

SCANNING LASER DOPPLER VIBROMETRY

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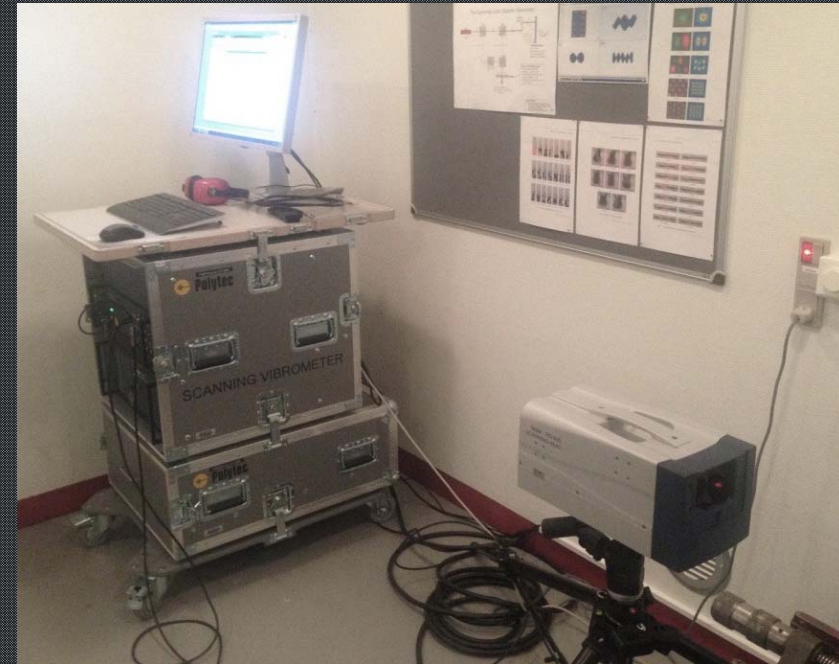


THE EQUIPMENT

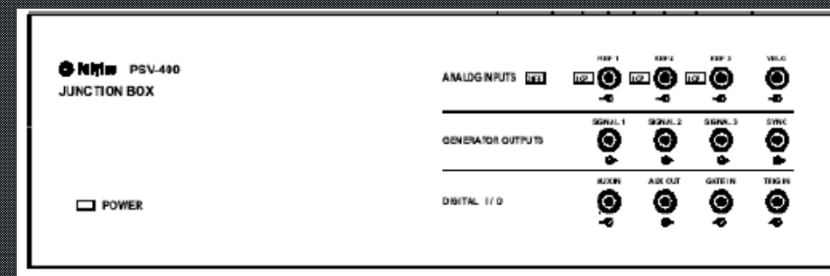
- THE SCANNING HEAD
- DATA MANAGEMENT SYSTEM
- FRONT END - JUNCTION BOX
- PSV SOFTWARE



Polytec, 2014



DTU lab, 2016

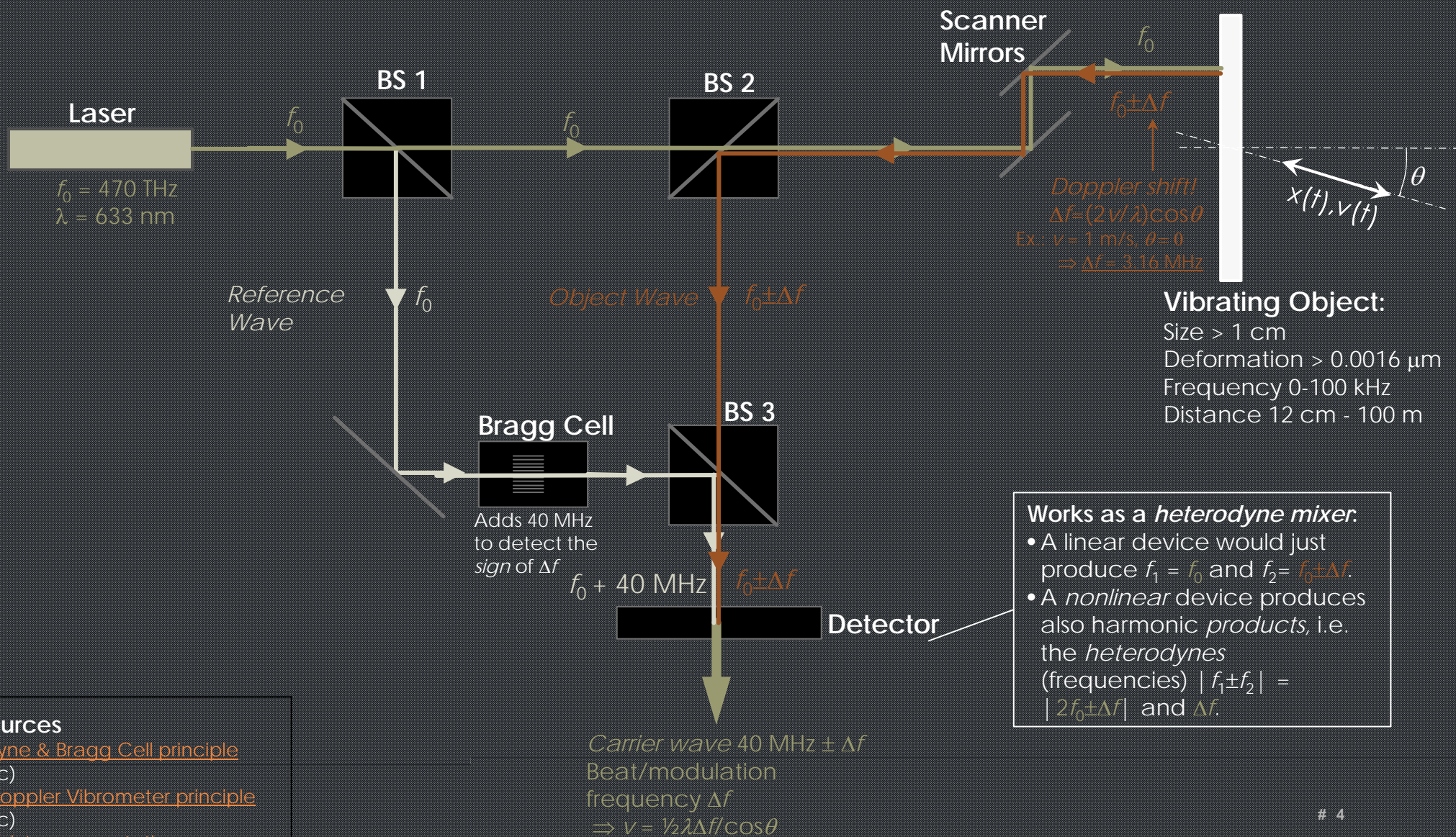


Polytec, 2014

ESSENTIAL NUMBERS

Displacement range	> 0.0016 μm
Velocity range	0.001-10 m/s
Frequency range	0-100 kHz
Object distance	12 cm-100 m
Object surface requirements	Diffusely reflecting
Object size	> 1 cm

THE MEASURING TECHNIQUE



- Some sources**
- [Heterdyne & Bragg Cell principle](#) (Polytec)
 - [Laser Doppler Vibrometer principle](#) (Polytec)
 - [More Polytec presentations](#)
 - [Laser Doppler Vibrometer](#) (Wikipedia)

PROS AND CONS

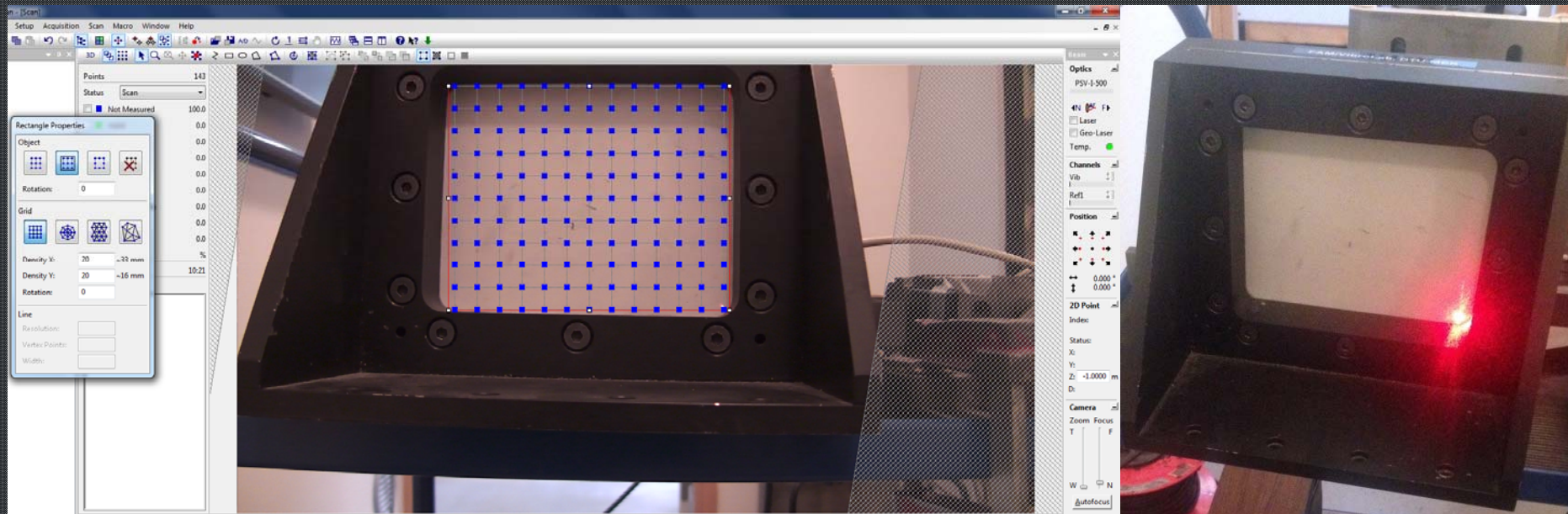
- CONTACTLESS
- HUGE RANGE OF DISTANCES
- SCANS A SURFACE
- COSTLY
- FRAGILE
- TAKES UP SPACE
- NOT VERY PORTABLE



Setup at DTU lab

APPLICATION IN PRACTICE

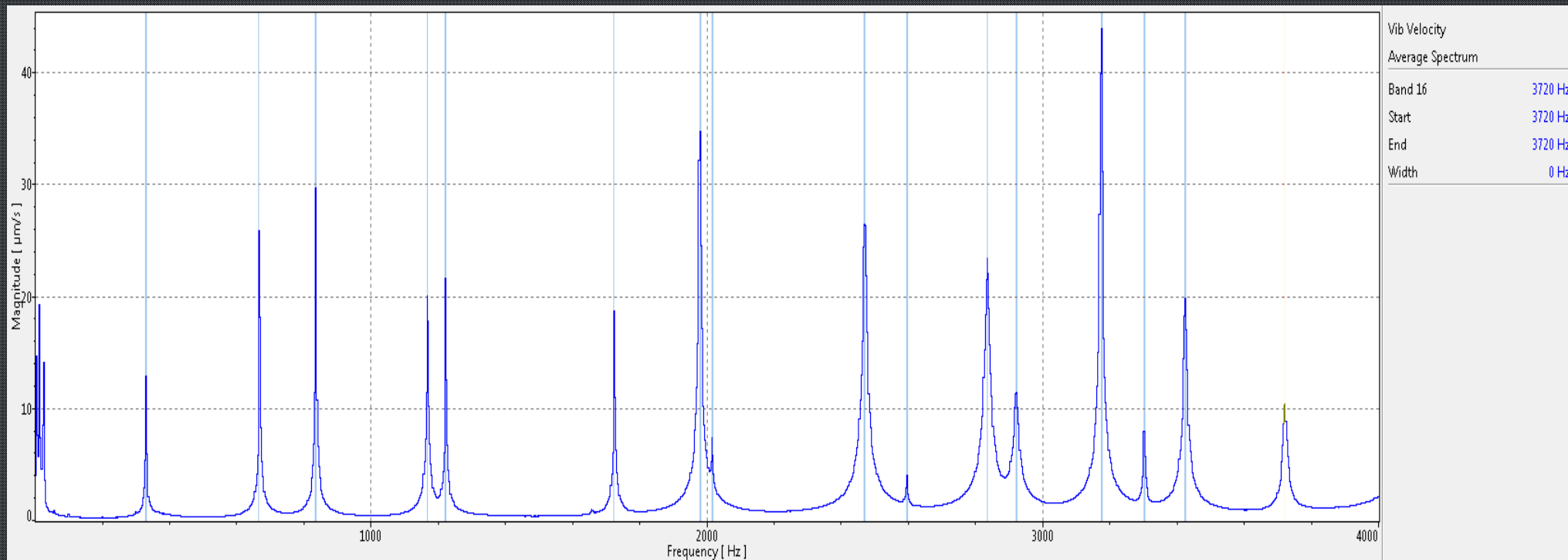
- USED FOR COURSE 41811 EXPERIMENTAL SOLID MECHANICS
- SIMPLE SUPPORTED PLATE
- EXCITATION: PIEZOELECTRIC DISC
- SURFACE TREATMENT: WHITE SURFACE



Example of measurement grid

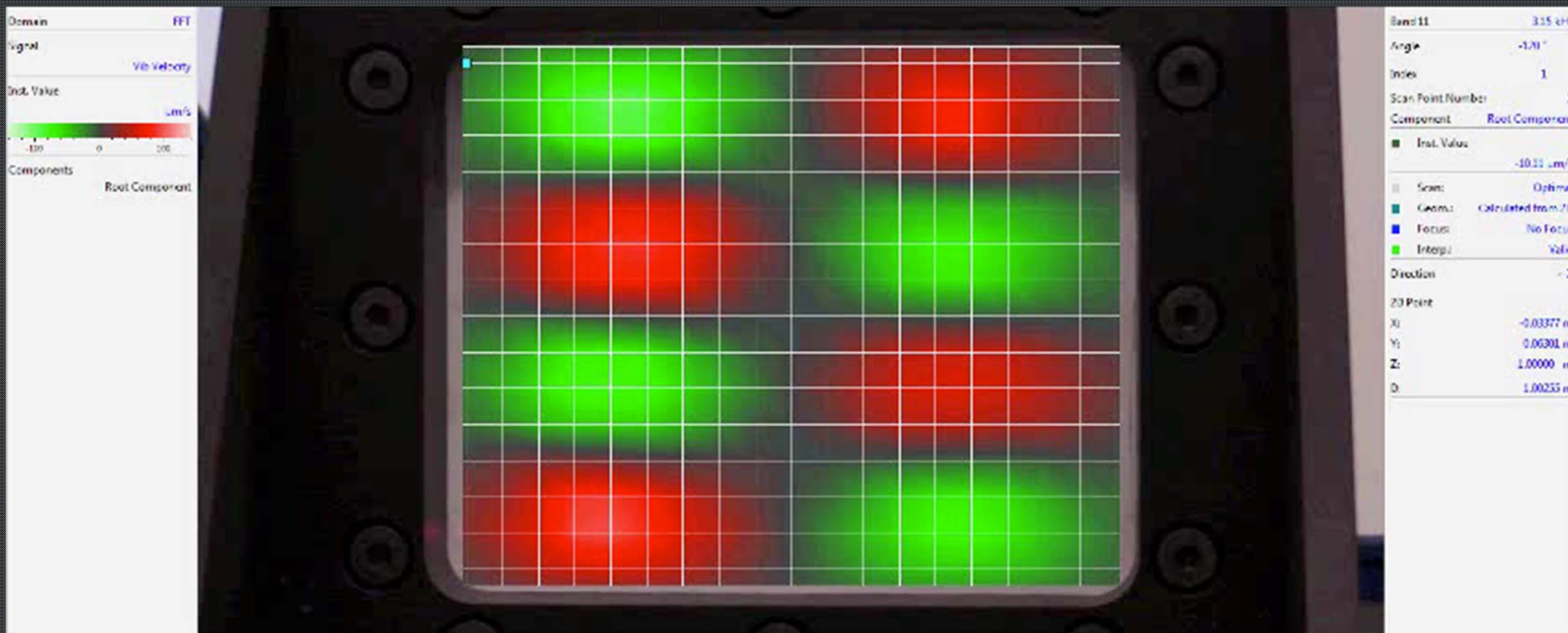
APPLICATION IN PRACTICE: PSV SOFTWARE

MEASURE & DISPLAY: FREQUENCY RESPONSES ON A SCANNED GRID



Example measured spectrum for a single grid point

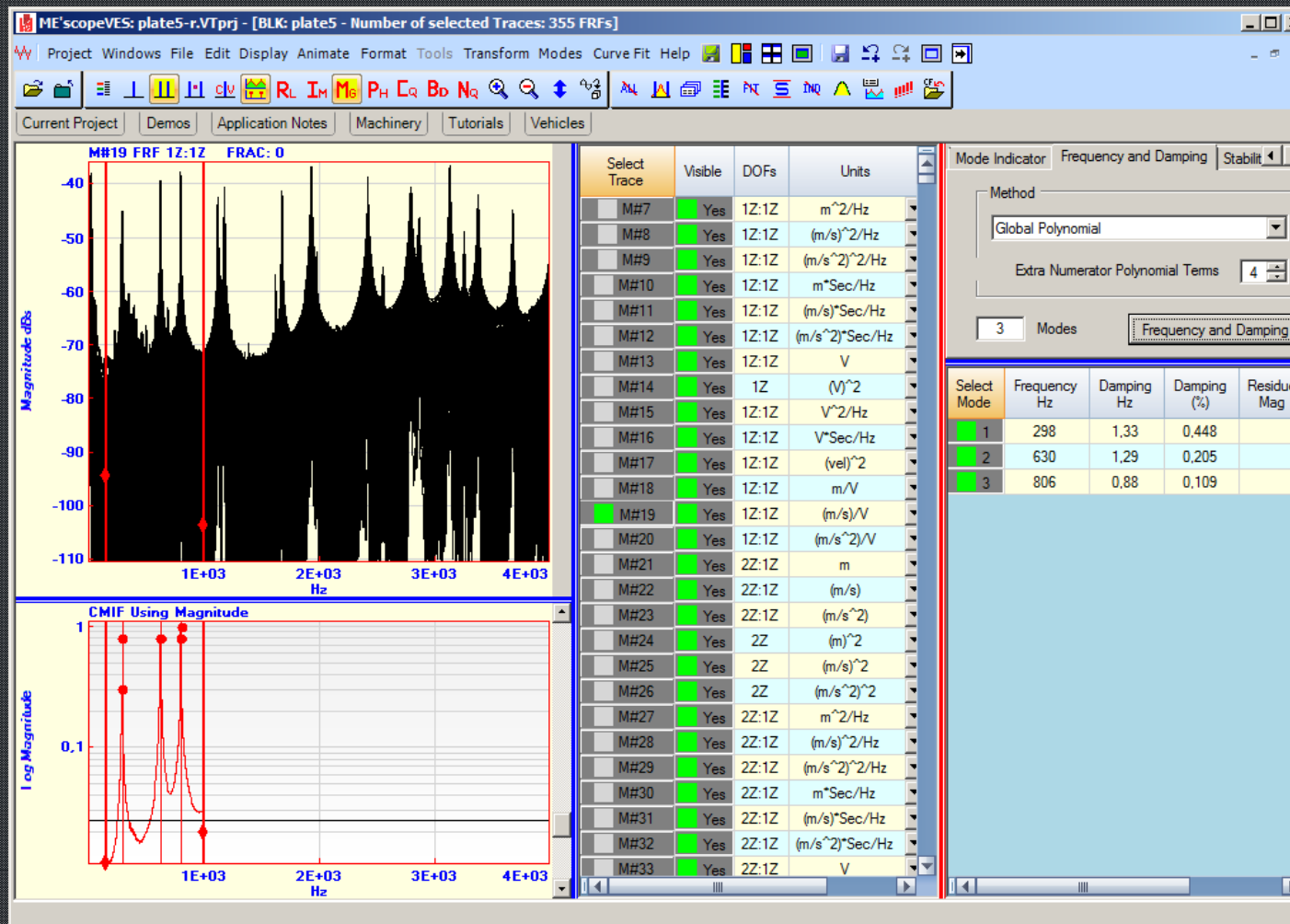
APPLICATION IN PRACTICE: PSV SOFTWARE



Example: operational deflection shape at a selected (resonant) frequency

APPLICATION IN PRACTICE

WITH ME'SCOPE: ESTIMATE MODAL PARAMETERS:
NATURAL FREQUENCIES, DAMPING RATIOS, MODE SHAPES

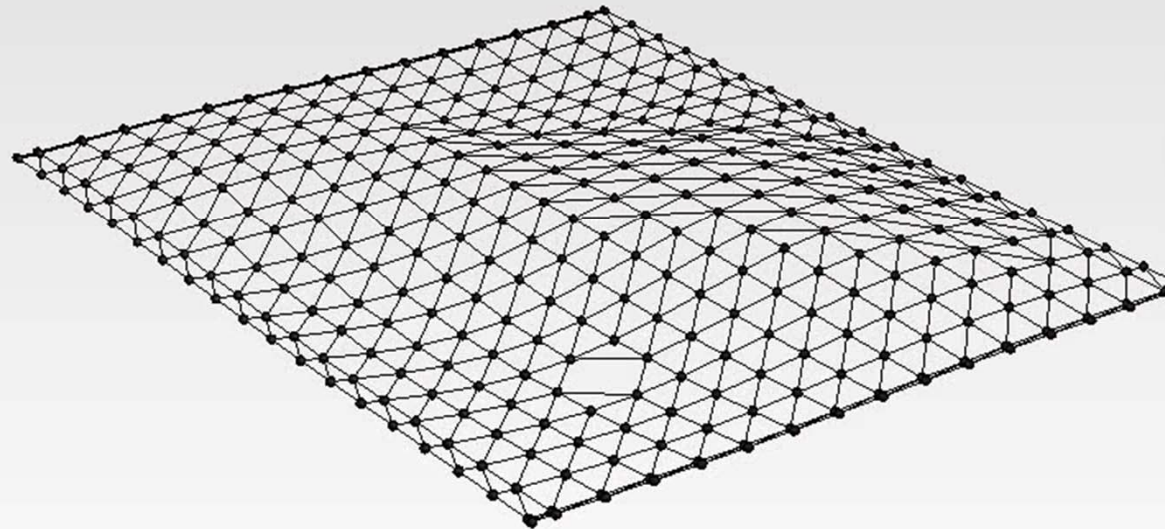


ME'Scope during modal parameter fitting

APPLICATION IN PRACTICE

View: 3D View
[Complex Shape]
SHP: Shape Table 1
Freq: 813 Hz
Damp: 0.111%

With ME'Scope: Estimate modal parameters:
Natural frequencies, damping ratios, mode shapes

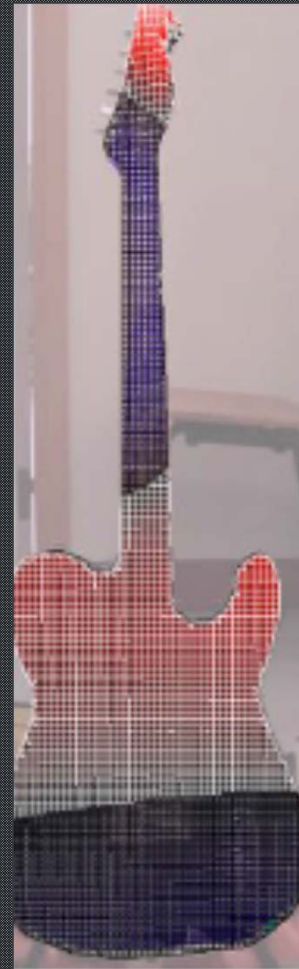


PROJECTS WITH SLDV

PHYSICS-BASED MODELLING OF ELECTRIC GUITAR SOUND AND VIBRATION

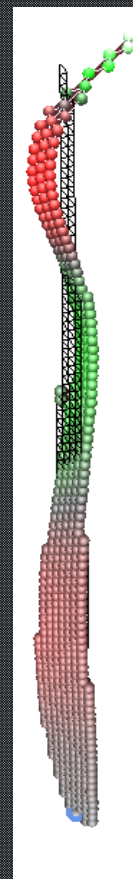
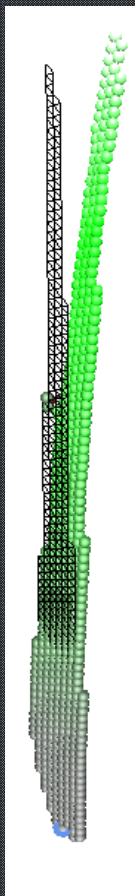
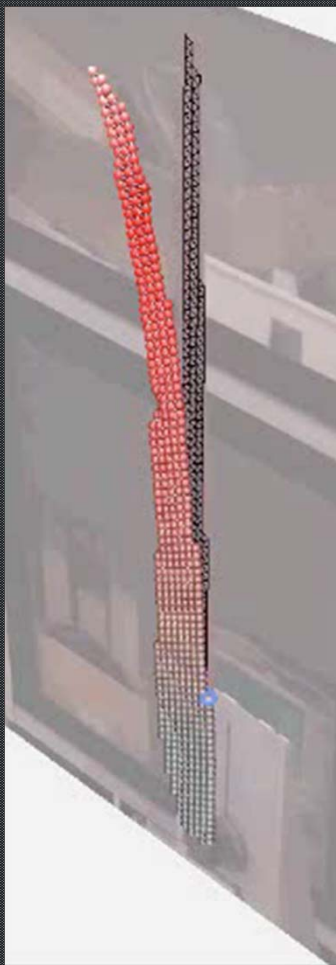


Guitar body & neck mode shapes
@193/1038 Hz [Joensen 2015]



PROJECTS WITH SLDV

VIBRATIONS OF A WIND TURBINE BLADE



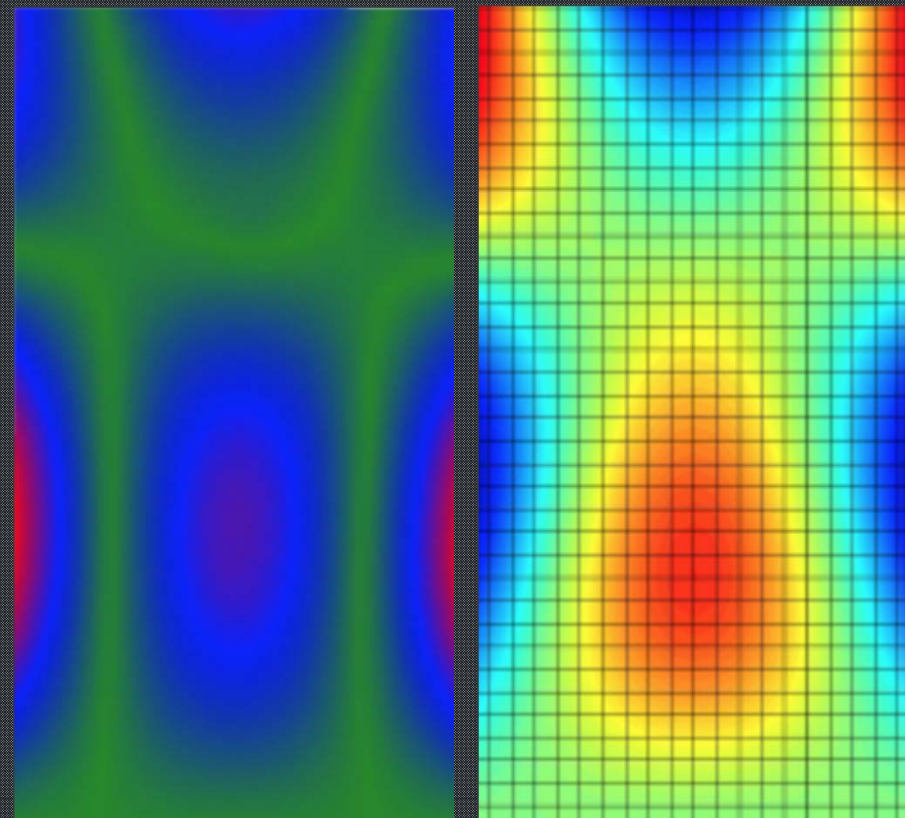
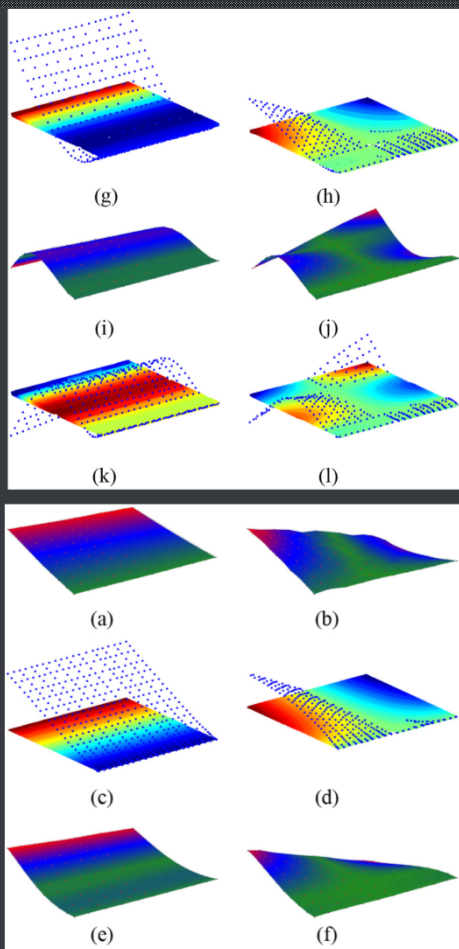
1st bending mode, 21 Hz

[Vladimir Fedorov, Researcher, DTU Wind Energy]

4th bending mode, 182 Hz

PROJECTS WITH SLDV

SMART MATERIALS APPLIED TO CONTROL GAS BEARING DYNAMICS
&
DYNAMICAL EXPERIMENTAL COUPLING USING SUPERELEMENTS

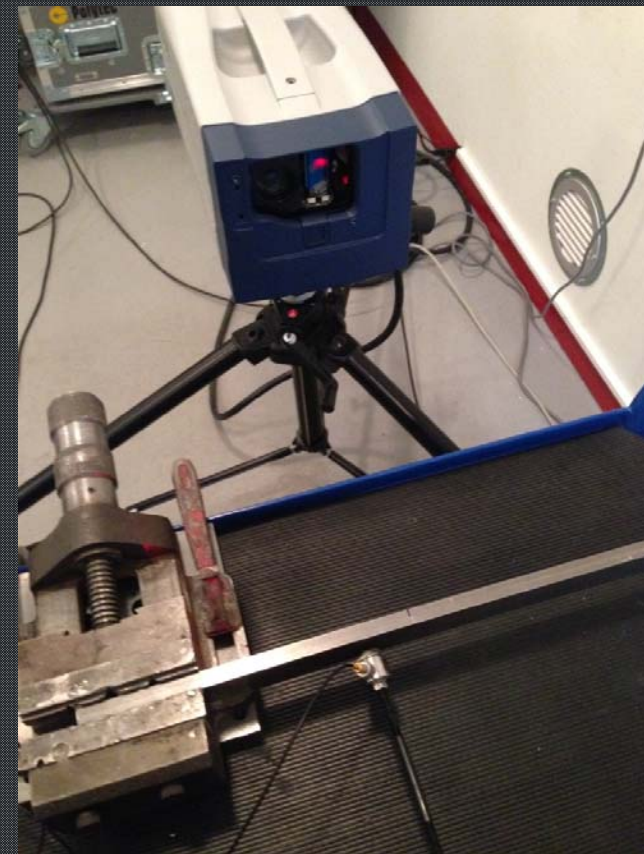
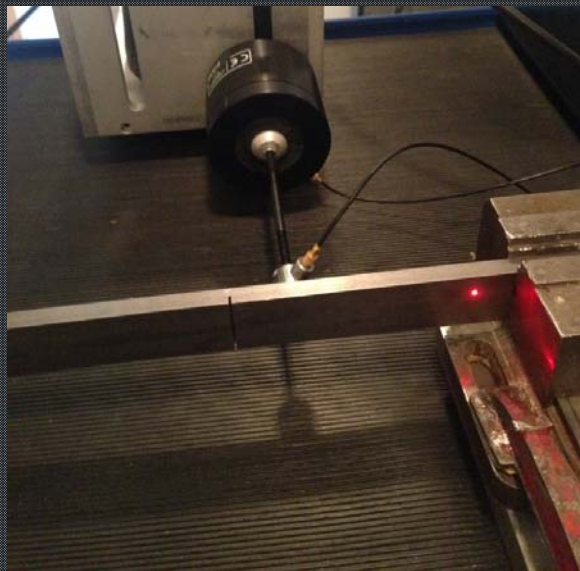
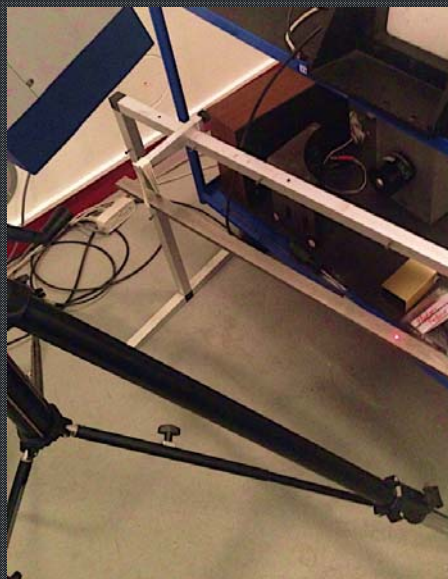


Clamped plate mode shapes, measured (left) and theoretically predicted (right) [Størme 2016]

[Martin Sander Nielsen Msc thesis]

CURRENT PROJECTS

TIMOSHENKO BEAM VIBRATION THEORY
&
CRACK DETECTION



[Mads Hilmer Christensen, Msc thesis 2016]

[Marie Brøns, Msc thesis 2016]

FUTURE PROJECTS

VIBRATIONS FOR ESTIMATING BOLTED JOINT INTEGRITY (VEBJI) PROJECT.

DFF GRANTED PROJECT CONCERNING BOLTED JOINTS.



USING THE SLDV FOR YOUR PROJECT?

- EMAIL JON J. THOMSEN
- LAB TECH. BENNY EDELSTEN WILL PROVIDE PRACTICAL ASSISTANCE
- CAN ONLY PROVIDE EQUIPMENT ACCESS TIME. BRING YOUR OWN EXPERTISE
- ACCESS ONLY FOR USERS NEEDING THE SCANNING FEATURE
- NO REALLY PORTABLE



SUMMING UP...

- LARGE RANGES IN MEASUREMENT DISTANCE, FREQUENCY AND DISPLACEMENT
- SCANS A SURFACE
- USED FOR MANY TYPES OF PROJECTS
- COSTLY AND FRAGILE
- EASY-TO-USE, IF YOU HAVE SOME VIBRATION MEASUREMENT EXPERIENCE

