Overview of the programs

Below is a list of the available trainings. It is still possible to adjust the program to the background and to the specific expectations of the participants.

Course BASICS

	Code	Duration (day)
Introduction to Acoustics	BAS-ACOU	1
Building acoustics	BAS-BAT	1
Transportation acoustics	BAS-TRA	1
Introduction to the numerical methods for acoustics	BAS-NUM	1

Course MEASUREMENTS

Measure with an impedance tube using 2, 3, 4 microphones	EXP-TUBE	0,5
Material characterisation – acoustic, elastic and damping parameters	EXP-CARAC	1
Building acoustic measurements – in lab and in-situ	EXP-BAT	1

These trainings are complementary to those associated with the installation of the experimental test benches provided by MATELYS. More information : http://www.matelys.com/products.html		

Course MODELLING

Porous material modelling – Basics	MOD-PORBAS	1
Porous material modelling – Advanced	MOD-PORADV	1
Modelling of perforated plates and resistive screens	MOD-PERF	1
Porous materials in flows	MOD-FLOW	1
Introduction to Micro-Macro approaches – starting-up with ScalingCell	MOD-SCAL	1
AlphaCell fondamentals	MOD-ACLINI	1
AlphaCell expert	MOD-ACLEXP	1

Course HYDRAULICS

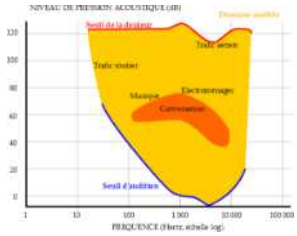
Analysis of hydraulic installations and pipes	EXP-PIPING	1,5

Want to mix the trainings ? Contact us training@matelys.com

Course BASICS

Introduction to acoustics — BAS-ACOU

Objectives
- understand and analyse the physical phenomena associated with the propagation of sound waves
- gain general working competences in acoustics
- integrate early vibro-acoustic considerations in a general design process



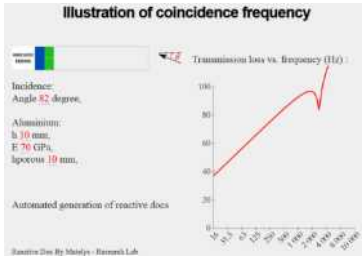
Participants
- technical sales
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program

→ Part 1 : Acoustics – generalities
- general principles of acoustics
- different types of noise sources
- absorption Vs. insulation

→ Part 2 : Acoustics – regulation issues
- regulation principles in buildings, transportation, industry and environment
- performance measurement : standardized and commonly used methods

→ Part 3 : Toward an optimized acoustic comfort
- modify the sound insulation properties :
  * effect of porous material treatments
  * influence of the treatment for a given base structure
  * influence of the base structure on the treatment performance
- modify the sound absorption properties :
  * influence of the absorption
  * influence of the room volume
- influence of mounting conditions
- listening to various auditory scenes regarding sound absorption and sound insulation



Background
- basic knowledge in physics and/or mechanics and/or acoustics

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Building acoustics — BAS-BAT

Objectives
- gain general working competences in building acoustics
- acquire the basic notions to discuss with acoustic design offices
- integrate early vibro-acoustic considerations in a general design process of a building

Participants
- technical sales
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program

→ Part 1 : Generalities
- general principles of building acoustics : absorption, insulation
- noise sources in buildings
- measurement methods

→ Part 2 : Regulation issues
- presentation of main acoustic indicators : sound absorption coefficient, reverberation time, sound transmission loss, sound insulation
- measure of the performances : standardized and used methods
- regulated level in buildings

→ Part 3 : Practical examples
- modification of the insulation properties :
  * influence of porous material linings
  * influence of lining for a prescribed base structure
  * influence of base structure on the lining performances
- modification of the absorption properties :
  * influence of the sound absorption

1

* influence of the room volume
* other influencing factors
- listening of various sound scenarii for the acoustic correction and sound insulation

Background
- basic knowledge in physics and/or mechanics and/or acoustics

Transportation acoustics — BAS-TRA

Objectives
- acquire a global view on vibro-acoustic issues for transportation applications
- gain to know the stakes of abatment measures for interior and exterior noise emission

Participants
- technical sales
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : Generalities**
- transportation noise sources and their frequency distribution
- regulation

→ **Part 2 : Noise sources : characterization and treatment**
- characterization of noise sources
- treatment of noise sources
- characterization of sound packages

→ **Part 3 : Practical examples**
- predictives methods
- trends and stakes in automotive, railway, aeronautics, marine applications

Background
- basic knowledge in physics and/or mechanics and/or acoustics

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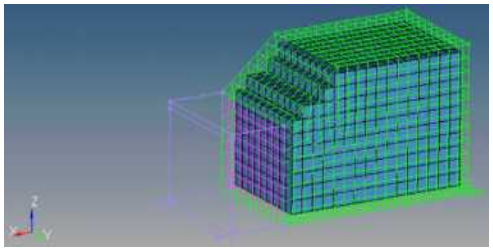
Introduction to the numerical methods for acoustics — BAS-NUM

Objectives
- acquire a global view of numerical methods used in vibro-acoustics
- be able to choose an adapted method for a prescribed problem

Participants
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : General methods and practical examples**
- FEM (Finite Element Method)
- BEM (Boundary Element Method)
- SEA (Statistical Energy Analysis)
- energetical methods (Radiosity
- FDTD (Finite Difference in Time Domain)
- Ray-tracing
- LBM (Lattice Boltzmann Method)
- TMM (Transfer Matrix Method)
- Wave based methods



→ **Part 2 : Complementary techniques**
- numerical integration
- minimization / optimization
- statistical / probabilistic calculations
- parallelized calculation, managing workflows
- web interface

Background
- basic knowledge in acoustics

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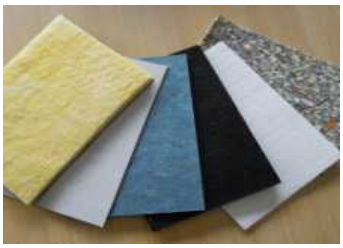
Course MEASUREMENTS

Measure with an impedance tube using 2, 3, 4 microphones	EXP-TUBE
Objectives - acquire the principles of impedance tube measurement - detect the main issues and be able to troubleshoot the measuring chain - be autonomous in selecting the type of measurement for a prescribed material **Participants** - operating technician, process technician - application engineer, design engineer, research engineer, researcher **Program** - stakes of impedance tube measurement → **Part 1 : Measure with 2 microphones** - presentation of the standard ISO 10534 (ASTM E1050) - practical recommendations → **Part 3 : Measure with 3 microphones** - presentation of the method (non standardized) - practical recommendations → **Part 3 : Measure with 4 microphones** - presentation of the method (ASTM E2611) - practical recommendations → **Part 4 :** Practicals - if possible, experimentations on impedance tube - demonstrations with TubeCell software product  **Background** - basic knowledge in acoustics - basic knowledge in signal processing for acoustics **Related information** http://tubecell.matelys.com	0,5

Material characterisation – acoustic, elastic and damping parameters	EXP-CARAC
Objectives - gain the knowledge of the main dissipation mechanisms associated with a porous material and be able to identify an adapted behavioural model - be able to lead an “easy” characterization - identify the issues and the resulting strategy to solve a “difficult” characterization **Participants** - operating technician, process technician - application engineer, design engineer, research engineer, researcher **Program** - definition and stakes of the characterization → **Part 1 : Characterization of acoustic parameters** - review of the main characterization methods of the acoustic parameters (audible and ultrasound frequency range) - presentation of the impedance tube method - practicals on available samples - practical recommendations - demonstration using RoKCell software product → **Part 2 : Characterization of elastic and damping parameters** - reminders on the elastic behaviour of porous materials - review of the main characterization methods - presentation of the quasi-static, uni-axial compression method - practicals on available samples - practical recommendations - demonstration using MecaCell software product  **Background** - basic knowledge in acoustics and mechanics - basic knowledge in signal processing for acoustics **Related information** http://rokcell.matelys.com	1

Building acoustic measurements – in lab and in-situ

EXP-BAT

Objectives
- gain knowledge about the main building performance indicators of materials and systems
- gain knowledge of the principles of ISO 354 (absorption) and ISO 10140 (insulation) standard series
- gain autonomy in the selection of the appropriate test method and indicator for a prescribed material and system

Participants
- technical sales
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program
- basic reminders in building acoustics
- reminders about the regulation

→ **Part 1 : Measurement for sound correction**
- presentation of the ISO 354 standard
- absorption single rating values
- practical recommendations and demos using BatCell software product

→ **Part 2 : Measuremenf for sound insulation**
- presentation of the ISO 10140-2 standard : air-borne sound insulation
- presentation of the ISO 10140-3 standard : impact sound attenuation
- single rating values for the sound insulation
- practical recommendations and demos using BatCell software product

→ **Part 3 : Complementary measurements**
- characterization of appliances : air inlet, noisy installations, …
- characterization of materials
- measurement of noise and exterior appliances : traffic noise, noise barriers, road surfaces, …

Background
- basic knowledge in physics and/or mechanics and/or acoustics
- basic knowledge in signal processing for acoustics

Related information
http://batcell.matelys.com

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Course MODELLING

Porous material modelling – Basics

MOD-PORBAS

Objectives
- gain the knowledge of the basic characteristics of porous materials used in vibro-acoustic applications
- gain the knowledge in experimental methods dedicated to porous material characterization
- get acquainted with the levers for designing and optimizing an efficient sound package

Participants
- commercial engineer, technical sales
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program

→ **Part 1 : Generalities**
- modelling principles
- presentation of the main parameters related to the micro-structure
- illustration of the phenomena
- particular cases of thin porous materials

→ **Part 2 : Experimental methods**
- characterization of acoustic parameters
- characterization of thin porous materials
- characterization of elastic and damping properties

→ **Part 3 : A few examples of optimization cases**
- influence the material association
- influence the microstructure

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- demos and discussions using AlphaCell software product
- some topics may also be illustrated using web based applications

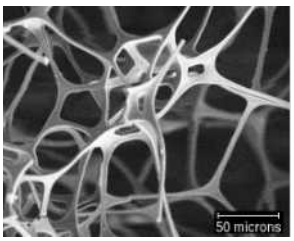
Background
- basic knowledge in physics and/or mechanics and/or acoustics

Related information
http://alphacell.matelys.com

Porous material modelling – Advanced — MOD-PORADV

Objectives
- get acquainted with the strategies of sound package modelling
- use optimization levers for an acoustically efficient design
- identify and select the adapted modelling approach for a prescribed sound package

Participants
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher



Program
→ **Part 1 : Homogeneous media**
- review of the existing models
- fluid-structure coupling, accounting for elastic effects
- *limp* and *rigid-body* models
- coupling between several layer of a system
- review of the different formulations : (U,u), (p,u), (u_s,u_t) …

→ **Part 2 : Model condensation**
- principles of upscaling approaches
- porous composites : rigid, elastic, porous, resonating inclusions

→ **Part 3 : Practical examples**
- perforated plates
- assembly of materials
- calculation from a thickness map
- demos and discussions using AlphaCell software product
- some topics may also be illustrated using web based applications

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Background
- training « Porous material modelling – basics »
- basic knowledge in physics and/or mechanics and/or acoustics

Related information
http://alphacell.matelys.com

Modelling of perforated plates and resistive screens — MOD-PERF

Objectives
- get acquainted with the main characteristics of a perforated plate or resistive screen used in vibro-acoustic applications
- get acquainted with the experimental methods related to the characterization of this type of materials
- acquire the levers for designing and optimizing an efficient sound package containing a perforated plate or a resistive screen

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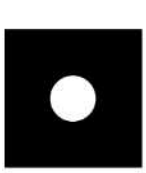
Participants
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

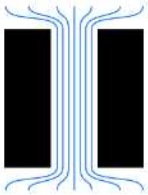
Program
→ **Part 1 : Generalities**
- modelling principles, links with porous material theory
- principles of the length correction
- illustration of the phenomena

→ **Part 2 : Experimental methods**
- characterization of perforated plates and resistive screens using the impedance tube
- link with the measurement of the air flow resistivity (ISO 9053) and the permeability of fabrics (ISO 9237) (no measurement planned)
- influence of the deformation, membrane vibration

→ **Part 3 : Optimization examples**

- single perforated plate
- perforated plate with other materials
- perforated plate under high sound pressure level
- demos and discussions using *Alpha*Cell software product
- some topics may also be illustrated using web based applications





Background
- basic knowledge in physics and/or mechanics and/or acoustics

Related information
http://alphacell.matelys.com

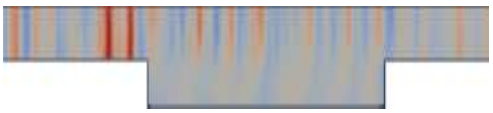
Porous materials under flow — BAS-FLOW

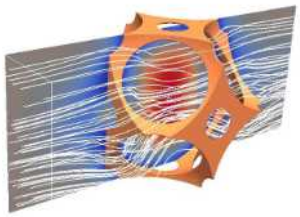
Objectives
- get acquainted with the main aeroacoustic phenomena related to the presence of a porous material in a flow
- acquire the levers for designing and optimizing an efficient sound package in these conditions

Participants
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : Generalities**
- porous material characteristics and sound wave dissipation principles
- main characteristics of a flow
- interactions between a porous material and a flow

→ **Part 2 : Modelling**
- presentation of the main modelling methods of a porous material under flow
- simple case of a liner
- boundary conditions at the domain limits
- cas of a diaphragm
- porous material in a complexe flow
- case of perforated plates under high sound pressure level





→ **Part 3 : Applications**
- demos based on simulations obtained with Pro-LB and AlphaCell software

Background
- basic knowledge in aeroacoustics
- basic knowledge in acoustics

Related information
http://alphacell.matelys.com
http://www.prolb-cfd.com

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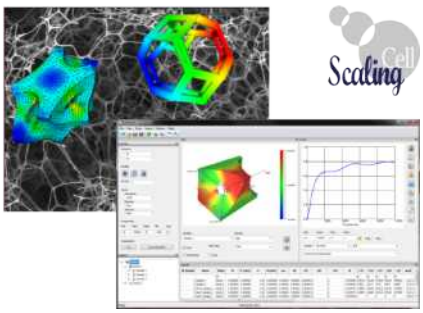
Introduction to Micro-Macro approaches – starting-up with ScalingCell — MOD-SCAL

Objectives
- get acquainted with the main micro-macro approaches
- be able to run a full computation with ScalingCell software product



Participants
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : Generalities**
- principle of micro-macro approaches
- computation of the acoustic properties
- computation of the elastic properties
- computation of the thermal properties

→ **Part 2 : Using ScalingCell**
- presentation of main software features
- use in scripting mode
- combined use with AlphaCell software product
- presentation of the development roadmap

Background

1

- basic knowledge in acoustics and vibrations

Related information
http://scalingcell.matelys.com

AlphaCell fondamentals — MOD-ACLINI

Objectives
- be acquainted with the principles of the TMM/FTMM method
- select the suited model for a given system
- be able to to carry out complete computations for simple models and evaluate the relevance of the results

Participants
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : Generalities**
- presentation of the TMM/FTMM method
- principles of the indicator computation
- modeling of the sound absorption
- modeling of the sound insulation

→ **Part 2 : Modeling of materials and systems**
- porous material models
- elastic material models
- accounting for studs and mechanical shortcuts

→ **Part 3 : Interaction with AlphaCell**
- format of input and output data
- using symbolic expressions
- assistant for result interpretation
- presentation of AlphaCell roadmap

Background
- basic knowledge in acoustics and vibrations

Related information
http://alphacell.matelys.com

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AlphaCell expert — MOD-ACLEXP

Objectives
- be acquainted with all the features of the available models
- be acquainted with all input and output data
- be able to identify the limits of TMM/FTMM method
- become AlphaCell expert user within a modeling team

Participants
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : Generalities**
- reminder of the TMM/FTMM method
- representation in the wave number domain
- spatial windowing methods

→ **Part 2 : Models for heterogeneous porous**
- model for compressed fibrous
- composite model: double porosity, inclusions, resonators

→ **Part 3 : Elastic material models**
- equivalent plate models
- orthotropic porous and plates
- stud modeling
- corrugated plates and ribbed plates

→ **Part 4 : Additional features**
- presentation of scripting computations : input data and models
- parametrised simulations
- post-processing of the results
- post-usage of XML material cards
- presentation of AlphaCell roadmap

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Background
- training « AlphaCell fondamentals » or prior usage of AlphaCell
- basic knowledge in acoustics and vibrations
- basic knowledge in signal processing for acoustics

Related information
http://alphacell.matelys.com

Course HYDRAULICS

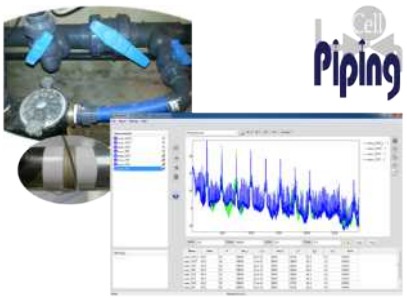
Analysis of hydraulic installations and pipes	EXP-PIPING

Objectives
- be acquainted with the stakes of the intrinsic characterization of a given noise and vibration source
- be acquainted with the dynamic behaviour of hydraulic installations : propagation of pressure pulses, coupling between the fluid and the pipe walls
- be acquainted with the experimental methods for analysing hydraulic installations

Participants
- operating technician, process technician
- application engineer, design engineer, research engineer, researcher

Program
→ **Part 1 : Theoretical basis**
- dynamic behaviour of pipes
- characterization method of sources
- analysis method for hydraulic installations
- determination of the fluid acoustic properties : sound speed, pressure amplitude

→ **Part 2 : Applications**
- dynamic pressure measurement : intrusive or non-intrusive sensors
- applications : propagation, fatigue, pipe monitoring
- demos on a dedicated test bench
- demos using *Piping*Cell software product



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Background
- basic knowledge in acoustics and vibrations
- basic knowledge in signal processing for acoustics

Related information
http://pipingcell.matelys.com