lva laboratoire vibrations acoustique

LABORATORY OF VIBRATION AND ACOUSTICS

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

membre de UNIVERSITÉ DE LYON

intoduction to the laboratory

The laboratory features innovative equipments for experiments and high-performance measurement rooms

The Laboratory of Vibration and Acoustics (LVA), which is part of the Mechanical Engineering and Design Department at the National Institute of Applied Sciences (INSA Lyon), was created in the 1970s to meet the growing interests of industrial companies – in particular transportation companies – centred around the connection between structural dynamics and acoustics

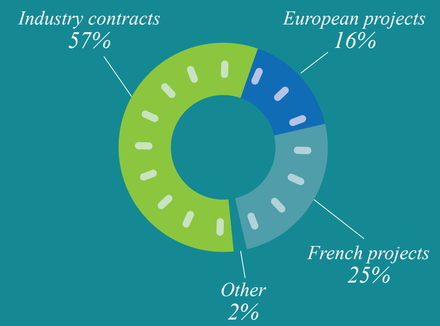
Since then, the LVA's research activities have always been carried out to monitor and anticipate challenges facing companies in industry.
These activities are based on 4 main themes: vibro-acoustics, the identification of sources, noise and vibration perception, and monitoring, diagnostics and non-destructive testing.

Each year, the LVA is involved in a large number of European, French or contract projects in fields as varied as transport, shipbuilding, aeronautics, health, imaging, nuclear and electromechanics.

The LVA, which is a founding member of the CeLyA (Lyon Centre for Acoustics) Laboratory of Excellence (LabEx), is part of the Carnot I@L Institute (Engineering @ Lyon) and takes part in organising the Visible Research Group and the Vibro-acoustics and Noise Control (GVB) Group of the French Acoustics Society (SFA).
The laboratory welcomes post-doctoral students, doctoral students from MEGA (School of Mechanics, Energy, Civil Engineering, Acoustics), Masters 2 students and students from the Mechanical Engineering and Design Department of INSA Lyon who are working on their final projects.

key figures

RESEARCH PROJECTS



STAFF

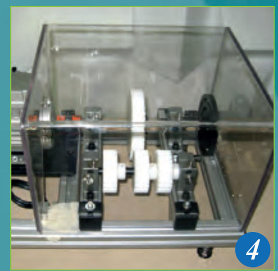
Administrative and technical staff

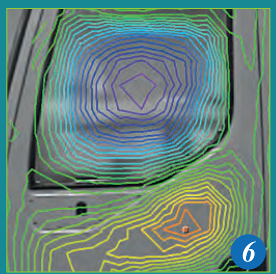
Doctoral and post-doctoral students

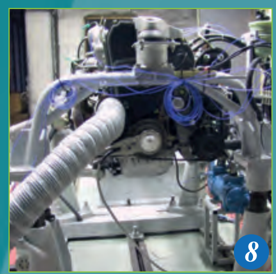
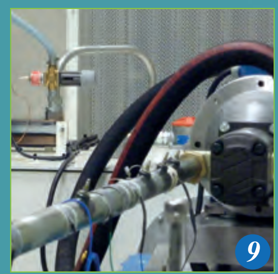
Teaching staff

equipment






1) *Anechoic chamber for characterising acoustic sources.*
2) *Microphone antennas (flat or spherical) for identifying acoustic sources.*
3) *Audiometric test room and dummy head.*
4) *Simulation test bench for defects in gear systems.*
5) *Kundt tube for characterising absorbent materials.*
6) *Use of scanning laser vibrometer for measuring structural vibrations.*
7) *Acoustic pressure/velocity probe antennas.*
8) *Power train test benches with instruments in an anechoic chamber.*
9) *Hydraulic bench for characterising pumps.*
10) *Anechoic chamber.*

Primary journals in which the laboratory has published articles:

Journal of the Acoustical Society of America, Journal of Sound and Vibration, Applied Acoustics, Journal of Vibration and Acoustics, Acta Acustica united with Acustica, Mechanical Systems and Signal Processing, Journal of Applied Physics; Smart Materials and Structures; Structural Health Monitoring, Journal of Intelligent material systems and structures, Nuclear Instruments and Methods, Pattern Recognition Letters, IEEE Transactions on Nuclear Science, IEEE Instrumentation and Measurement.

CeLyA Centre Lyonnais d'Acoustique UNIVERSITÉ DE LYON

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vibro-acoustics



Modelling, understanding and predicting the transfer of vibrations and the acoustic radiation of structures in the air, in water (maritime applications) or in the ground (railway applications) are the primary issues for this research topic.

Advanced digital methods are developed for solving problems at low frequencies (modal approaches based in particular on the use and post-processing of data from finite element methods), and medium and high frequencies (energy methods).

Vibration and noise reduction devices (absorbent materials, padding, multiple layers, multiple materials, micro-perforated structures) are characterised experimentally and used in numerical models.

The development of active digital systems that use MEMS (Micro-electro-mechanical systems) technology is also carried out, notably to create loudspeakers or innovative digital sensors.

Key words

Airborne and structure-borne transmission - acoustic transparency - fluid-structure interaction - digital loudspeaker - MEMS - Sound absorption by irregular shapes - vibro-acoustic ageing of materials - structural response to turbulent flows - vibro-acoustics of stiffened structures - numerical sub-structuring methods - finite elements - boundary elements - NVH synthesis - modelling using equivalent fluid.

Key words

Near-field acoustic holography - spherical antenna - deconfinement and separation of sources - Transfer Path Analysis - data completion - intensity measurement - acoustic identification by virtual volume - discretisation of the equation of motion.

identification of sources

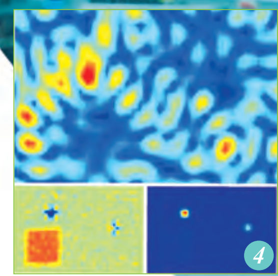
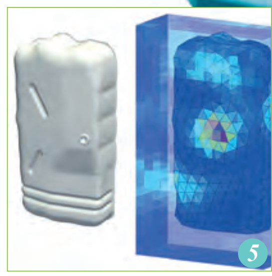
The identification of sources is based on so-called «inverse» methods because the consequences (noise, vibrations) are measured in order to quantify and locate the cause (vibration velocity, effort).

For acoustics, the laboratory uses methods based on antennas (flat or spherical), near-field acoustic holography or the solution to the Helmholtz equation in a closed cavity.

The notions of the deconfinement of sources, of regularisation, of Bayesian a priori, of least complexity and of parsimony are developed and implemented for this topic.

For vibration, the velocity field of the structure is measured to identify the efforts applied as well as to quantify the Young modulus and the damping and even to identify the adapted theoretical model.

The intrinsic characterisation of sources such as pumps is also studied, in particular using methods based on impedance and mobility.


1) *Acoustic radiation inside and outside a car engine compartment using the Patch Transfer Functions Method.*
2) *Development of medium-frequency vibro-acoustic methods to maintain the acoustic performance of streamlined lorry cabs.*
3) *Digital loud-speakers array.*
4) *Location of visco-elastic damping patches and of efforts on a plate by discretisation of the equation of motion.*
5) *Method for identifying the vibratory field of a 3D part using acoustic measurements.*
6) *Near-field acoustic holography for detecting sources from a car engine.*

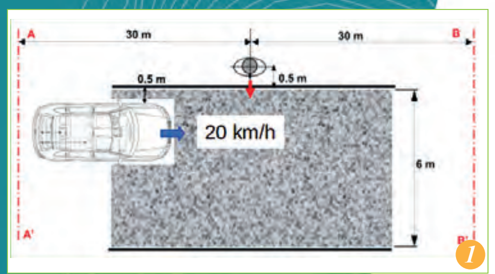
2

Key words

Detection of sounds in an urban noise environment - classification of defects by sound perception - perceptive models - realistic vibro-acoustic environment of a vehicle - sensory methods - psycho-physical laws.

noise and vibration perception

The goal of this topic is a better understanding of how the sound of an industrial object is assessed by a listener.
Simple noise quantification criteria, such as the potentially A-weighted overall level, are not sufficient to predict this subjective assessment.
Other phenomena are involved: peripheral phenomena associated with the operation of the hearing mechanism and cognitive phenomena which directly influence the assessment of a noise according to the listener's expectations, history and tastes.
This is the purpose of this research topic, which also addresses vibratory comfort and the coupling between the acoustic and vibratory modalities.



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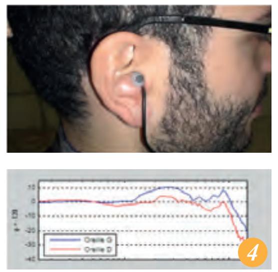
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Key words

Structural Health Monitoring [SHM]- detection - identification - diagnostic - prognosis and self-healing - monitoring of machining - classification of defects - merging information - cyclostationarity - acoustic microscopy.


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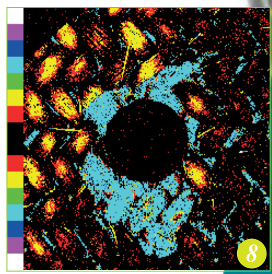
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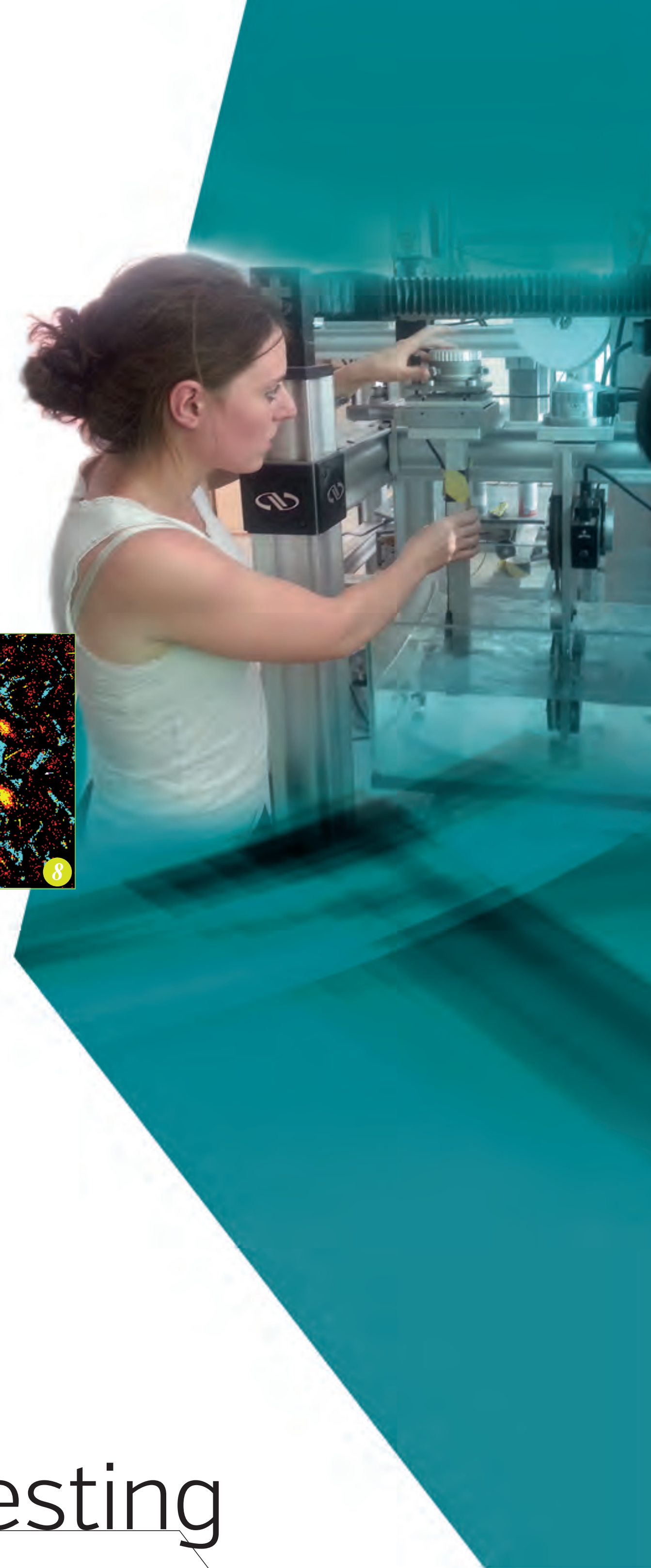

1) *Detection of warning signals from pedestrians for electric vehicles in an urban noise environment.*
2) *Binaural recordings of noise caused by shutting a car door in an anechoic chamber.*
3) *Simulation test bench for the vertical vibrations of a car seat and for listening to the noises recorded in the cabin.*
4) *HRTF [Head Related Transfer Function] measurements.*
5) *Dummy head for binaural signal recordings.*
6) *Vibration monitoring of rotating equipment for machining.*
7) *X-ray tomography.*
8) *Acoustic microscopy.*

monitoring, diagnostics, non destructive testing

This research topic is dedicated to the development of methods based on vibratory and acoustic analysis for monitoring and diagnostics relating to rotating equipment (condition monitoring) as well as on the detection, localisation and characterisation of defects.
Likewise, the characterisation of the materials and monitoring of structures (Structural Health Monitoring) is addressed using ultrasound measurement methods.
Acoustic microscopy is an imaging and characterisation method that uses mechanical waves of a high enough frequency (from a few MHz to several GHz) to reach resolutions comparable to those of optical microscopes.

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