

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 fundamentals	MOD-ACLINI	1
AlphaCell expert	MOD-ACLEXP	1

Course **HYDRAULICS**

Analysis of hydraulic installations and pipes	EXP-PIPING	1,5
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Want to mix the trainings ? Contact us training@matelys.com



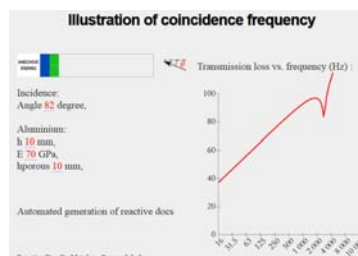
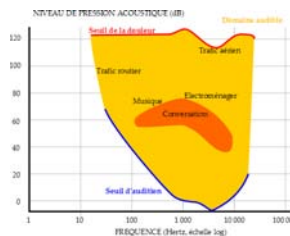
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Course BASICS


Introduction to acoustics	BAS-ACOU
<p>Objectives</p> <ul style="list-style-type: none"> - 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 <p>Participants</p> <ul style="list-style-type: none"> - technical sales - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <p>→ Part 1 : Acoustics – generalities</p> <ul style="list-style-type: none"> - general principles of acoustics - different types of noise sources - absorption Vs. insulation <p>→ Part 2 : Acoustics – regulation issues</p> <ul style="list-style-type: none"> - regulation principles in buildings, transportation, industry and environment - performance measurement : standardized and commonly used methods <p>→ Part 3 : Toward an optimized acoustic comfort</p> <ul style="list-style-type: none"> - modify the sound insulation properties : <ul style="list-style-type: none"> * 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 : <ul style="list-style-type: none"> * influence of the absorption * influence of the room volume - influence of mounting conditions - listening to various auditory scenes regarding sound absorption and sound insulation <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in physics and/or mechanics and/or acoustics 	<p style="text-align: center;">1</p>

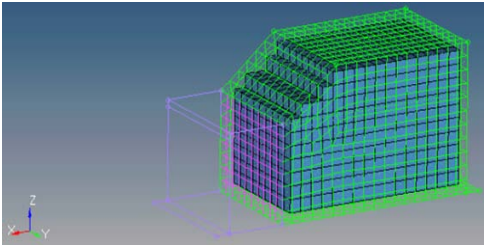


Building acoustics	BAS-BAT
<p>Objectives</p> <ul style="list-style-type: none"> - gain general working competences in building acoustics - acquire the basic notions to discuss with acoustic design offices - integrate early vibro-acoustic considerations in a general design process of a building <p>Participants</p> <ul style="list-style-type: none"> - technical sales - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <p>→ Part 1 : Generalities</p> <ul style="list-style-type: none"> - general principles of building acoustics : absorption, insulation - noise sources in buildings - measurement methods <p>→ Part 2 : Regulation issues</p> <ul style="list-style-type: none"> - 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 <p>→ Part 3 : Practical examples</p> <ul style="list-style-type: none"> - modification of the insulation properties : <ul style="list-style-type: none"> * 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 : 	<p style="text-align: center;">1</p>




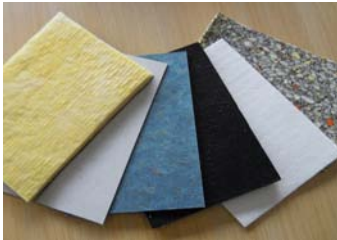
<ul style="list-style-type: none"> * influence of the sound absorption * influence of the room volume * other influencing factors - listening of various sound scenarii for the acoustic correction and sound insulation <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in physics and/or mechanics and/or acoustics 	
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Transportation acoustics	BAS-TRA
<p>Objectives</p> <ul style="list-style-type: none"> - acquire a global view on vibro-acoustic issues for transportation applications - gain to know the stakes of abatement measures for interior and exterior noise emission <p>Participants</p> <ul style="list-style-type: none"> - technical sales - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <p>→ Part 1 : Generalities</p> <ul style="list-style-type: none"> - transportation noise sources and their frequency distribution - regulation <p>→ Part 2 : Noise sources : characterization and treatment</p> <ul style="list-style-type: none"> - characterization of noise sources - treatment of noise sources - characterization of sound packages <p>→ Part 3 : Practical examples</p> <ul style="list-style-type: none"> - predictive methods - trends and stakes in automotive, railway, aeronautics, marine applications <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in physics and/or mechanics and/or acoustics 	 1



Introduction to the numerical methods for acoustics	BAS-NUM
<p>Objectives</p> <ul style="list-style-type: none"> - acquire a global view of numerical methods used in vibro-acoustics - be able to choose an adapted method for a prescribed problem <p>Participants</p> <ul style="list-style-type: none"> - application engineer, design engineer, research engineer, researcher <p>Program</p> <p>→ Part 1 : General methods and practical examples</p> <ul style="list-style-type: none"> - 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 <p>→ Part 2 : Complementary techniques</p> <ul style="list-style-type: none"> - numerical integration - minimization / optimization - statistical / probabilistic calculations - parallelized calculation, managing workflows - web interface <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in acoustics 	 1

Course MEASUREMENTS


Measure with an impedance tube using 2, 3, 4 microphones	EXP-TUBE
<p>Objectives</p> <ul style="list-style-type: none"> - 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 <p>Participants</p> <ul style="list-style-type: none"> - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <ul style="list-style-type: none"> - 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 <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in acoustics - basic knowledge in signal processing for acoustics <p>Related information</p> <p>http://tubecell.matelys.com</p>	 <p>0,5</p>

Material characterisation – acoustic, elastic and damping parameters	EXP-CARAC
<p>Objectives</p> <ul style="list-style-type: none"> - 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 <p>Participants</p> <ul style="list-style-type: none"> - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <ul style="list-style-type: none"> - 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 <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in acoustics and mechanics - basic knowledge in signal processing for acoustics 	 <p>1</p>

Related information
<http://rokcell.matellys.com>

Building acoustic measurements – in lab and in-situ		EXP-BAT
<p>Objectives</p> <ul style="list-style-type: none"> - 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 <p>Participants</p> <ul style="list-style-type: none"> - technical sales - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <ul style="list-style-type: none"> - 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 : Measurement 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, ... <p>Background</p> <ul style="list-style-type: none"> - basic knowledge in physics and/or mechanics and/or acoustics - basic knowledge in signal processing for acoustics <p>Related information http://batcell.matellys.com</p>	 	<p>1</p>

Course MODELLING

Porous material modelling – Basics		MOD-PORBAS
<p>Objectives</p> <ul style="list-style-type: none"> - 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 <p>Participants</p> <ul style="list-style-type: none"> - commercial engineer, technical sales - operating technician, process technician - application engineer, design engineer, research engineer, researcher <p>Program</p> <ul style="list-style-type: none"> → 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 		<p>1</p>

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

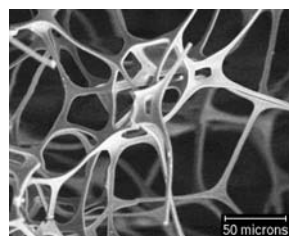
- review of the existing models
- fluid-structure coupling, accounting for elastic effects
- *limp* and *rigid-body* models
- coupling between several layer of a system
- review of the different formulations : (U,u), (p,u), (u_s,u_t) ...

→ **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



1

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

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**



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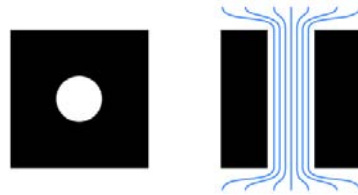


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- characterization of perforated plates and resistive screens using the impedance tube
- link with the measurement of the air flow resistivity (ISO 9053) and the permeability of fabrics (ISO 9237) (no measurement planned)
- influence of the deformation, 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 *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 materials under flow

BAS-FLOW

Objectives

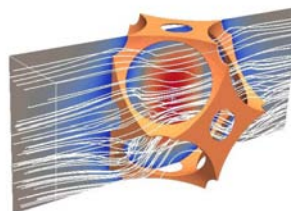
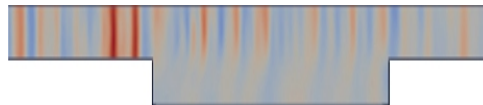
- get acquainted with the main aeroacoustic phenomena related to the presence of a porous material in a flow
- acquire the levers for designing and optimizing an efficient sound package in these conditions

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



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Background

- basic knowledge in aeroacoustics
- basic knowledge in acoustics

Related information

<http://alphacell.matelys.com>
<http://www.prolb-cfd.com>

Introduction to Micro-Macro approaches – starting-up with ScalingCell

MOD-SCAL

Objectives

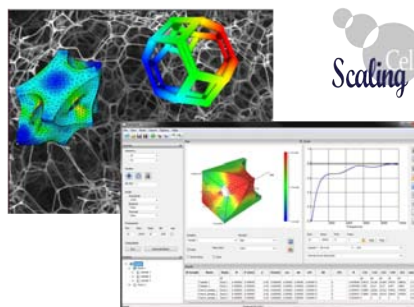
- get acquainted with the main micro-macro approaches
- be able to run a full computation with ScalingCell software product

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**



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- presentation of main software features
- use in scripting mode
- combined use with AlphaCell software product
- presentation of the development roadmap

Background

- basic knowledge in acoustics and vibrations

Related information

<http://scalingcell.matelys.com>

AlphaCell fundamentals	MOD-ACLINI
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Objectives

- be acquainted with the principles of the TMM/FTMM method
- select the suited model for a given system
- be able 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



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Background

- basic knowledge in acoustics and vibrations

Related information

<http://alphacell.matelys.com>

AlphaCell expert	MOD-ACLEXP
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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**

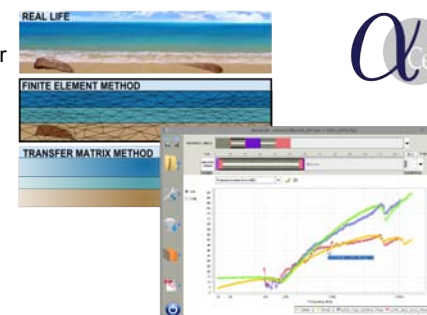
- reminder of the TMM/FTMM method
- representation in the wave number domain
- spatial windowing methods

→ **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



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- 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

Background

- training « AlphaCell fundamentals » 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

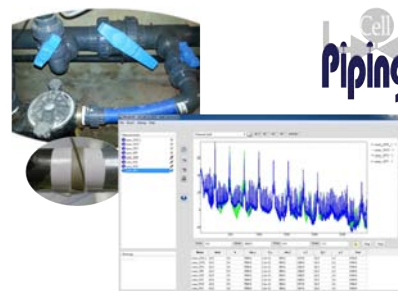
Program

→ **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 *PipingCell* 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>