N° 58 - May 2009

CEDRAT NEWS

Flux Solutions & Mechatronic Products

Editorial

A calm but active period.

Some say times are quiet, others are taking benefit from their existing resources to prepare for tomorrow and get stronger in the market, using performance tools, trying to optimise their product's cost or reduce development time, and integrating new technologies to keep ahead of the competition. Resourcefulness offers us the opportunity to get ready for new challenges, this is what we note from many of our customers these past months.

In this latest CEDRAT News we'll share some expertises about solutions we contribute to develop: from the smallest to the biggest application, from known systems that can't be prototyped to new phenomena that will bring new industrial solutions.

CEDRAT TECHNOLOGIES has been selected in various R&D European Projects (FP7, Manumet). An undeniable recognition !

In the mean time, the CEDRAT Group is keeping its growth by intensifying its sales presence, but also by reinforcing its dedicated applications team to perpetrate its expertise.

You can trust on our solutions.

Vincent Marché, Operational Marketer - CEDRAT Group.

Flux/Portunus Co-simulation...

Bertrand du Peloux - CEDRAT Group

With version 10.3 of Flux, it is now possible to take into account the strong interactions between your electromagnetic device and its system environment thanks to the new Flux-Portunus co-simulation ... (see complete article on page 8)

Flux 10.3: New powerful features

Vincent Leconte - CEDRAT Group.

Many improvements will come soon in this new version to make the use of Flux always more efficient ... (see complete article on page 9)

Ultrasound micro plastic injection...

Christophe Benoit - CEDRAT TECHNOLOGIES.

Vibration-assisted and injection processes are currently hot topics. CEDRAT TECHNOLOGIES has been trying to get closer to the industrial world ... (see complete article on page 13)

Software Solutions

Mechatronics

Synergy

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CIVA^{nde} 9.2: New release of the NDT simulation platform.

Fabrice Foucher (CEDRAT) , Philippe Dubois (CEA LIST).

We are proud to announce the release of CIVA^{nde} 9.2. This new version comes with numerous enhancements in its three simulation modules: Ultrasonic Testing, Eddy Current Testing and Radiographic Testing. We describe below the main new features.

UT Phased-array: More possibilities with angular scanning

Angular scanning is a powerful inspection technique provided by UT phased-array probes. CIVA^{nde} already had the capability to simulate sectorial scan in one given axis. With CIVA^{nde} 9.2, it is now possible to use the capabilities offered by matrix phased-arrays **to tilt the angular scanning in any direction**. As several orientations are often needed to detect disoriented defects, CIVA^{nde} 9.2 also enables a **series of angular scanning operations**.
CIVA^{nde} computes the corresponding delay laws and simulates advanced electronic scanning management of these arrays. In this example, a series of 20 angular scanning operations at different tilt angles of 60 shots each is simulated with a matrix probe. Interaction with two defects is shown.

UT Phased-array: Dynamic beam

The beam calculation tool included in the CIVA platform permits visualisation of the ultrasonic field refracted in the component to be inspected. Associated to a phased-array probe, it is now possible to display in one cumulated image the **beam generated by multiple delay laws**, not just one. **Dynamic tools** also means easy visualisation of beams generated by the different laws, and by switching between the different shots, animated videos can be generated.

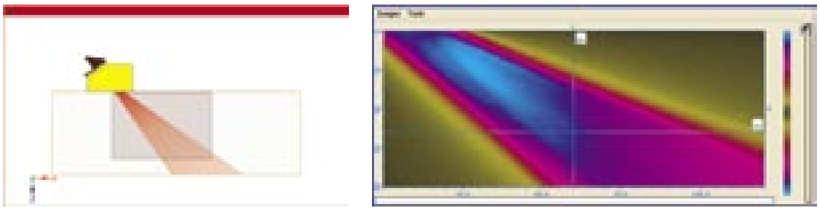


Fig. 3: Configuration and cumulated image obtained after post processing "all shots".

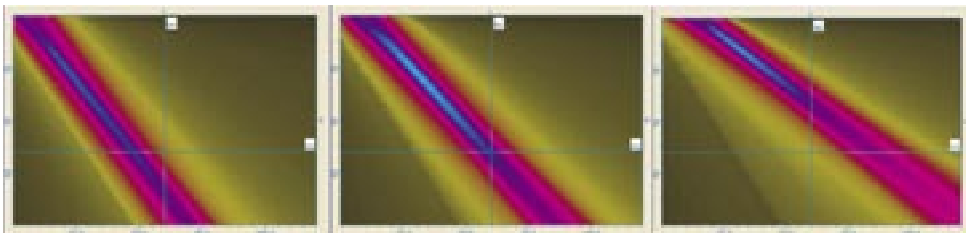


Fig. 4: Different shots obtained by changing shot number.

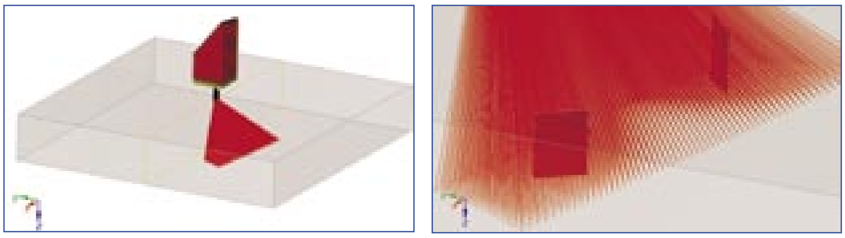


Fig. 1: Series of 20 angular scanning of 60 shots each.

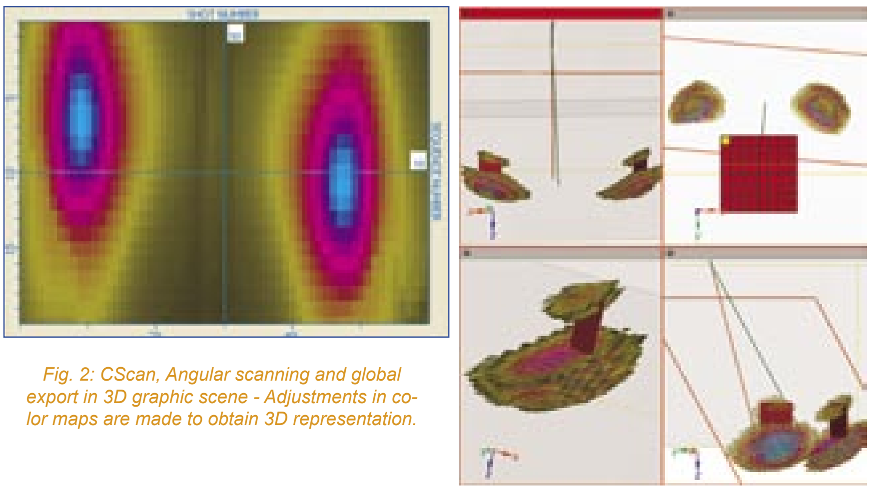


Fig. 2: CScan, Angular scanning and global export in 3D graphic scene - Adjustments in color maps are made to obtain 3D representation.

EC Testing: Defect in rivets

CIVA^{nde} 9.0 could simulate the Eddy Current response of a rivet positioned in a multilayer structure. In CIVA^{nde} 9.2, it is now possible to add a defect near the rivet and compute its response for different positions. The figure below illustrates the result of such a configuration:

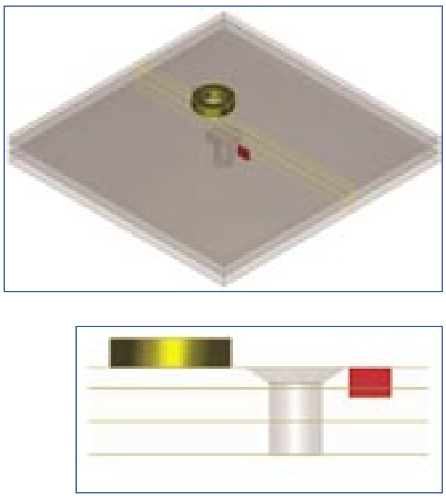


Fig. 5: Example of ECT simulation with defect near a rivet.

CIVA^{nde} 9.2: New release of the NDT simulation platform... (continued)

Fabrice Foucher (CEDRAT) , Philippe Dubois (CEA LIST).

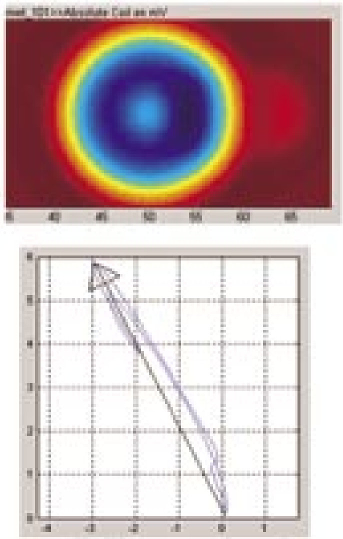
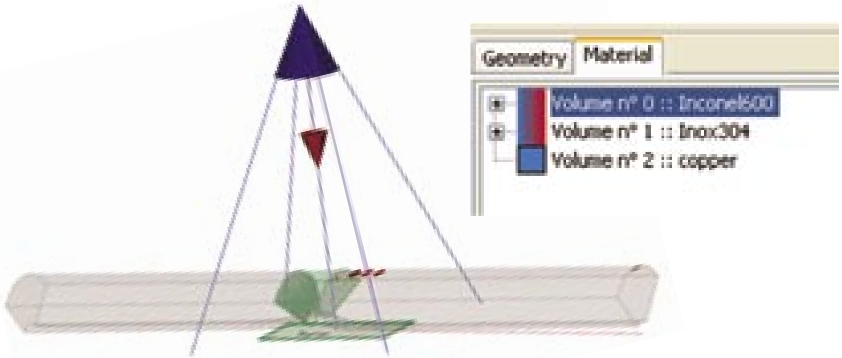
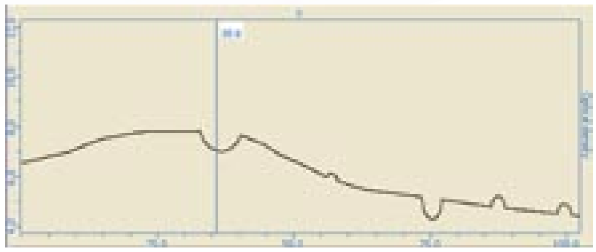


Fig. 6: Example of ECT simulation with defect near a rivet.





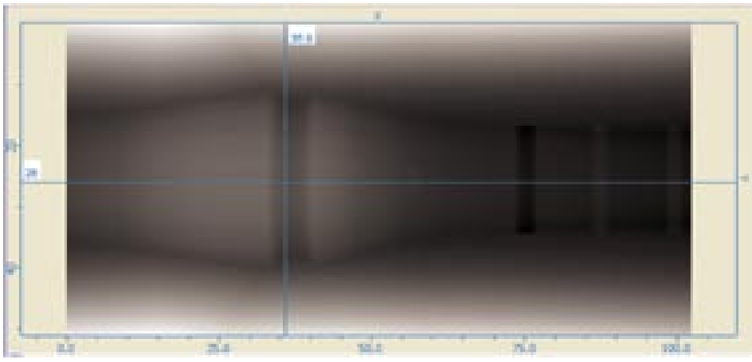


Fig. 6: Heterogeneous X-Ray direct radiation simulation.

EC Testing: Parametric scenario for lift-off

Lift-Off is one of the most important parameters for ECT inspections. Its value has a real influence on results. It is therefore useful to be able to make calculations taking into account various values of lift-off. CIVA^{nde} 9.2 allows the user to enter a range of different values of lift-off by pressing F11 key. The **scenario** created can be launched in batch and results can be automatically extracted.

Radiographic Testing: Possibility of simulating an heterogeneous specimen

CIVA^{nde} 9.2 allows simulations with **heterogeneous** materials. Different volumes can be defined in the specimen, each of them with a different material. The example below shows an interface for volume settings and the result obtained after computation. The specimen is a section of a cylinder. Stainless steel and copper are joined by a weld made of Inconel. A gamma ray source is used, planar and cylindrical flaws are inserted in the specimen. A film is used as detector.

CEDRAT Student Paper Contest 2009.

Final Reminder

Any student using CEDRAT's solutions *(Flux, Motor-CAD, SPEED, Portunus, InCa3D, PSCAD, CIVA^{nde})* in University and pursuing a master or a doctorate degree can participate to the *CEDRAT Paper Contest 2009*.

Submit your topic directly as a final paper before the deadline. If selected, you will present your paper to an audience of your peers at the ***Flux Users Conference 2009*** in Autrans, France on 21-23 October 2009.

Award for the best paper:

- **1 laptop** (value: 1.000 €)
- Publication in our CEDRAT News magazine.

Pre-selected contributions will be published in the proceedings of our conference and on our website.

For submittal instructions and information, please contact Cécile CARNOY: cecile.carnoy@cedrat.com or browse our web pages at: www.cedrat.com

Deadlines:

Submission of papers: 30 May 2009
Notification of acceptance: 30 June 2009
Flux Users Conference 2009: 21-23 October 2009

PSCAD: Tracing ground path resonances in a Subtransmission network with cables.

Dr. Adel Hammad, SwissPowerSystems.

This article summarizes a comprehensive study carried out by the Swiss Utility NOK following a 3-phase-ground fault at a 110-kV cable terminal connected to a large distribution substation. The fault developed a particularly high overvoltage in another 110-kV substation, which entailed damage to potential transformers and cable sheath arresters. The initial analysis showed that the overvoltage had a very high component at 127 Hz.

This study was, therefore, necessary in order to clarify the source of this abnormal event and to define existing and future problems in the 110 kV network and offer solutions to prevent potential problems encountered during the several phases of the 110 kV network expansions.

The fault event

Figure 1 depicts the part of the network affected during the disturbance. The 110 kV network is fed from the 220 kV transmission via Star-Star transformers. The neutral points on the 220 kV side are solidly grounded, whereas most of the neutral points on the 110 kV side are grounded through reactors. And the 16 kV distribution network is directly fed from the 110 kV substations.

The inadvertent closing of the cable terminal grounding switch 'FT' while the breaker 'XB' at the other terminal 'B' is still closed developed a 3-phase-ground short circuit. This was cleared by the opening of the breaker 'XB' in about 400ms.

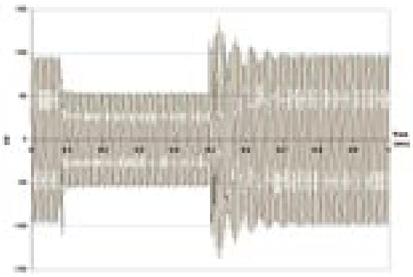


Fig. 2: Three-phase voltage measured at substation WA (1 sec. duration).

Figure 2 shows the 3-phase voltages produced by the disturbance fault recorder located at substation 'WA'. However, after less than 20 seconds, several new phase-ground faults (phases c and a) occurred successively at substation 'WB' and on cables 'WB'-'B' and 'WB'-'F'. As a result, substation 'B' and all the 16 kV distribution networks fed from it lost all supply. Apparently, after the fault clearing the overvoltages caused damage to the voltage measurement transformers and cable sheath arresters in substation 'WB'. Figure 2 shows the brutal voltage oscillations which represents also an asymmetry between the phases. The oscillations and asymmetry are damped after approximately 250 ms.

Figure 3 shows the Amplitude vs. Frequency of the measured voltage signal. Along with the 50 Hz component and the dc offset one recognizes the very high component at 127 Hz, followed by a smaller 150 Hz component.

EMTDC Simulations

The complete 110 kV network of NOK was simulated in details using PSCAD®/EMTDC™. The 16 kV distribution networks connected to the substations in the vicinity of the disturbance were represented as well. Low order filtered measurements were also necessary to reproduce the actual measured signals. Minor adjustments of the 16 kV load models were required in order to match the amplitude and damping of the measured voltage signals at substation 'WA'.

Figures 4 and 5 illustrate respectively the voltage waveform at substation 'WB' and the filtered voltage at substation 'WA' of the EMTDC simulations. As shown in figure 4, the voltage at 'WB' have very large spikes, particularly in phases c and a, at the fault clearing instant. The peak voltages at 'WB' are generally slightly higher than at 'WA'.

In order to make a robust comparison with the measured values, the simulated filtered voltage at 'WA' is split into two segments, namely at fault start and after fault clearing, and synchronized in time with the measured signal. The comparison of the 3-phases of measured and simulated filtered voltage at 'WA' for the two segments is shown in figures 6 and 7.

Indeed, the coherency between the two signals proves the accuracy of the model used for simulations.

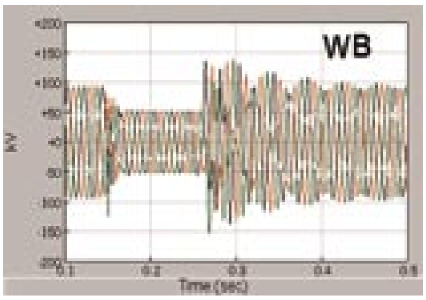


Fig. 4: Simulated network voltage at substation 'WB'.

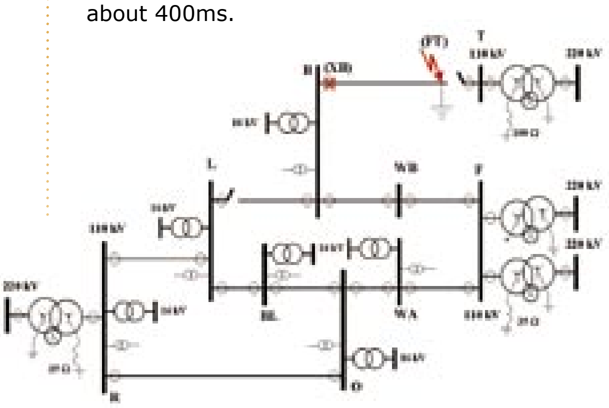


Fig. 1: Schematic of network portion affected by the disturbance.

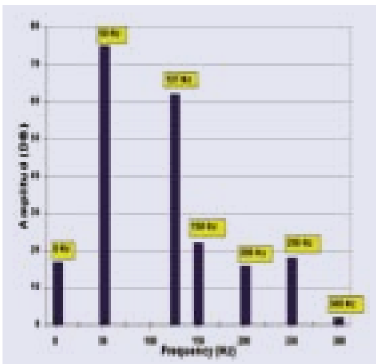


Fig. 3: Frequency composition of the measured voltage.

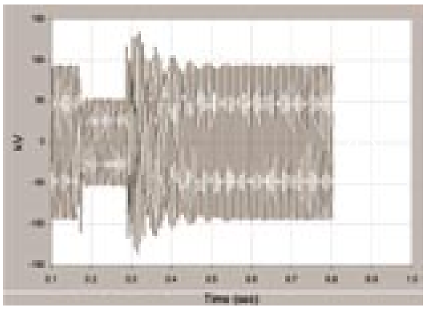


Fig. 5: Simulated filtered voltage at substation 'WA'.

(see continued on page 5)

PSCAD: Tracing ground path resonances in a Subtransmission ... (continued)

Dr. Adel Hammad, SwissPowerSystems, Switzerland.

Note that short-circuits in the three phases do not start all simultaneously and the opening of the faulted line takes place for each individual phase successively. This means that the network during fault start and fault clearing periods is asymmetrical.

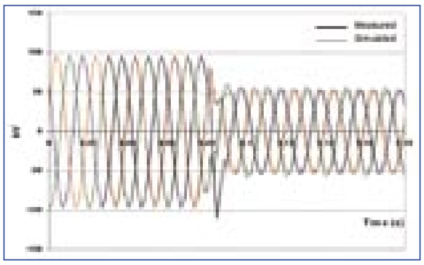


Fig. 6: Comparison between measured and simulated filtered voltage at substation 'WA' at fault start .

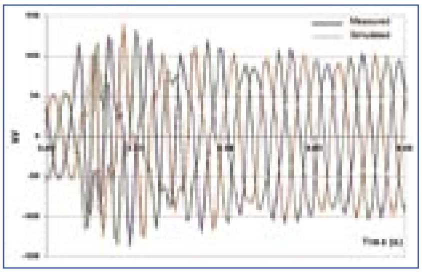


Fig. 7: Comparison between measured and simulated filtered voltage at substation 'WA' after fault clearing.

Therefore, any frequency-domain analysis should consider all sequence impedances of the network. The frequency scan [1] for the sum of network positive, negative and zero sequence impedances seen at substation 'WB' is shown in figure 8 during three stages of asymmetric operation of the network; (1) start of short circuit at 'FT' with resonance frequency of 100 Hz, (2) opening breaker 'XB' with resonance at exactly 77 Hz and (3) after fault clearing where the impedance resonance moves to 65 Hz but has an additional peak at 77 Hz. Due to the 50 Hz carrier frequency effect of the AC system, a 77 Hz resonance in the frequency domain shows as (77+50) 127 Hz in the time domain. Similarly, the 100 Hz resonance frequency shows as 150 Hz in the time domain. The damping of such resonances is approximately inversely proportional to the peak impedance. It is clear that the 77 Hz resonance is dominant, whereas the 100 Hz resonance is well damped.

This result explains the outcome of frequency composition of the measured voltage of figure 3.

In an attempt to explain why the equipment damages were confined to substation 'WB' and to cables 'WB'-'B' and 'WB'-'F', the impedance frequency scan during short circuit and opening of breaker 'XB' is established for different sub-stations as shown in figure 9. It is evident that the strongest resonance effect for this particular fault location lies at 'WB', 'B' and 'F' substations. A resonance that led to a very high overvoltages with 127 Hz at those locations.

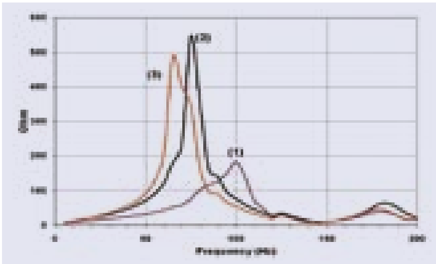


Fig. 8: Frequency scans at substation 'WB' for asymmetric network operation.

Resonance Influencing Factors

Fault Type

Both 3-phase-ground and 2-phase-ground faults can excite such low frequency resonances.

Circuit Cable Content

Due to the difficulty of isolating all the factors affecting the resonance and the arising overvoltages, a range of 25% to 30% of cable contents were identified as being a critical limit.

Neutral Point Grounding

Since the resonance is predominantly affected by the zero-sequence impedance of the network, the relatively high values of neutral-point grounding reactors used throughout the network are the main cause of the low frequency (< 200 Hz) resonance problem.

Damping of resonance

Reducing the reactance of neutral-point grounding reactors can be a possible solution for alleviating the low frequency resonance problem [2].

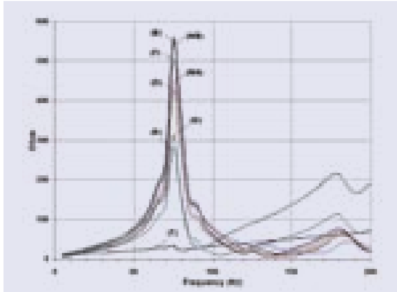


Fig. 9: Frequency scans at different substations for asymmetric network operation during short circuit and opening of breaker 'XB' .

However, the obvious disadvantage of this method is the increase in fault currents that may be beyond the existing switchgear design values.

Another method is to increase the resonance damping, without changing the frequency of oscillations. This can be realized by adding a small resistance in series with the existing neutral point reactors or by adding a large resistance in parallel to those reactors. Figure 10 shows the results of the simulation which is realized with all neutral point grounding reactors shown in figure 1 fitted with parallel resistors having approximately three times the impedance value of such reactors. Note how the overvoltage in the 3-phase voltage at 'WB' is reduced and all post-fault oscillations are practically eliminated.

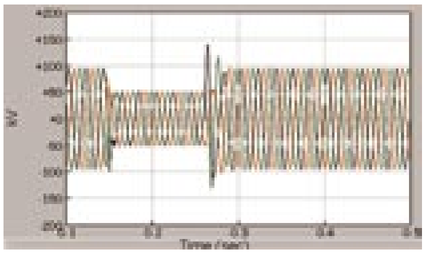


Fig. 10: Voltage at substation 'WB' with parallel neutral point resistances.

For practical implementation of a standard economic solution, all existing and future neutral point reactors in the network are replaced with new reactors having very high inherent resistance by using different material other than aluminium.

References

[1] A. Hammad, 1990, "Eigenvalue and Frequency Domain Analysis of Second Harmonic Resonance in a Complex AC/DC Network", IEEE Power Engineering Society Special Publication, No. 90, TH0292-3 PWR, 61-66.

[2] S. Läderach and G. Köppl, 2001, "Beeinflussungs-problem bei Mehrfachleitungen", Bulletin SEV, 7/02, 9-12.

Pellenc SA: Makers and constructors of wine-growing equipments.

Jean-Louis FERRANDIS - PELLENC SA.

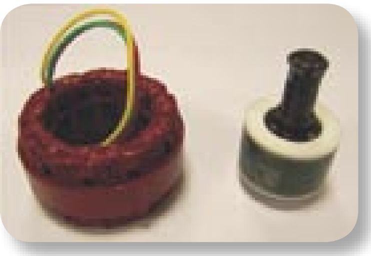
PELLENC SA, a French group started in 1973, benefits from a worldwide distribution network. Makers and constructors of viticulture equipements and arboriculture, our complete series of products meet all the expectations from the cutting to the picking.

Our main business fields are:
1. Wine-growing
2. Olive-growing
3. Professional electroportable tools
4. Grassy areas

The parent company established in Pertuis gathers 300 employees. This number reaches 600 with the subsidiaries located in Australia, Spain, Italy, Marocco, Turkey, the United-States, Chile, Slovakia and China.

The Group's turnover is about 100M€ with 77M€ realized by PELLENC SA.

PELLENC SA integrates magnetic structures in a considerable numbers of its realizations (magnet motors and alternators, asynchronous motors, transformers, inductances, electromagnetic valves…)



Synchronous motor 5000tr/mn 68mm

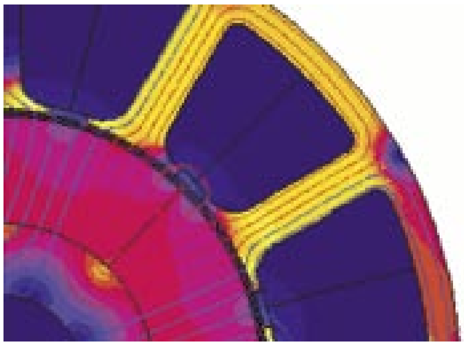
Synchronous motor 16000tr/mn 30mm

SELION (chainsaw)

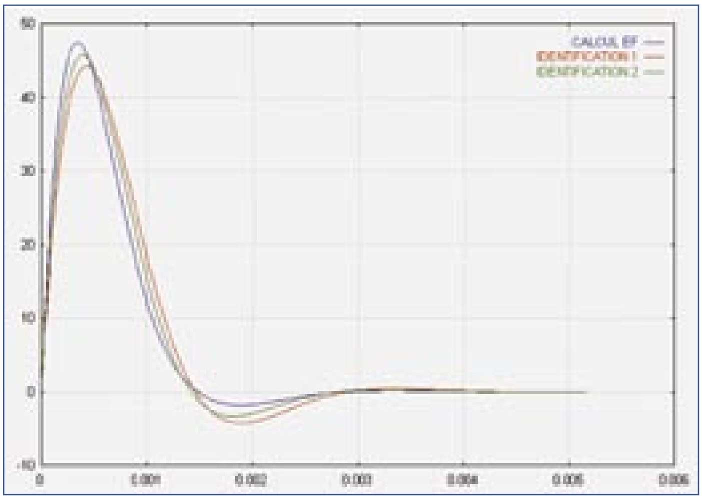
These realizations are often associated to perturbated electrical sources of energy.

The Flux 2D software was essential in nearly all our studies relative to these tools…

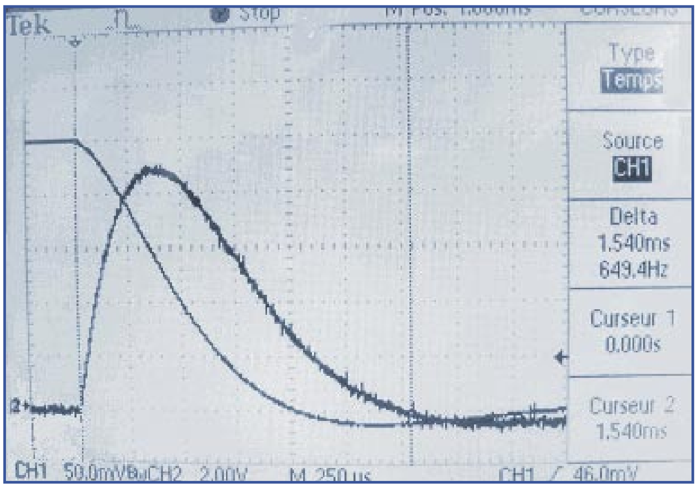
- Harmonic spectrum of electro-motive forces
- Study of the saturation and the flux magnetic traject sizing
- Magnetic forces and couples in various hypothesis
- Loss in massive components due to flux interferences or mechanical fluctuation…



Distribution of induction lines at a given time instant.
8 poles permanent magnet motor (SELION chainsaw).
2D transient magnetic study.



Current variation according to a discharge between phases A and B with an electrical angle of 120°:
- Transient computation with Flux 2D.
- Analytical answers (two methods).



Results of the same computation with the real device => Simulations and tests are well correlated. This last study can be seen as one of all the transient magnetic applications that can be done by the software Flux 2D.

(see continued on page 7)

Pellenc SA: Makers and constructors of wine-growing ... (continued)

Jean-Louis FERRANDIS - PELLENC SA.

In every instance we have noticed a very satisfactory correlation between the results obtained by Flux and the test after realization.

With an open and user-friendly interface this software solution ensures both performance and reliability. It is an excellent tool for the conception of a large number of our products.

The overall goal is partly in this paper is to quantify the behavior of a system of currents which imposes on growth or decreases rapidly in the presence of certain types of magnets.

The significant results found using Flux 2D software, were compared with measurements on our test bench.

This led us to integrate our devices into control commands, several processes of great interest.
They are currently being developed in our laboratories.

LiXion (pruning shear)

InCa3D: Advanced simulations of interconnection performances.

Enrico Vialardi, Yann Le Floch - CEDRAT Group.

InCa3D, our simulation tool dedicated to the **modelling of electric connections**, continues its growth thanks to several new developments which are now planned and which will be available soon. With this software CEDRAT aims to become a major actor of virtual prototyping in the fields of **power electronics and electromagnetic compatibility**.

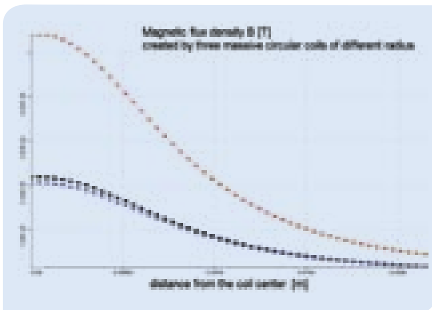
Based on a **PEEC** (Partial Element Equivalent Circuit) solver which proved to be very efficient for any electrical distribution system, InCa3D is well adapted for almost any connector like: busbars, power modules, PCB tracks and ground planes, electronic and microelectronic circuits… It allows one to study parasitic effects of cables, to optimise the cable paths, to decrease copper mass, to study radiated magnetic fields by a system…

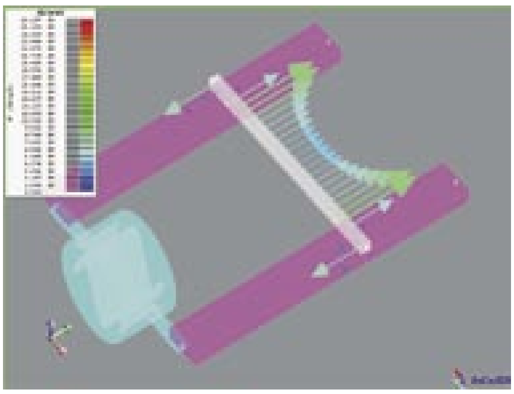
CEDRAT teams are intensively working on a large variety of new functionalities, going from enhanced efficient physical models to robust and automatic meshing techniques, from a strong bidirectional coupling with Portunus to a more user-friendly geometric definition of the system to be analysed.

All these advances will enable you to virtually investigate your systems at higher and higher frequencies, to take into account new materials, to rapidly open new doors and explore novel application domains!

Last January, with the latest release of InCa3D (2.1.2) a third application (besides the two historical ones, namely Supplied Conductors and Conductors Impedances) is available to users: it deals with the computation of the electrodynamic Laplace forces on electric systems. It is a specific DC implementation of the Supplied Conductors application in a simplified context especially tailored for non-expert users, like laboratory technicians and students*.

It is a powerful tool to simply explain basic electromagnetic laws and phenomena, with graphical view of the system and of the obtained results. For example, as shown in the figures, the so-called Laplace experience can be easily reproduced or the computation of the magnetic flux density B created by a massive circular coil can be carried out in a very short time.





* With Schneider Electric collaboration.

CEDRAT Software suite improved thanks to Flux/Portunus Co-simulation.

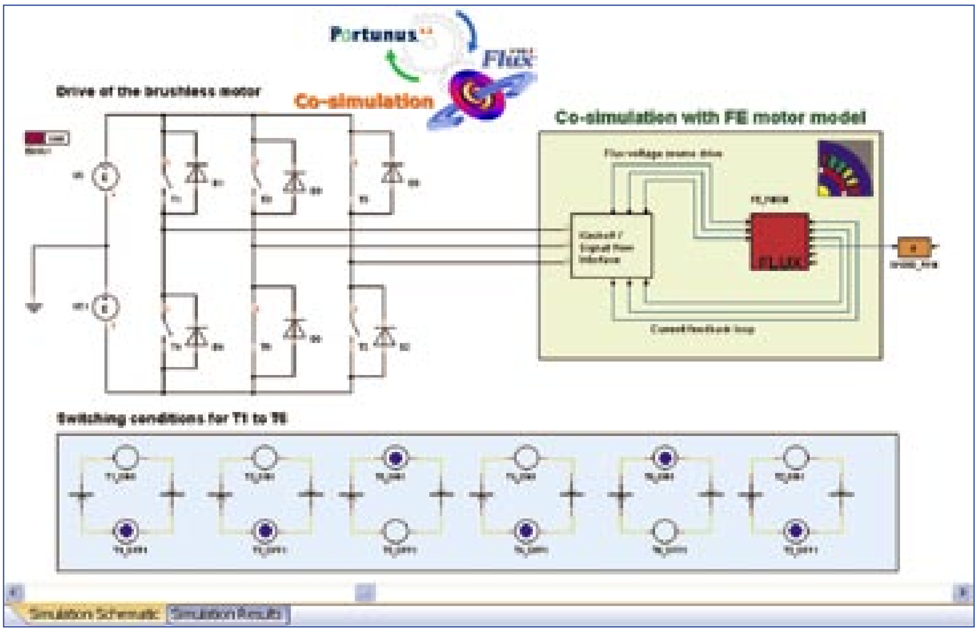
Bertrand du Peloux - CEDRAT Group.

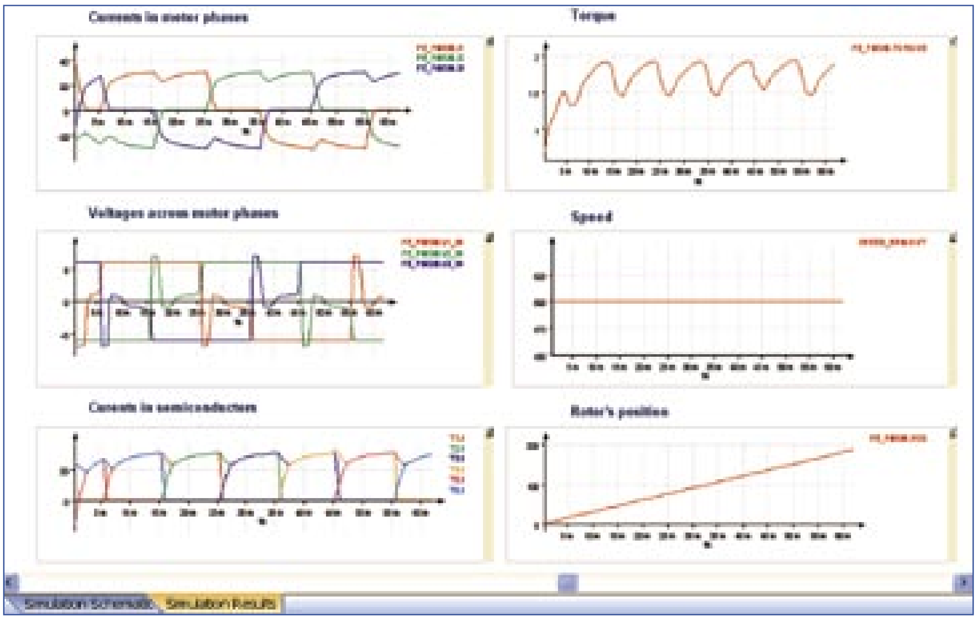
Taking into account the effects of system load or improving its drive is now easier thanks to **Flux/Portunus co-simulation**.

With version 10.3 of Flux, it is now possible to export finite element models into a system environment that will perform co-simulation.
Co-simulation works for **both 2D and 3D applications** within Flux 10.3 and there is virtually **no limit to the parameters** that can be shared between the two programs.
Benefits range from the study of load impact (as well mechanical or electrical loads, thermal effects, etc…) to the design of complex drives.

Because Portunus is a multi-domain system simulation software, modelling within the same simulation sheet a **complete mechatronic system** is made easy.
Kirchhoff representation (analogue signals) can be used in parallel with signal flow (block diagrams) and digital signals (state machines, logical statements, etc…).
Furthermore, this complete environment has been enhanced with the **support of the VHDL-AMS standard** which opens up numerous modelling capabilities.
Thus, co-simulation between Flux and Portunus means that **the designer is now able to combine all these modelling approaches with finite element models!**

By way of example, figure 1 shows the results of a rated speed study of a permanent magnet machine with its inverter and drive.





The benefits for the designer who is able to model the whole chain with appropriate methodology and models are obvious: the inverter is built with electronic components whereas the control of the semi-conductors uses logical state-machines. The electrical machine is set up using the BPM overlay of Flux, and is easily plugged into Portunus using the co-simulation interface (simple file import).

Because several dynamics can be found in a system, and to help the designer to handle different time constants, the coupling interface comes up with **several co-simulation algorithms** that can be parameterized according to the case study needs:

- Step time management
- Software synchronization
- Data extrapolation and input variation criteria
- Signals decoupling thanks to delay insertion

This improves simulation time given the accuracy required or the nature of the system (its dynamics, if included in an open or closed loop, etc…)

Communication between our finite element software Flux and our system simulator Portunus should remove simulation or modelling roadblocks and open up new fields of exploration.

Evaluate our new Portunus software at: http://www.cedrat.com/en/software-solutions/downloads/portunus-demo-version.html.

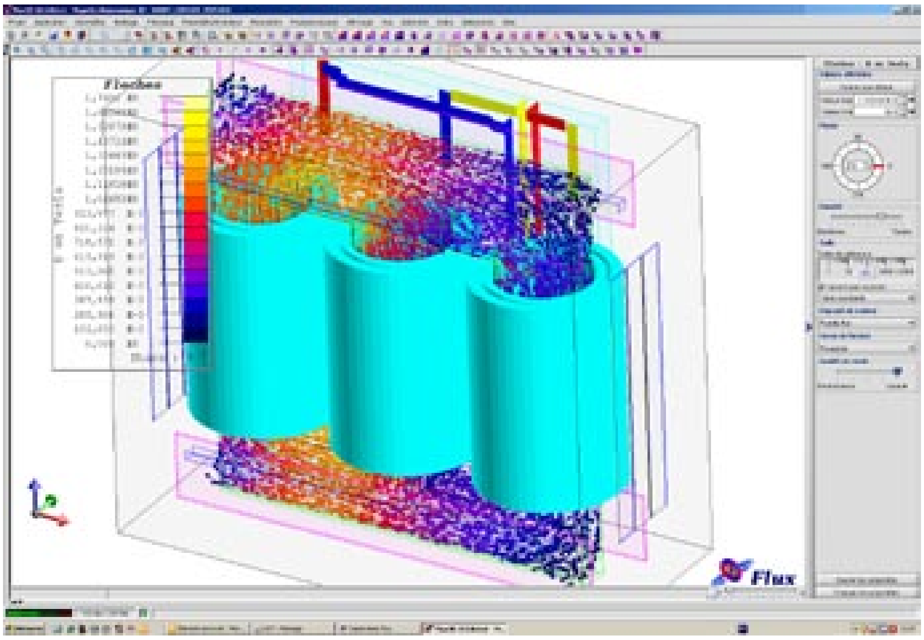
Flux 10.3: New powerful features are coming soon !

Vincent Leconte - CEDRAT Group.

Many improvements have been added in this new version to make use of an increasingly efficient Flux:

- **New mesh generation** made quick and easy. Get your mesh within a few clicks even if you are not an expert.
- **Reduced solving time** for circuit-coupled models.
- **Enhanced post-processing tools** for dynamic and accurate views of your results which will enable you to generate the most detailed studies.
- Flux 10.3 takes full advantage of the efficiency and flexibility of **Linux** systems.
- Don't miss the **Flux-Portunus co-simulation** (read more on page 8) !

Less time for model set-up and solving means more time for your actual design work, just as you would want it!



Flux 10.3 - New powerful user interface.

CEDRAT's Software products in India with EMSAC.

Jayesh Amrutiya, Vincent Marché - CEDRAT Group.

CEDRAT has been developing business in India for long years, and needs to build its dedicated technical & sales team structure to support its Software Solutions growth in the country.
CEDRAT's software products are well known to offer simulation solutions in rotating machine segment.

Some of the recent customers added to our big client data base are:

- Automotive: Bajaj and TVS
- Motor / Generator Manufacturer: Leroy sommer, Alstom, Best & Cromton
- Research: RCI (Research centre Imarat), NFTDC
- Universities: IIT Mumbai, IIT Delhi

Apart from the above mentioned Machine and Generator sector, the CEDRAT Group also plays a very important part in sectors like Actuators, Sensors and Induction Heating with valuable customers like Siemens India, Schneider India, GH Induction India etc…

The new structure in India.

In December 2008, the joint venture EMSAC was founded, between Maccon - leader for Motion Control - and Sika - focused in Projects, Systems and Engineering Services for Aerospace, Space, Marine and Automotive Industries.
CEDRAT is counting on its collaboration with EMSAC for Flux magnetic FEM software and Portunus system modelling program to develop its presence in India. This partnership is a second step of existing relationships established in the field of motor design software with SPEED and MotorCAD programs.

The active sales engineering team will support the EMSAC team in serving Indian customers in the field of CAD-tools for electric motor design.

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Motor-CAD V5.1: New features.

Dave Staton (Motor Design), Kevin Benoit (CEDRAT).

Motor-CAD is the leading software package dedicated to the thermal analysis of motors and the optimisation of motor cooling. Motor-CAD enables motor designers to optimise their designs for energy efficiency, size and cost reduction.

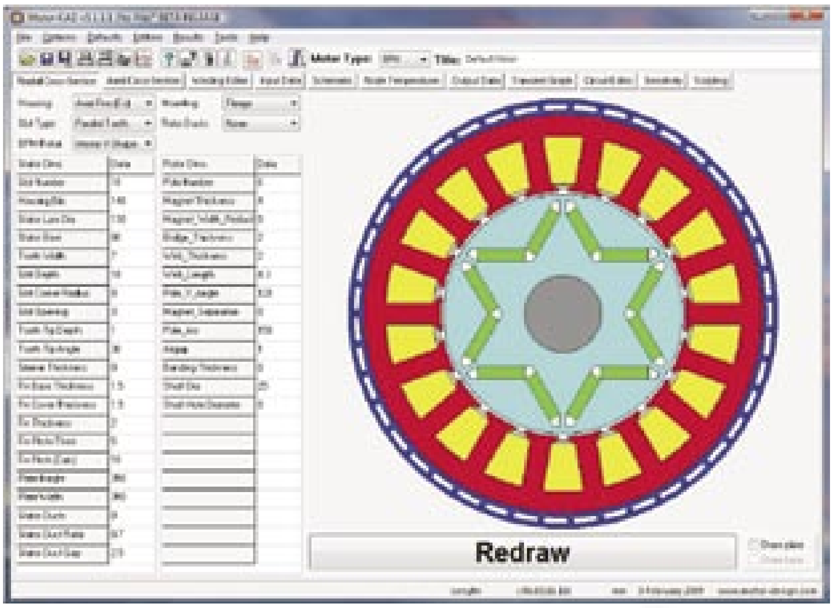
Motor-CAD provides the crucial link between the electromagnetic design and thermal analysis of motors. It makes it quick and straightforward for non heat transfer specialists to evaluate different cooling options during the design process.

Motor-CAD has a user friendly interface that allows the user to enter the geometry, winding data, losses, materials and cooling details. All the thermal parameters such as convection and radiation coefficients are automatically calculated.
Motor-CAD supports a wide range of Motor Types and has a comprehensive range of cooling options available.

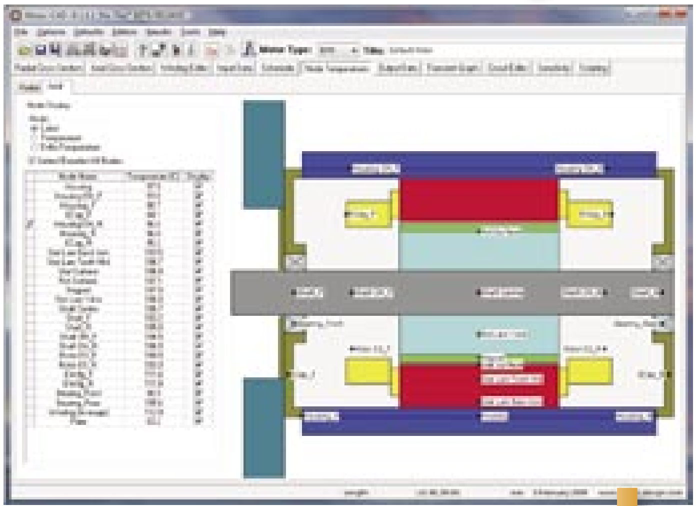
Motor-CAD provides the ability to quickly and easily perform steady state and transient thermal analysis of Electric Motors. The results are presented in an easy to view form.

A range of new features have been added that include:

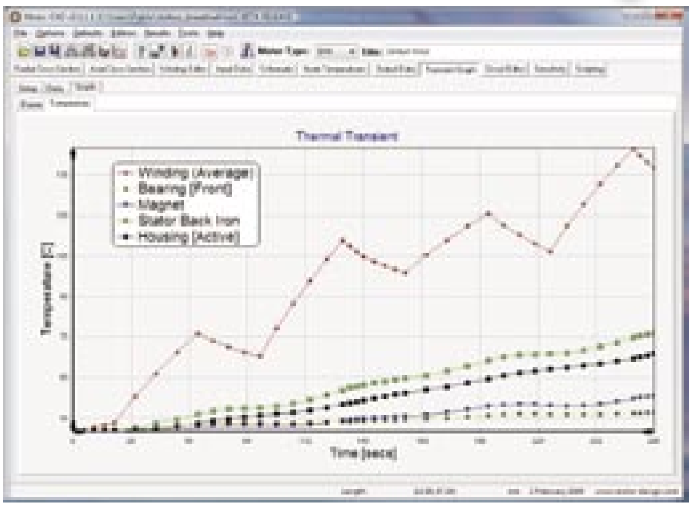
- New Geometries:
- BPM Interior magnet rotors (IPM)
- Slotless Winding Geometry
- Housed BPM Outer Rotor
- BPM Outer Rotor Axle mounting
- Sensitivity Analysis – multi-parametric and linked solving with improved graphing capabilities.
- Fluid Database – allows fluid property variation with temperature to be modelled.
- Reduced Node Transient model – creates a simplified thermal network for faster transient calculation and for use in thermal overload protection.
- Improved links to SPEED software – allowing the automatic calibration of the SPEED thermal models.
- Internal scripting interface – allows Visual Basic scripting of Motor-CAD and any other ActiveX compatible tools.



Motor-CAD radial cross section editor.



Temperatures Displayed on Axial Cross Section.



Motor-CAD Transient results.

10

Please feel free to evaluate our demo version at:

http://www.cedrat.com/en/software-solutions/downloads motor-cad-demo-version.html

New MRF (Magneto Rheological Fluids) Actuators.

Christophe Benoit , Grégory Magnac - CEDRAT TECHNOLOGIES.

For several years now, we at CEDRAT TECHNOLOGIES have been convinced by the many benefits of Magneto Rheological fluids, which is why we initiated the design of MRF Actuators. These are new electromechanical components based on Magneto Rheological Fluids. Depending on the magnetic field applied, these smart fluids can change their rheological properties; they can indeed switch from liquid to almost solid state in a matter of milliseconds. Magneto Rheological Fluid (MRF) Actuators are complex structures needing careful design, using Flux FEM software for magnetics and CFD FEM for computing flow dynamics.

Because the automotive industry began introducing this technology in their damping systems (in the AUDI R8, for instance) and because the demand for controllable dampers continues to grow, we are confident this technology has a bright future, either in semi-active dampers, smart shock absorbers or latches. And not only in the automotive industry, but also in the aerospace, medical, machine-tool and even consumer goods industries.

One of the main technical challenges with MRF actuators is to achieve ever-smaller sizes with the highest possible force. During our research, we reached an important milestone a couple of months ago with the design, manufacture and testing of a new, smaller unit with 10 times higher forces called the B-MRF. The requirements for this new damper were:

Blocked force	>1000N at 0A
Free force	< 100 N
Stroke	> 8 mm
Size	Length 66mm, diameter 32mm

Because of the need for compactness and reliability, and because we had successfully tested it in a previous project (see CEDRAT News n° 56), the twin tube structure was selected.

A key point was the design of the magnetic circuit. To offer a blocking force at rest which can be nullified when current is applied, a magnet is

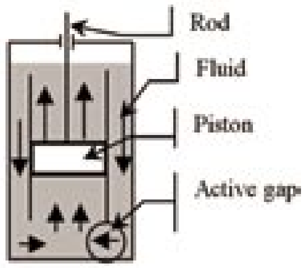


Fig. 1: MRF damper general concept.

used to create a high induction in the fluid gap, and a coil is used to override this induction. Flux software allowing finite element modelling is definitely a very efficient and convenient tool to speed up this design phase. To address dynamic behaviour and study the theoretical actuator response time from blocked to free state, transient simulations were achieved too. They took into account the eddy currents created and the magnetic field propagation time according to material characteristics.

Once fluidic and magnetic designs had been completed, detailed design, including mechanical part drawing, could begin. Close attention was paid to reliability and leakage. The choice of the seals is crucial, as the actuator has a high blocking force in a small size. This causes high internal pressure when applying a force to the actuator.

After manufacture, trials were carried out on a specific test bench, addressing static and dynamic forces, response time and thermal behaviour. The results were better than expected, with a blocking force of 1500N, and a free force below 100N.

Fig.2: View of a new MRF-B actuator managing a very high mechanical energy density.

2009: CEDRAT TECHNOLOGIES New Projects.

Learnform project: This FP7 project began on April 1st. It aims to create a breakthrough in sheet metal forming. The objective is a radical substitution of today's trial-and-error approach in deep drawing by a knowledge-based, self-learning production system. CEDRAT is in charge of the high-force actuators for vibration assistance in the sheet metal forming process.

SmartJoint project: The goal of this research project, coordinated by FEBO (Italy), is to develop motorized robot joints, with no backlash, including an embedded torque sensor, for high-precision 3D assembly operations. Within this project, CEDRAT is developing the contactless torque sensor (CTS), which will be installed on the gearbox developed by STAM. This project is an opportunity to experiment with this innovatory CTS technology, and is representative of robotic and industrial needs.

Chameleon project: This project proposes a new approach in the use of active intelligent devices integrated into machine tools. The main idea is to equip a machine tool with a variety of active intelligent devices, which would be intelligently activated and parameterised to change overall configuration and performances. CEDRAT is in charge of the actuators for vibration assistance in machining, working on both piezoelectric and magnetic solutions.

Magneto rheological fluid damper for DGA: CEDRAT and the LPMC laboratory from the University of Nice have joined forces to develop a new MRF damper for military applications with DGA funding. This project is scheduled over 36 months, and is the result of our investment in this field a few years back, making it an important milestone for CEDRAT

Limited Angle Torque actuator (LAT).

Nabil Bencheickh , Christophe Benoit - CEDRAT TECHNOLOGIES.

In linear positioning applications which require high resolution with long stroke (over than 1 mm), linear magnetic actuators such as voice coil are adequate because of they offer infinite resolution and controllable forces without cogging. The equivalent technologies for rotary displacement are Limited Angle Torque (LAT) actuators which can be used in gimbals assembly.

The architecture of the actuator consists of two toroidal windings on the stator. The permanent magnets are fixed on the rotor. LAT actuators use Lorentz force to produce a smooth and accurate motion. The actuator was designed and optimised using the finite element software (Flux®).

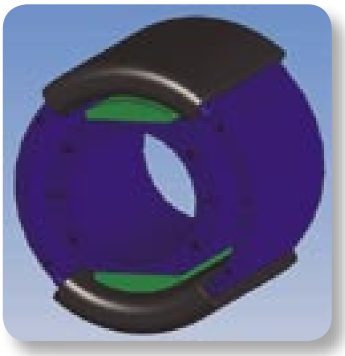


Fig. 2 : CAD view of the LAT actuator.

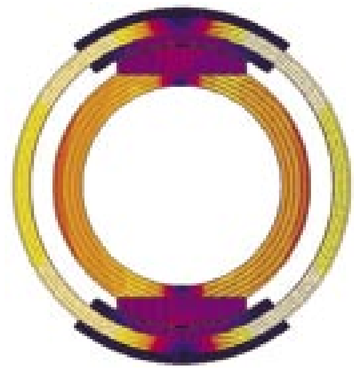


Fig. 1 : Distribution on the magnetic flux on the Limited Angle Torque.

Fig. 3 : Limited Angle Torque prototype.

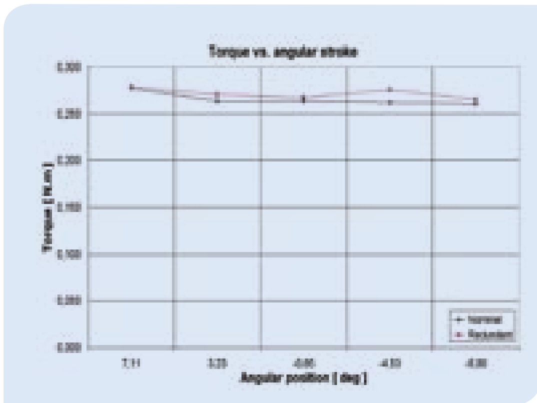


Fig. 4 : Torque over angular stoke curve.

Objectives

LATs were initially designed for space applications which need redundant coils for security reasons. The redundancy scheme was chosen to optimise the electrical response time of the actuator.

Space environment leads to over-moulded coils using space compatible potting. The specification required for this application is rotary displacement; angular stoke is over +/- 7°.

Performances

After preliminary magnetic and mechanical design, the first prototype was manufactured and tested. After functional tests, the LAT was submitted to a thermal shock test and a thermal vacuum test.

On the first test bench, the LAT was assembled in conjunction with flexible pivots and powered using a linear amplifier (LA24 from CEDRAT TECHNOLOGIES SA).

The LAT delivered a near-constant torque over the functional angular stroke, providing good controllability.

Conclusion

The Limited Angle Torque finds applications in actuate gimbals systems, scanning systems, position controls, etc...

Cedrat Technologies' Distributor Days, 25 – 27 March 2009

T. Maillard - CEDRAT TECHNOLOGIES.

From 25th to 27th of March, CEDRAT TECHNOLOGIES organised its first international distributors' meeting in the CEDRAT Group Headquarters in Meylan, France.

15 partners attended to these 3 intensive & fruitful days of work and exchange about the piezo actuators technology and business worldwide. The program of these 3 days was mainly dedicated to training, partners presentation, CEDRAT products and services presentation (piezo actuators and mechatronic engineering), facilities tour, marketing and strategy. Of course, entertainment and French cuisines cheered the attendance up during the 2 social events scheduled in the evenings.

The feedback from the 15 partners is very positive and all of them came back home with a clear answer on their expectations and a deep knowledge of our existing and potential business in their respective country. This distributor event is a part of CEDRAT TECHNOLOGIES strategic actions supported by COFACE concerning the international sales expansion of its piezo actuators product & mechatronic engineering services.

Sonoplast Project: New and innovative technology for producting small parts.

Ch. Benoit - CEDRAT TECHNOLOGIES.

Vibration-assisted and injection processes are currently hot topics. CEDRAT TECHNOLOGIES has been trying to get closer to the industrial world for some time now and a project like SONOPLAST is certainly a good way to achieve this. This project was launched last June and completion is scheduled within a year.

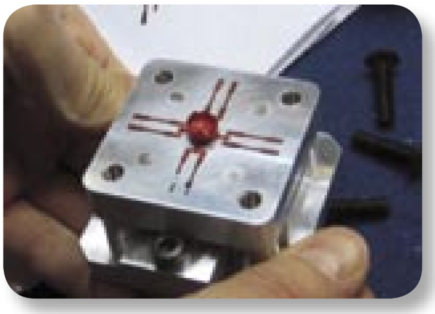
The outcome will be a revolutionary technological breakthrough for the plastics industry because it can be adapted to any injection or pressing machine. To summarize, the purpose of this FP7 European collaborative project is to design and build the first ultrasound micro-injection moulding machine for the production of small and micro parts in plastic. Seven partners from five countries are working together in the SONOPLAST project.

In addition to the Technological Centres, the companies that are part of the consortium will ensure that the products of the program can be industrialised and marketed in the plastics sector.

In this specific project, CEDRAT TECHNOLOGIES is in charge of the characterisation and vibration generation of the transducers. We are especially responsible for two Work Packages:

- **WP2:** The study of the plastic melting process using ultrasound. This is a critical step because the list of requirements will be determined from its work package results.
- **WP9:** The development and implementation of a detailed Training, Technology Transfer and Dissemination Plan.

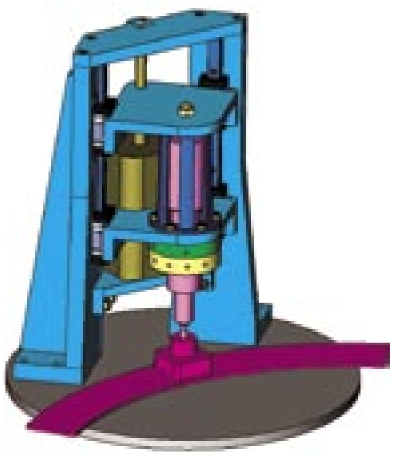
Initial results are very encouraging. Our contribution has, amongst other things, improved the kinematics of the machine. If you would like any further information about the project, we invite you to check out the website ***www.sonoplast.eu***.

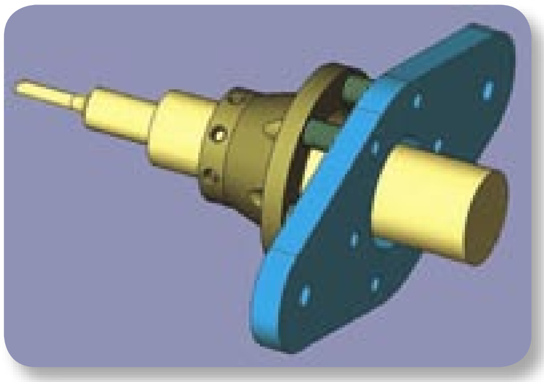


a)

b)

a) - b) : Example of achievement: miniature parts manufactured using ultrasound moulding.





Principle: The moulding process especially the filling of the micro cavities is affected by the ultrasonic vibration applied into the plastic material.

CEDRAT TECHNOLOGIES will perform in **joint event** with SMART'09 a **Piezo Actuators Training** the 16th of July 2009 in Porto, Portugal:

http://paginas.fe.up.pt/~smart09/welcome.html

Information: training@cedrat.com

Piezoelectric Actuators Introductory Course 16th July 2009

http://www.cedrat-groupe.com/en/services/trainings/technology-training.html

IV ECCOMAS THEMATIC CONFERENCE
SMART'09
SMART STRUCTURES AND MATERIALS

2009 Flux Conference in Autrans ...

Karoline Ballini - CEDRAT Group.

CEDRAT is delighted to invite you to its annual **Flux Users Conference** in Autrans Grenoble (France) on October 21 at 12am to October 23 at 2pm.

You will be welcome to the confortable Escandille hotel to the earth of the Alps in the Vercors.

Escandille hotel from Autrans, near Grenoble.

Why should you attend this event?

- ***NEW:*** Dedicated workshops in small groups: Flux links with others software, EMC modelling with CEDRAT software
- And also Share your experience with other experts and learn about last papers
- Learn about new software versions
- Software demos: Get answer by the support and technical team
- Student paper contest 2009

Should you be interested in learning more about our software solutions, we are organising **pre-conference training** (Flux update, PyFlux, InCa3D, Flux-Portunus Link).

Further information about the conference can be found at ***http://flux-conference.cedrat.com*** that will be continually updated as new information become available.

CEDRAT Group is partner of this exhibition:

May 26-29 2009
EMF 2009, 8th International Symposium on Electric and Magnetic Fields, Mondovi, Italy.

July 13-15 2009
SMART'2009, 4th international conference Smart Structures and Materials, Porto, Portugal.

CEDRAT Group will take part of these exhibitions:

May 26-28 2009
POWERGRID Europe, Transmission & distribution, Cologne, Germany.

June 24-25 2009
EMM 2009, Mechatronics for vehicles and production, Paris, France.

ISEF has evolved, over the last 34 years, to become one of the most popular international events within the electromagnetic community. Faithfully followed by leading experts from around the world, the symposium offers a perfect opportunity for discussions and networking, as well as for exchanging and disseminating information about recent research advances. It is a great pleasure for the city of Arras to host the meeting - for the first time in France - and to welcome all participants.
In addition to the well established conference topics, the Arras meeting will introduce a new area of noise and vibration of electrical machines. Another novelty will be a special session which will include presentations by PhD students working in the field of electromagnetism.

- Since last CEDRAT News edition, our team has increased from 12 people, of which 1 Ph.D., who will be dedicated to development & research and application support.

Briefly...

- ***Seminars in Turkey – April 28th to May the 1st.***

In collaboration with local universities, CEDRAT successfully organized **1-week road show seminars** in Turkey focused on **Electromagnetic systems design** using Flux, the **leading software solution for EM simulation**. Engineers and designers joind us to discover how Flux can help to **improve the efficiency and the design of devices**, such as: electrical motors and generators, linear actuators, transformers, induction heating, NDT, HV devices, cables, EMC, sensors...

Training

A full list of training programs can be obtained from our training department at CEDRAT Group, or from our new web site **http://www.cedrat-groupe.com/en/services/trainings.html**. *The dates are already fixed up until the end of year 2009, allowing you to prepare your training course calendar. Email:* **training@cedrat.com**.

English Sessions

DATES	THEME
May 2009	
14-15	• Flux 2D Application advanced course
28	• Methods and Equipment for Mechatronic Measurements
29	• Electromechanical and Electroacoustical Transducers
June 2009	
09-12	• Flux 3D Application and Rotating Machines
16-18	• SPEED PC-BDC Design of Brushless PM motor
18-19	• PSCAD introductory course
3-5	• Magnetism for Mechatronics
July 2009	
09-12	• Piezo Actuators Introductory course (Porto)
September 2009	
09-11	• Flux and Induction Machines
24-25	• Portunus Introductory course
24-25	• Flux and the PyFlux command language
29-1/10	• Magnetism for Mechatronics
October 2009	
01	• Piezo Actuators Introductory course
02	• CEDRAT Piezo Actuators Technologies
21-23	• Flux 2D Application and Rotating Machines
21-23	• Flux 3D and Non Destructive Testing
November 2009	
03	• Magnetism introductory course
04-06	• Flux 3D Application Introductory course
05	• Electronic and Control in Mechatronics
12-13	• CAD import for electrostatic study with Flux
18-20	• Rotating Electrical Machines
19-20	• InCa3D Introductory course
23	• Usual and new magnetic materials
24-26	• Flux 2D Application Introductory course
24-27	• CIVA[nde] Introductory course at CEDRAT
December 2009	
03-04	• Flux 3D Application advanced course

French Sessions

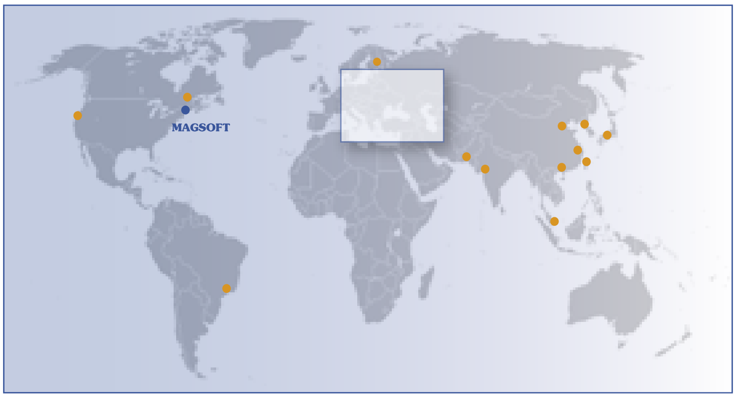
DATES	SUJET
Mai 2009	
12-14	• Flux Application 3D stage de base
26-28	• Flux Application 2D stage de base
26	• Méthodes et moyens de mesures en mécatronique
27	• Transducteurs électromécaniques et électroacoustiques
Juin 2009	
03-05	• Flux Application 2D et les machines tournantes
09-11	• Le magnétisme pour la mécatronique
16-18	• Technologie des actionneurs magnétiques linéaires (Cetim Annecy)
17	• Les actionneurs piézo : initiation (Cetim Annecy)
23	• Le magnétisme : initiation (Cetim Annecy)
24	• Matériaux magnétiques classiques et nouveaux (Cetim Annecy)
Septembre 2009	
22-24	• Matériaux et actionneurs piézoactifs (Cetim Annecy)
24-25	• Flux et le language de commande PyFlux
29-1/10	• Le magnétisme pour la mécatronique (Cetim Annecy)
29-1/10	• Flux Application 3D stage de base
Octobre 2009	
02	• Technologies des actionneurs piézo CEDRAT
06	• Electronique et asservissement en mécatronique
21-23	• Flux Application 3D et le contrôle non destructif
26-30	• CIVAnde stage réalisé au CEA
Novembre 2009	
3-5	• Les machines électriques tournantes - Le cours
12-13	• Flux et les imports CAO pour l'électrostatique
17	• Le magnétisme : initiation
17-19	• Flux Application 2D stage de base
Décembre 2009	
01-02	• Flux 2D Application Stage de perfectionnement
01-03	• Le magnétisme pour la mécatronique
02-03	• PSCAD stage de base
03	• Contrôle actif de vibrations, amortissement (Cetim Senlis)
07	• Matériaux magnétiques classiques et nouveaux
08-10	• Technologies des actionneurs magnétiques linéaires
08-11	• Flux Application 3D et les machines tournantes

Events

CEDRAT, CEDRAT TECHNOLOGIES, MAGSOFT Corp. and partners will take part in the above exibitions.

May 13-14, 2009 (CEDRAT)	**Les rendez-vous de Carnot 2009,** Versailles, Paris, France.
May 26-29, 2009 (CEDRAT)	**EMF 2009 ELECTRIC AND MAGNETIC FIELDS),** Mondovi, Italy.
May 26-28, 2009 (CEDRAT)	**POWERGRID,** Cologne, Germany.
June 14-16, 2009 (CEDRAT)	**EASA 2009,** St Louis, MO, USA.
June 15-18, 2009 (CEDRAT Technologies)	**Laser World of Photonics,** Munchen, Germany.
June 24-25, 2009 (CEDRAT Technologies)	**EMM European Mechatronics Meeting**, Paris, France.
July 5-7, 2009 (CEDRAT)	**MARELEC (International Marine Electromagnetics conference),** Stockholm, Sweden.
July 13-15, 2009 (CEDRAT Technologies)	**SMART'09 Smart Structures and Materials,** Porto, Portugal.
July 14-16, 2009 (CEDRAT Technologies)	**SEMICON West ,** San Fransico, CA, USA.
July 21-23, 2009 (Magsoft)	**ENDE (International Workshop on Electromagnetic Nondestructive Evaluation),** Dayton, OH, USA.
September 8-10, 2009 (CEDRAT)	**EPE (European Power Electronics and Applications Conference)**, Barcelona, Spain.
September 10-12, 2009 (CEDRAT)	**ISEF (International Symposium on Electromagnetic Fields)**, Arras, France.
September 15-17, 2009 (CEDRAT)	**BINDT Materials Testing**, Blackpool, United Kingdom.
September 20-24, 2009 (Magsoft)	**ECCE 2009 (Energy Conversion Congress & Exposition)**, San José, CA, USA.
September 23-25, 2009 (CEDRAT Technologies)	**ESMATS 2009 The European Space Mechanisms and Tribology Symposium**, Vienna, Austria.
September 24-25 2009 (CEDRAT Technologies)	**Les journées EF' 2009**, Compiègne, France.
29 September-01 October 2009 (Magsoft)	**Electrical Manufacturing Coil Winding & Coating Expo 2009**, Nashville, Tennessee, USA.
29 September-01 October 2009 (CEDRAT Technologies)	**Mesurexpo - Opto**, Paris, France.
October 12-14, 2009 (CEDRAT)	**5th International Workshop NDT in Progress**, Prague, Czech Republic.
October 13-15 2009 (Magsoft)	**Coil Winding, Insulation and Electrical Manufacturing Exhibition and Conference CWIEME 2009**, Chicago, IL, USA.
October 15-17 2009 (CEDRAT)	**AIPND Associazione Italiana Prove non Distruttive Monitoraggio Diagnostica**, Roma, Itlay.
October 19-23 2009 (Magsoft)	**ASNT Fall Conference**, Colombus, OH, USA.
October 21-23 2009 (CEDRAT)	**Flux Users Conference 2009, Autrans, France**
November 18-21 2009 (CEDRAT Technologies)	**Compamed Medica**, High Tech solutions for medical technology, Dusseldorf, Germany.

Distribution channel



Worldwide representation:

Europa:

Austria: Applied Magnetics. (CAE)
magnetics@bluewin.ch - http://www.maglink.net/

Benelux: Servotronic Benelux. (Piezo)
ev@servotronic.be - http://www.servotronic.be

Croatia-Bosnia: Faculty of Engineering. (CAE)
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Greece: Paragon Ltd. (Piezo)
paragon1@otenet.gr - http://www.paragon.gr

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info@spinmag.it. - http://www.spinmag1.it

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Slovenia: Bober Inzeniring. (CAE)
info@boberinzeniring-bb.si - http://www.boberinzeniring-bb.si

Spain: Indielec. (CAE)
indielec@indielec.es - http://www.indielec.es

Spain: GREENLIGHT SOLUTIONS . (Piezo)
l.perez@greenlightsl.com - www.greenlightsl.com

Switzerland: Applied Magnetics. (CAE)
magnetics@bluewin.ch - http://www.maglink.net/

UK: Motor Design Ltd. (CAE)
info@motor-design.com - http://www.motor-design.com

UK: ORLIN Technologies Ltd. (Piezo)
sales@orlin.co.uk - http://www.orlin.co.uk

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Brazil: Electromagnetics Tecnologia e Informática s/c Ltda. (CAE) *cardoso@pea.usp.br*
http://www.electromagnetics.com.br/

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dwhite@deltaphotonics.com - http://www.deltaphotonics.com

USA - Canada: Magsoft Corp. (CAE)
info@magsoft-flux.com - http://www.magsoft-flux.com

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USA: Micromechatronics Inc. (Piezo)
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Asia:

China: A&P Instrument Co., Ltd. (Piezo)
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China: SoftWave Ltd. (CAE)
info@softwave.cn - http://www.softwave.cn

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India: EMSAC Engineering Pvt. Ltd
ganesh.n@emsac.in - http://www.emsac.de/

India: Maxsoft. (Piezo)
info@maxsoft-india.com - http://www.maxsoft-india.com

Japan: Keystone International Co. Ltd. (Piezo)
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Japan: Small Motors Laboratory. (CAE)

Korea: Jaewoo Technology Co. Ltd. (CAE)
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Korea: Innotics Inc. (Piezo)
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Singapore: Laser 21 Pte Ltd. (Piezo)
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Taiwan: Scientific Formosa Inc. (CAE)
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Taiwan: Superex Technology Corp. (Piezo)
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Partners:

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info@hvdc.ca - http://www.hvdc.ca

France: CEA (CIVA^{nde} Software).
civa@cea.fr - http://www-civa.cea.fr

France: Laboratoire Ampère.
alain.nicolas@ec-lyon.fr - http://www.ampere-lab.fr/

France: ENSE3 - G2E Lab. (FLUX Software).
Yves.Marechal@g2elab.grenoble-inp.fr- www.leg.ensieg.inpg.fr/G2Elab

France: Magnetic Alloys (Magnetic materials).
info.iup@iup.arcelor.com - http://www.imphyalloys.com

Germany: Mecatronix GmbH (Mechatronic systems).
klesen@mecatronix.de - http://www.mecatronix.de

Italy: Inova Srl. (Induction Heating).
info@inovarsl.it - http://www.inovasrl.it

Sweden: R.I.T. (KTH) (Motors).
juliette@ekc.kth.se - http://www.ekc.kth.se/eme/eme_eng.html

UK: Elektro Magnetix Ltd. (Mechatronix Systems).
elektro@elektro.co.uk - http://www.elektro.co.uk

UK: Speed Laboratory (Speed Software).
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