz

✓ Sample dimension:

- Up to 16" x 16" x 8"

✓ Weight limitation:

- 5 lbs.

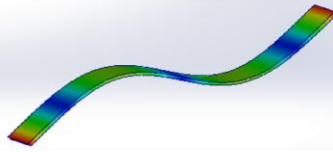
Please ask, limits may be exceeded in some cases!

Laser Acoustic Resonance Spectroscopy (LARS)

Working Principle

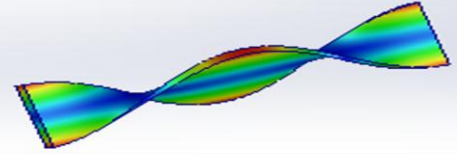
Every object has a unique set ("fingerprint") of natural vibrational resonance modes where the amplitude of vibrations peaks.

Bending



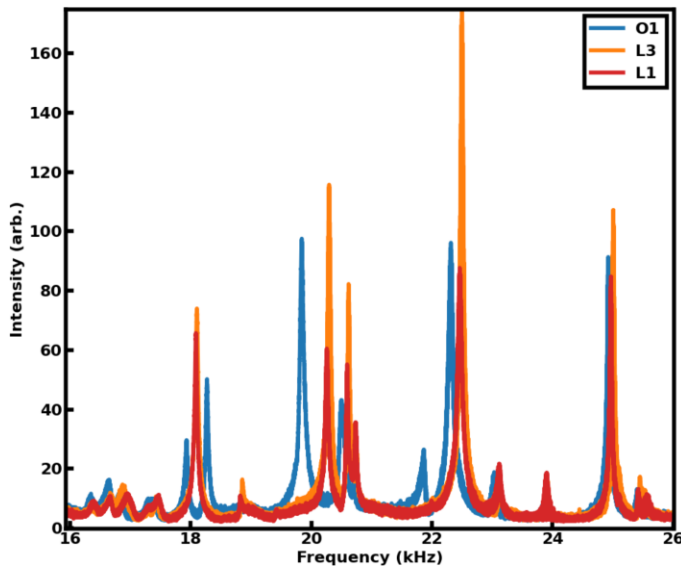
$$f_n = \frac{tc(n)}{L^2} \sqrt{\frac{E}{\rho}}$$

Torsion



$$f_t \propto \frac{c(n, t, w)}{L} \sqrt{\frac{E}{(1 + \nu)\rho}}$$

E – Young's Modulus, ρ – Density, ν – Poisson's ratio
 L – length, w – width, t – thickness, c – const. function

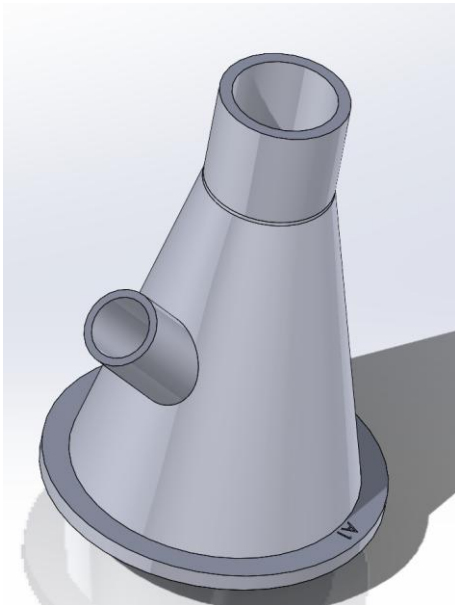
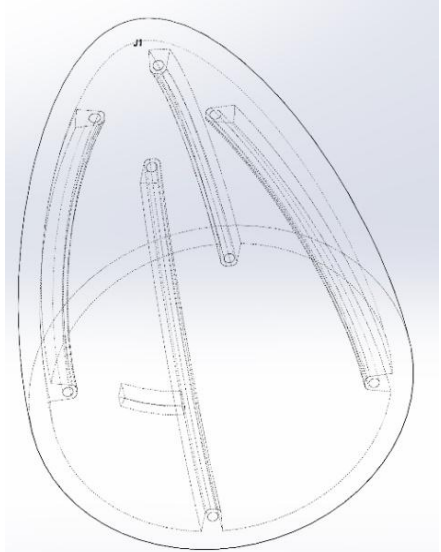
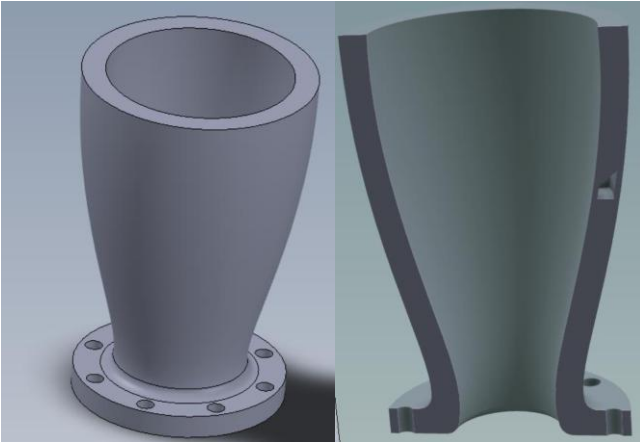


Above: O1 (blue, bracket with 0.4% internal void) has a different acoustic resonance fingerprint than L3 and L1 (orange and red, pristine brackets)

LARS measures the acoustic resonance spectrum of a part excited by a piezoelectric transducer using a Laser Doppler Vibrometer.

Damage, porosity, voids, and other defects cause changes in the fingerprint because of changes in geometry or elastic properties.

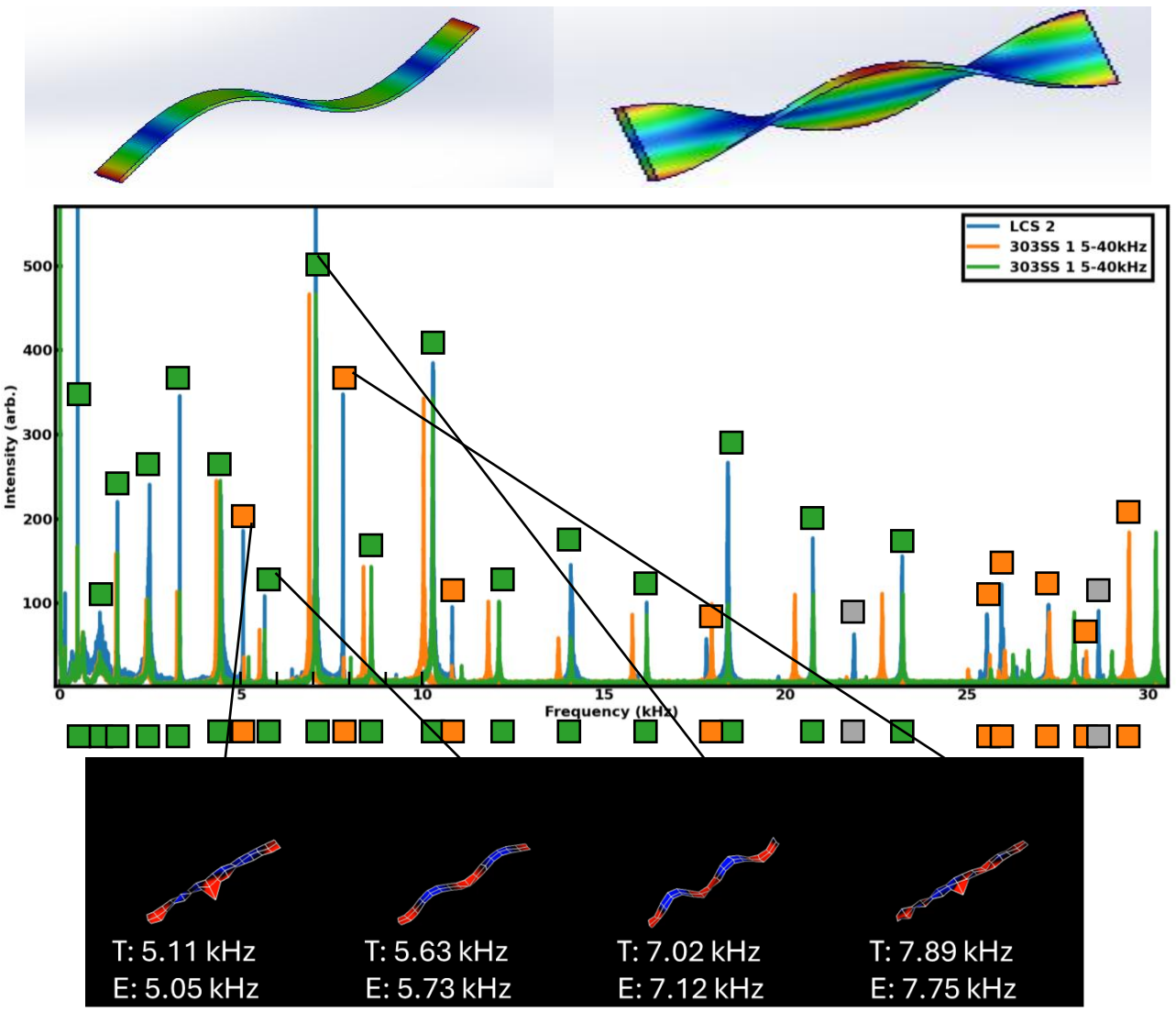
Aerospace



Rapidly characterize and qualify additively manufactured parts, including complex shapes with internal structures. Identify defective or cracked parts before use or before failure. Identify porous parts without slow and expensive CT scans.

Please ask, limits may be exceeded in some cases!

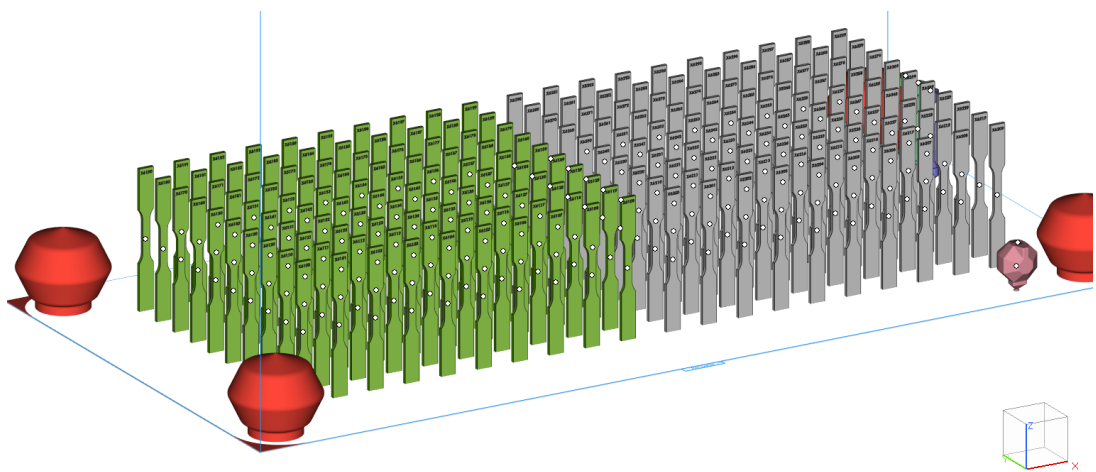
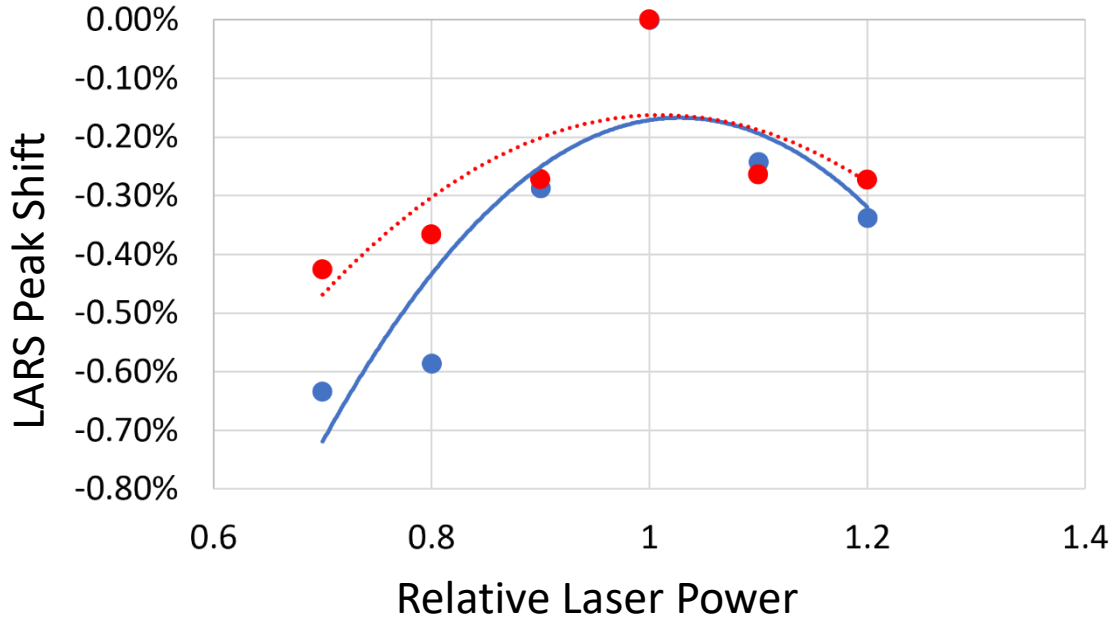
FE Model Validation



Precisely update FE models with elastic properties accurate to better than 0.1%
Identify discrepancies in vibrational properties of FE models as compared to real parts.

Please ask, limits may be exceeded in some cases!

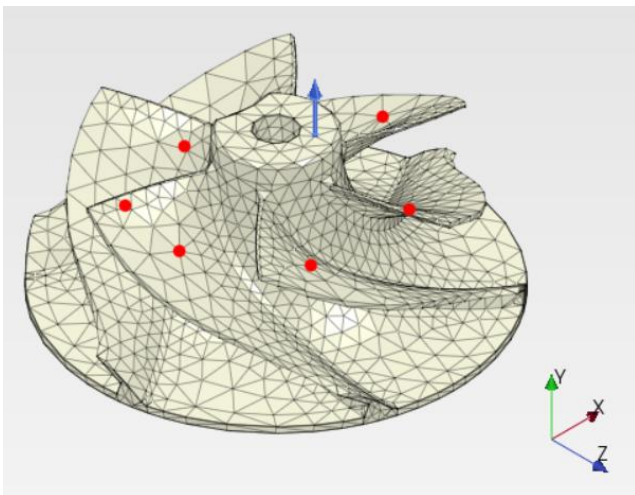
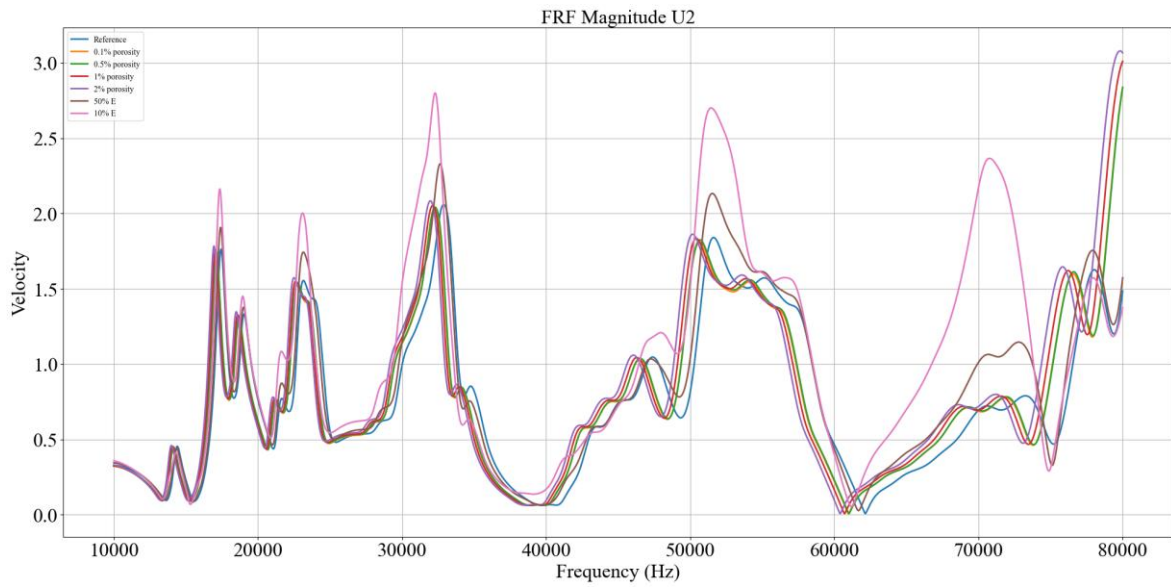
Additive Manufacturing



Rapidly qualify critical or high value parts.
Provide customers with assurance that their parts are right.
Catch defective parts (voids, porosity, bad elastic properties, wrong dimensions) before they are sent to customers.

Please ask, limits may be exceeded in some cases!

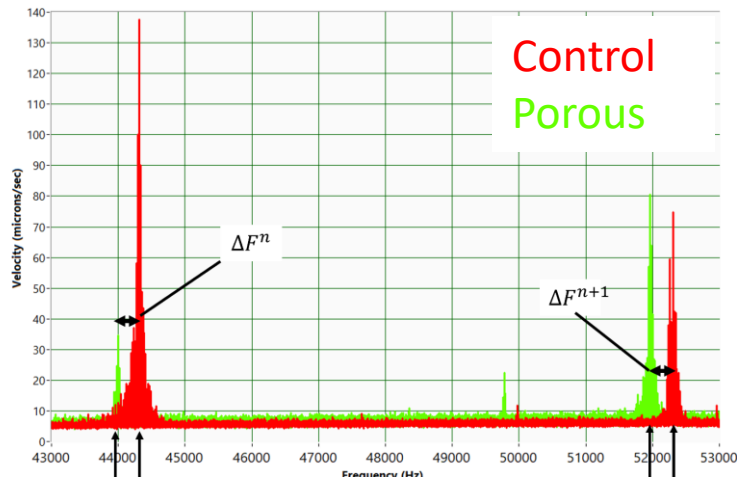
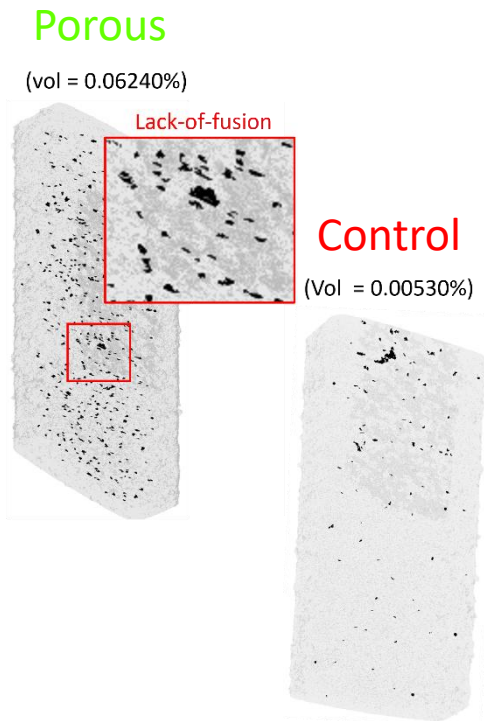
Automotive



Rapidly characterize and qualify additively manufactured parts, including complex shapes with internal structures. Identify defective or cracked parts before use or before failure. Identify porous parts without slow and expensive CT scans.

Please ask, limits may be exceeded in some cases!

Porosity Detection

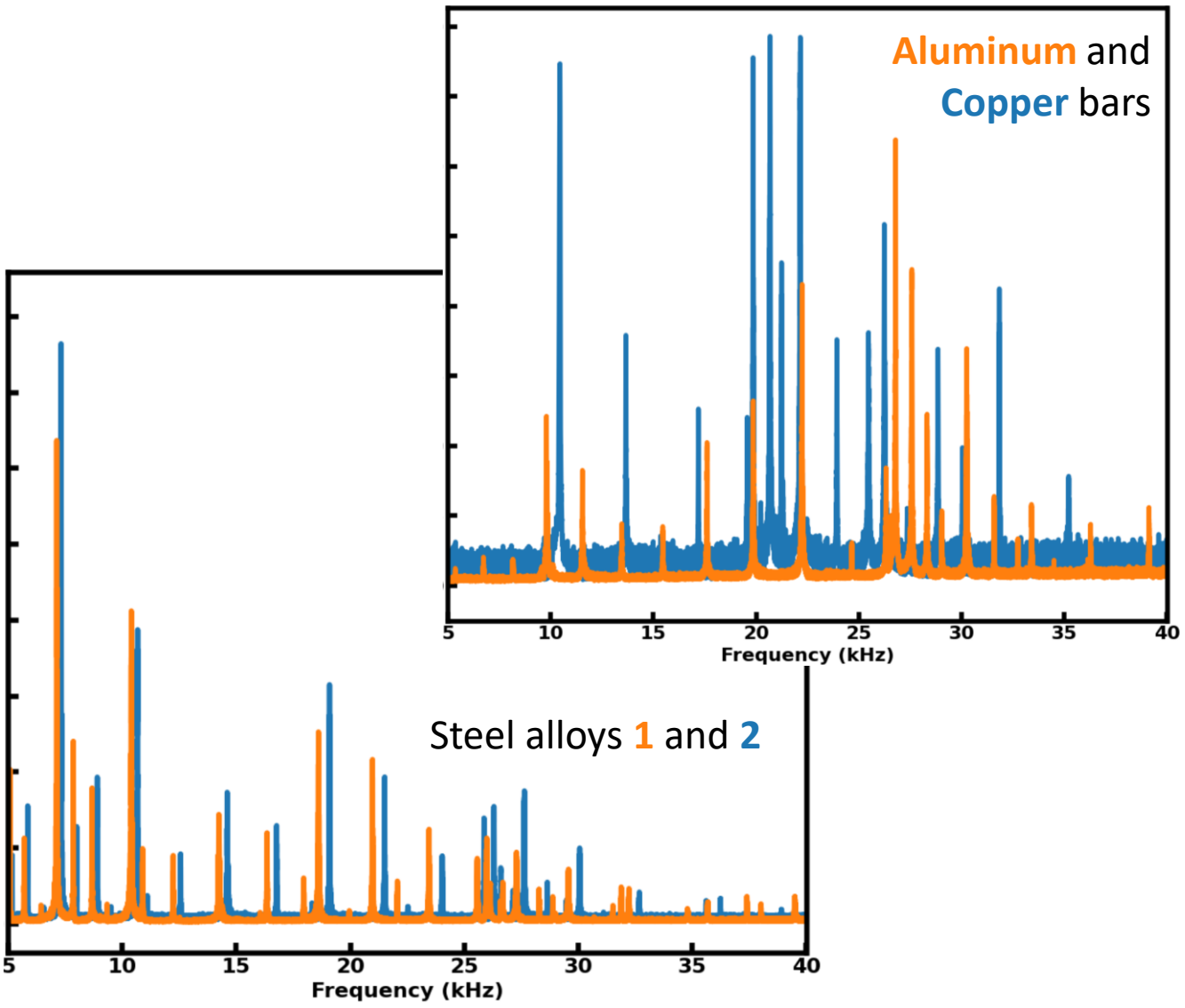


Identify elastic property changes of less than 0.1% due to porosity.

Rapidly characterize and qualify additively manufactured parts.

Please ask, limits may be exceeded in some cases!

Alloy Authentication

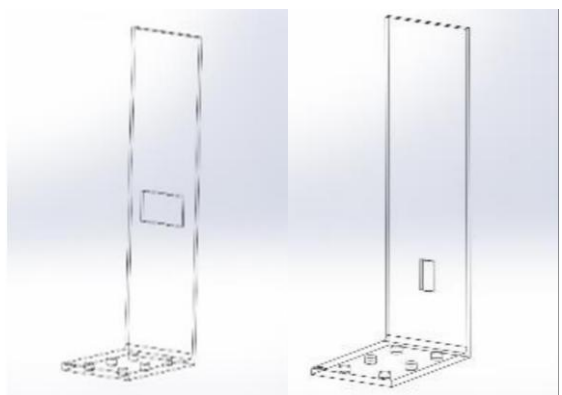
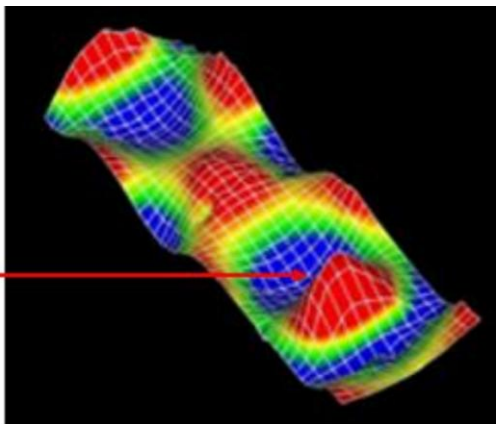
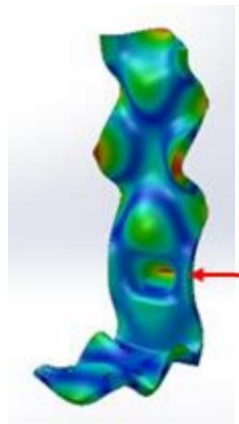
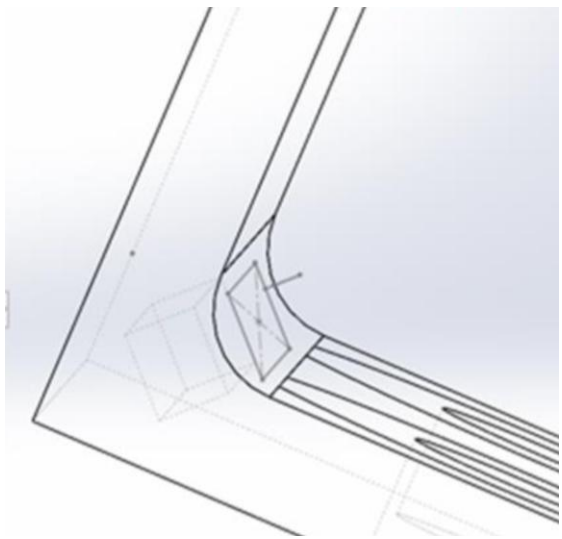


Rapidly identify parts made of the wrong material, with as little as a 0.1% variation in density or modulus.

- Parts manufactured with a cheaper alloy
- Precious metals replaced by identical density alloys

Please ask, limits may be exceeded in some cases!

Void Identification



FEA Simulation

LARS (Real Part)

Identify voids of less than 0.1% of the part volume
Rapidly batch parts into passing and defective categories
Technical Service Only: Identify mode shapes, which can reveal the location of voids

Please ask, limits may be exceeded in some cases!

Laser Acoustic Resonance Spectroscopy (LARS)

Technical services available upon inquiry:

Nondestructive quality assurance, authentication, and vibrational characterization

MetroLaser Inc.
22941 Mill Creek Drive
Laguna Hills, CA 92653, USA
Ph: (949) 553-0688 ext. 244
Fax: (949) 553-0495
Email: sales@metrolaserinc.com

