

# PHOENICS News

**Spring 2013**

## Editorial

Welcome to the Spring 2013 edition of the PHOENICS Newsletter where we trying out a "new look".

CHAM is active in the modelling of data centres and, as part of its activities, is sponsoring and exhibiting at the upcoming Institute of Mechanical Engineers event to be held at Broadway House, Tothill Street, London SW1H 9NQ on June 6 2013. The event is entitled **"Data Centre Cooling and Optimisation: Working with the Environment"**; more information can be found online at [www.imeche.org/events/S1748](http://www.imeche.org/events/S1748).

**We look forward to seeing you there.**

On April 19 Professor Spalding will receive an Honorary Degree from the **Moscow Energy Institute**. More information will appear in the next Newsletter.

If any of you are attending the **ASME 2013 Summer Heat Transfer Conference** in Minneapolis, Minnesota (and it would be good to see you there) a Symposium is being held in honour of Professor Spalding. Meeting dates are July 14-19 and full details, including attendance information, can be found at [www.asmeconferences.org/HT2013/index.cfm](http://www.asmeconferences.org/HT2013/index.cfm).

The Newsletter contains information on features of the December 2012 release of PHOENICS. A précis was contained in the Winter 2012/13 issue; we hope readers find the extended article useful. There are also Product Update articles on CHAM's CVD and CAD activities. A "plugin" to Rhino is expected to be added to current CAD capabilities in the near future.

*Colleen King, Editor*

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## 1) PHOENICS-2012 December Update by John Ludwig, CHAM

### 1.1 PHOENICS Pre-processor

Changes to the VR-Editor include:

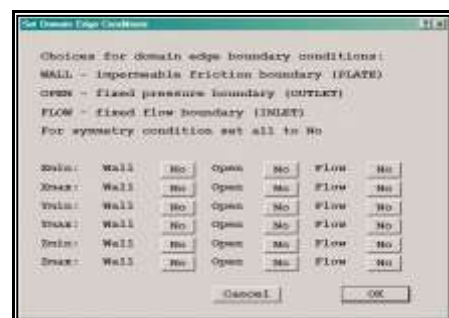
- Inlet objects have a vector arrow showing flow direction.
- Main Menu allows domain edge boundary conditions to be set as below but users must set non-default values as objects are created with default settings.

**Wall Yes** - create a **PLATE** object at this domain face. The name (for X) will be DOM\_XMIN\_W or DOM\_XMAX\_W

**Open Yes** - create an **OUTLET** object at this domain face. The name (for X) will be DOM\_XMIN\_O or DOM\_XMAX\_O

**Flow Yes** - create an **INLET** object at this domain face. The name (for X) will be DOM\_XMIN\_I or DOM\_XMAX\_I

Existing PLATE, OUTLET, INLET objects (with any name) covering a whole domain face will be recognised and set dialog flags.



- Activation of transient restarts made easier. On the 'Time step settings' dialog, set 'First step number' > 1 and a dialog will offer to activate the restart. All necessary file names will be deduced.
- Object names can be up to 12 characters.
- Q1 can be saved to a different name without saving all output files 'File - Save Q1 As...'

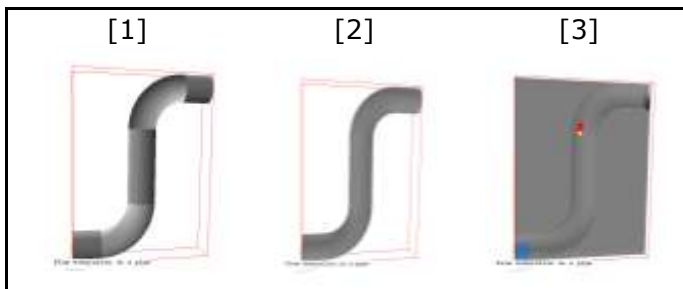
- Dialog for starting parallel is more flexible.
- Improved facilities to repair and manipulate CAD data during and after import. The new **DatMaker** utility can:
  - Mend holes
  - Ensure all facets point outwards
  - Repair folded facets
  - Split an object into separate bodies
  - Merge objects
  - Subtract objects

Often problems with geometry detection can be eased or removed by merging several touching or overlapping objects into one. The same applies to subtracting an air space from a surrounding blockage.

DatMaker is used by default when importing single or multiple CAD files, to translate CAD to DAT format. Supported formats are:

- STL - Stereo lithography file available in many popular CAD programs as export format.
- DXF - Drawing Exchange Format file (AutoCAD)
- 3DS - Autodesk 3ds Max
- WRL - Virtual Reality Modelling Language file
- DW - DesignWorkshop from [Artifice](#)<sup>®</sup>
- AC - Files generated by AC3D from [Inivis](#)<sup>®</sup>
- IV - Files generated by Open Inventor

DatMaker can be used to perform operations on objects already created in VR. Existing objects can be merged, split or subtracted. (1) Here there are 5 air blockages making a channel through a hidden solid; (2) then merged into one object; and (3) now subtracted from the solid leaving a channel.

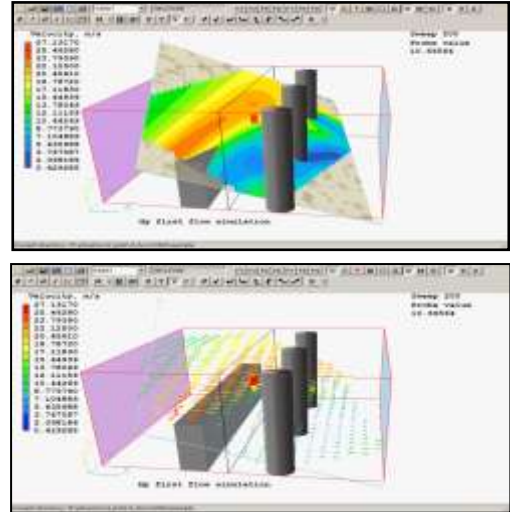


### 1.2 PHOENICS Post-Processor

Changes to VR-Viewer include:

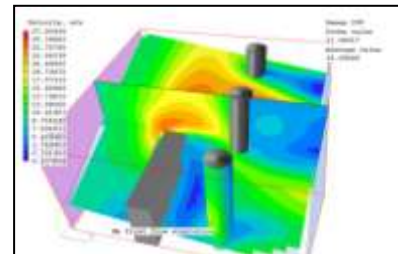
- Start-up dialog offers latest set of results.
- Function key F9 loads most recent set of results.
- Domain can be mirrored in any direction.
- Vectors can be drawn as 3D arrows.
- Contours and vectors can be plotted on an arbitrary surface of any shape – the 'Plotting Surface' object.

- Rotate to any position:
- Select the new object, right-click and select 'Surface contours'
- Or select 'Surface vectors'

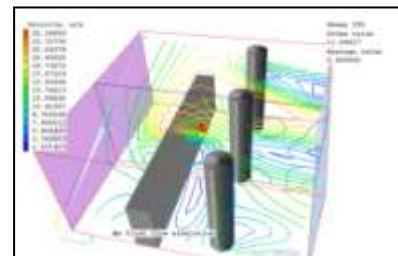


Contours have new options [1] **Fill**, [2] **Lines** and [3] **Lines and fill**. These can be applied to contour planes, contours on surfaces of objects and contours on Plotting Surface objects:

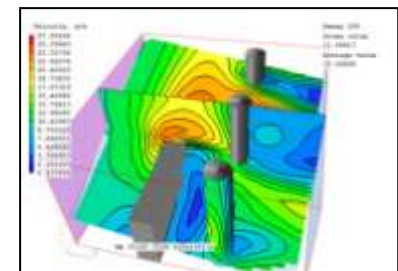
[1] Fill



[2] Lines



[3] Lines and Fill



An extra selection mode has been added. Hold *shift + ctrl* to select all objects under the cursor, not just the nearest. Objects have a 'Selectability' flag; objects that obstruct others can be made 'unselectable' (from the screen) so that those behind can be selected. The view centre can be set to the middle of a selected object and the working directory is displayed in the status bar at the bottom of the window.

### 1.3 PHOENICS Solver

EARTH has been modified to include a full double-precision version of the EARTH solver with better convergence than the standard single-precision version. This is especially true for transient cases where the domain is huge and not much is happening. To utilize this feature twice the memory is required.

Normalised residuals are now a much-improved reflection of the level of convergence.

#### The old normalisation produced:

Whole-field residuals before solution at sweep 400 with resref values determined by EARTH & resfac=1.0E-06

variable	resref	(res sum)/resref	(res sum)
P1	4.781E-06	2.584E+02	1.236E-03
U1	3.045E-06	1.262E+03	3.844E-03
V1	2.239E-06	2.129E+03	4.767E-03
W1	6.775E-05	7.379E+01	4.999E-03

#### The new normalisation produces:

Whole-field residuals before solution at sweep 400 with resref values determined by EARTH & resfac=1.0E-06

variable	resref	(res sum)/resref	(res sum)
P1	9.297E+02	1.333E-06	1.240E-03
U1	1.957E+04	1.982E-07	3.879E-03
V1	1.957E+04	2.496E-07	4.885E-03
W1	1.957E+04	2.574E-07	5.038E-03

The actual residual is almost the same, but the normalised value is small and more similar to CONV\_TABLE.CSV.

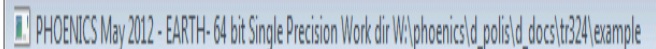
There have been three modes of operation for the graphical convergence monitor:

- Spot value and residual;
- Maximum correction and sum of nett sources; or
- Maximum and minimum value in the field.

It has always been possible to switch mode during a run, but the graph switched only at the moment of change, so previous values were not displayed. Monitoring values for all three modes are now held, and when the mode is changed the entire graph is redrawn in the new mode. It is possible to set a flag (Options, Solver Monitor Options) to have images of all three modes saved at the end of a run.

Other changes and bug fixes include:

- A new 'rolling' mode for the convergence monitor where only the last, say, 100 sweep values are shown helps show detailed behaviour of long runs, where the normal display condenses everything.
- Wall function coding has been updated so that cut-cells and fully blocked cell faces use the same code sequences. This should result in better heat transfer calculations when cut cells are present.
- A problem with fully-rough wall functions when roughness height was set  $\leq$  the near-wall cell half-height has been fixed so the run does not fail. As a by-product of this, boundary conditions required by various low-Reynolds number turbulence models have been made available for cut cells and EARTH-generated wall functions. Previously low-Re models only worked properly with plates and with EGWF=F.
- A new InForm command: *NETS(var,place)* where *var* is the name of a variable and *place* is the name of an object or patch is useful to link two or more objects. It returns the net source of the variable.
- Calculation of average outlet temperature for printing in RESULT has been made more accurate and robust.
- The net friction force on a BLOCKAGE object is now printed to RESULT.
- Adding *STORE(QDX,QDY,QDZ)* to Q1 allows storage of diffusive/conductive heat fluxes.
- In parallel PHOENICS, the infrequent 'Neighbour has other number of pbc-bound cells' error has been removed.
- The working directory, 32-bit or 64-bit and single or double precision status are echoed to the title bar of the Earth solver window, as shown,



and to the RESULT file.

```
-----
Running with 64-bit Single Precision executable
Working directory:
W:\phoenics\d_polis\d_docs\tr324\example
```

If a table file is open (eg in Excel) when Earth wants to write to it, the Earth run will pause and a dialog will open advising that the file should be closed before continuing (previously the Earth run would crash as the file was locked). Similarly, if the hard drive becomes full when writing the solution file, the Earth run will pause allowing file deletion and space creation.

## 1.4 SUNLIGHT OBJECT Update

The SUNLIGHT feature was created in 2010 in response to user demand for a Heat Isle module. See: [www.cham.co.uk/casestudies/CCS\\_HeatIsland\\_Application.pdf](http://www.cham.co.uk/casestudies/CCS_HeatIsland_Application.pdf) for a description of the prototype.

An updated version with improved flexibility is ready for release. The main improvements are:

- There is a separate SUN object no longer accessed through WIND.
- Required inputs can be read from standard EPW Weather Data File; fields read include:
  - Latitude
  - Direct and diffuse solar radiation
  - Air and ground temperature
  - Humidity
- Easy download of weather data files via a link to the EPW site.
- WIND object can take wind speed and direction from the same weather file.
- Transient operation has been improved.
- Incident solar radiation absorbed by each object in the scene can be set by the user.
- BLOCKAGE and PLATE objects have an extra 'Solar absorption' input box which allows the absorption factor for that object to be set. For most substances absorption will be 0.5 or greater. Bricks, weathered steel or marble can be up to 0.9. Polished metal surfaces can be 0.1 – 0.2.
- User no longer has to ensure that objects are faceted for them to be picked up by the illumination algorithm.
- Illumination algorithm will detect PLATE objects as well as BLOCKAGES
- Following additional output variables can be activated directly from SUN object dialog:
  - Illumination flag LIT
  - Potentially illuminated surface flag #SRF
  - TEM1 heat source per cell #QS1
  - Total heat source per unit area #QS2
  - T3 heat source per cell (for IMMERSOL) #Q3
  - Solar absorption factor #SOL

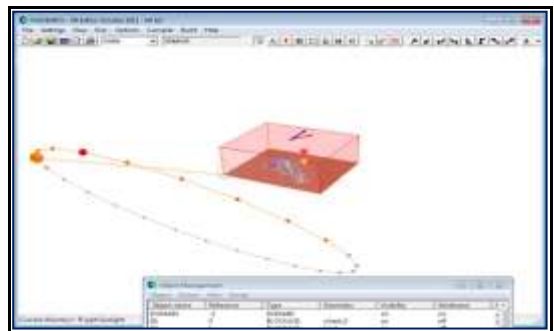
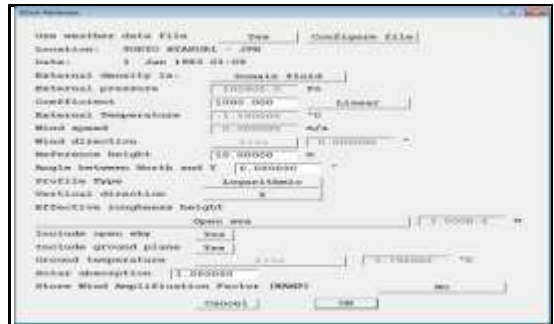


These can be used to check correct functioning of the illumination model.

- Conditions can now be taken from a weather file and applied directly. Having created a SUN object and opened its attribute dialogue to use and configure a weather data file, the default browser will open the Energy Plus site from where the weather data file can be selected and downloaded [clicking on 'Start browser' will enable a weather file to be downloaded.] Once selected, the data file can be loaded directly into the VR Editor.

The WIND object can use the weather data file.

- The pre-attached data file is used, and the current data are shown:



- The WIND object graphic shows the current North (blue) and wind (red) direction.
- In a transient case, the time-step-setting dialog controls time step size and number of steps to run. The time of day at the start of the run is the time chosen from the weather data file. The data values from the file are transmitted to EARTH, and at each time step the solver interpolates between the data-file values to get the current inlet values. The solar shading is updated at the start of each time step, and the current direct and diffuse solar radiation values are interpolated from the weather data file. Animation is available to show, for example, a 24-hour sequence.
- When a weather file is in use for a transient case, external pressure and temperature are updated at each time step from the weather file. This was done by updating the external pressure at outflow boundaries. In practice, it turned out that changing the external pressure can have

unexpected consequences, for example creating inflows when the external pressure rises. This has been addressed by keeping the external pressure at zero relative to the reference pressure, PRESS0, and updating PRESS0 each time step.

- In addition, the reference density for buoyancy, BUOYD, is also updated each time step to match the new external pressure and temperature. The transient behaviour is much improved by these two measures.
- When a SUN object is active, the 'Solar absorption' factor of the WIND ground plane can be set. The 'Wind Amplification Factor' (local absolute velocity divided by reference velocity) can be STORED by a button-click on the WIND object attributes dialog.

### 1.5 Previous Highlights

Improvements in the previous release include, in the VR-Editor:

- The 'Object affects grid' attribute has been split into the three coordinate directions.
- An Auto-mesher error has been corrected.
- Grid refinement stops when the ratio between the size of the last cell in one region and the first in the next region falls below a set criterion.
- The auto-mesh dialog was set as a fraction of domain size but treated as a physical dimension when compared to cell sizes which meant that, for large domains, the refinement process terminated earlier than expected.
- There is a new option to set minimum and initial cell sizes as physical dimensions rather than fractions of the domain size.

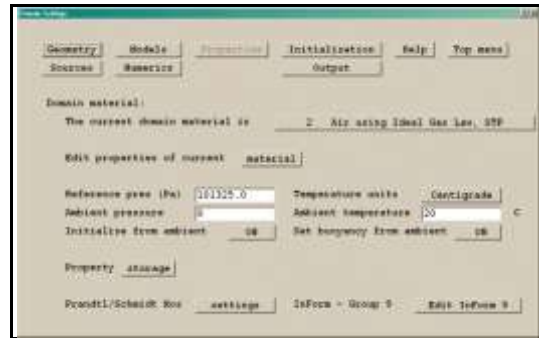
In the EARTH solver of PHOENICS/FLAIR, the 'Calculate link temperature' and 'Activation temperature' settings for a SPRAY\_HEAD object automatically activates the spray when activation temperature is reached.

In previous versions a message was written to RESULT when the criterion was met but the spray was not activated automatically. A table file containing the calculated link temperatures at the end of each step is also produced.

In the VR-Editor there are now ambient pressure and temperature settings which represent pressure and temperature outside the domain.

They can be used as the initial value and are default values at all inlets and openings. The reference

density used for buoyancy is derived from the ambient values which should ensure that buoyancy settings are self consistent and make it easy to change external temperature at all openings or inlets.



Often EARTH needs to link temperature and flow rate at one boundary condition to flow and temperature at another. Typical examples are:

- Ducting that is not explicitly modelled that joins one part of the domain to another.
- Intake and exhaust from an Induction Fan.
- Active chilled beams.

This can be achieved, now, by a pair of linked ANGLED-IN objects. One ANGLED-IN, set to extract flow, acts as a 'donor', whilst the immediately-preceding or immediately-following ANGLED-IN takes the flow rate from the 'donor' and uses it as the inflow:

- The temperature, smoke and other scalars are taken as the mass-averaged average values at the 'donor' object.
- The density is evaluated at the average temperature and ambient pressure.
- The velocity is deduced from the mass flow rate (taken from the 'donor'), the flow area and the deduced density.
- The turbulence values are computed from the turbulence intensity, velocity and hydraulic diameter.

The linking happens in pairs, so that a linked pair can be copied or arrayed and the correct objects will stay linked. For example, having a pair of linked ANGLED-Ins used to represent a duct joining the left and right-hand sides of the domain, or using a pair of linked ANGLED-Ins to represent an Induction Fan.

See: [http://www.cham.co.uk/phoenics/d\\_polis/d\\_docs/tr006/ph2012-dec.pdf](http://www.cham.co.uk/phoenics/d_polis/d_docs/tr006/ph2012-dec.pdf) for a power point presentation of features of PHOENICS-2012.

## 2) CHAM Product Information

### 2.1 CVD Update – March 2013 – The DC potential calculation function by Peter Spalding, CHAM

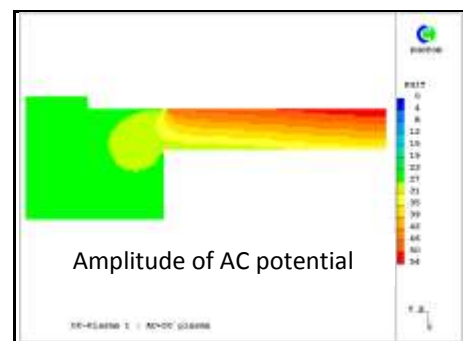
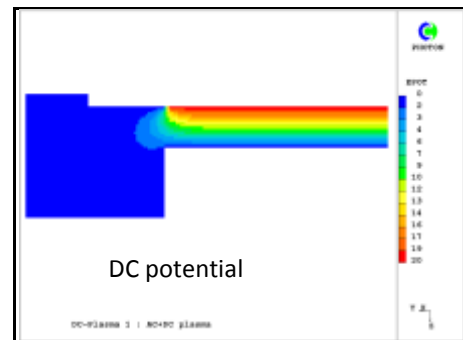
The PHOENICS-CVD module has been upgraded to allow the plasma model to solve for the time-average (DC) potential as well as the real and imaginary parts of the harmonic (AC) potential. This follows a request from CHAM's Japanese outlet, CHAM-Japan.

[http://www.cham.co.uk/DOCS/cham\\_product\\_update\\_CVD.pdf](http://www.cham.co.uk/DOCS/cham_product_update_CVD.pdf)

Changes include:

- expansion of CVD menu files to allow new settings to be made;
- modification of PLATE and BLOCKAGE files in Satellite to allow DC boundary conditions to be set, read and written from Q1 and written to eardat; and,
- modification of the GXPLAS.HTM file from Earth to set boundary conditions and properties.

The new coding runs existing CVD library cases, and all the new test cases supplied by CHAM-Japan, with no change to the expected results,. The images show results from a Parallel Plate Plasma Reactor, solving for both AC and DC potential.



Test Case 1 AC + DC - Plasma

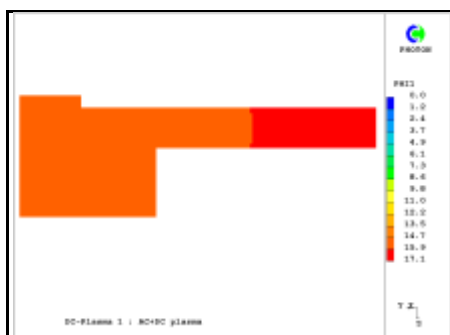
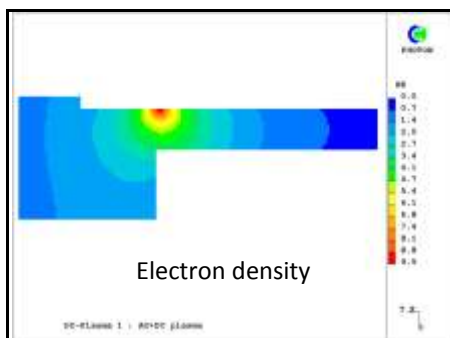
**For further information about PHOENICS-CVD, licence arrangements, consultancy, seminars and courses and, more specifically, what it can do for you, contact [Sales@cham.co.uk](mailto:Sales@cham.co.uk)**

**Links:** [CVD Applications Library](#), [PHOENICS-CVD](#)

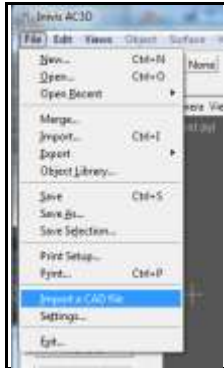
### 2.2 PHOENICS and CAD by Geoff Michell, CHAM

CHAM has improved the ability to use CAD geometry in PHOENICS. For some years we have encouraged use of AC3D as a simple model editor to create new shapes for use in PHOENICS; it also provides a useful means of converting some file formats into our DAT files.

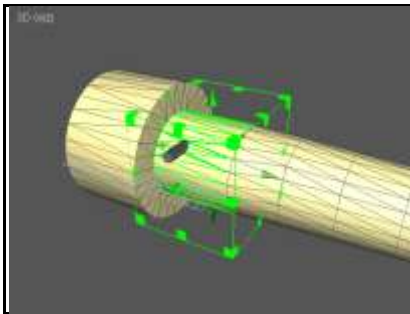
The main missing feature was importing CAD files, where the format is often closed. CHAM has found that SimLab Composer can read many CAD files and produce a format useable in AC3D. An interface was developed to allow AC3D to import CAD files seamlessly via SimLab; the user need only examine the loaded file, identify and correct problems (ie if objects have incorrect facet orientation or small gaps) and export the DAT file to use in PHOENICS.



**Example:** A cyclone model in IAM format (Autodesk Inventor). Choose Import a CAD file:

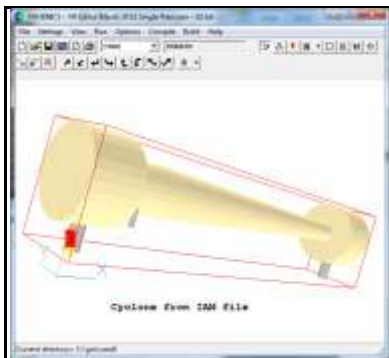


Find the file in the usual way; after a few seconds it is loaded and ready to edit.



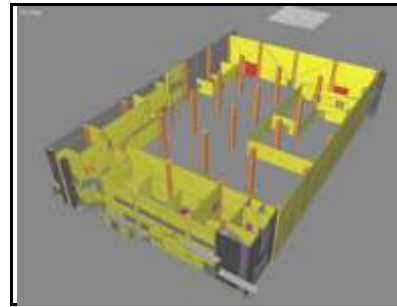
The model was examined, exported and imported into VRE ready to add boundary conditions. Users may wish to remove visible gray plugs and export them for use as separate inlet objects.

The plugs have 3 components: circular ends and the open cylinder joining the ends which users may wish to combine into a single component (easy to do in AC3D). The original CAD model can be changed if the user has CAD skills.



Files have been converted successfully in STP (step) DXF, DWG, SKP (sketchup), & SAT format.

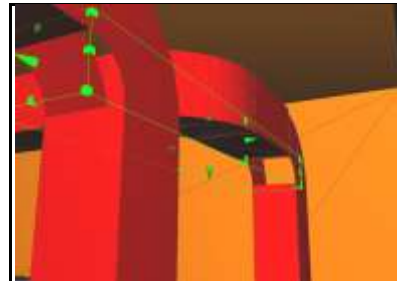
**Examples:** Converted and visualised in AC3D, the models are easily used in VRE & PHOENICS.



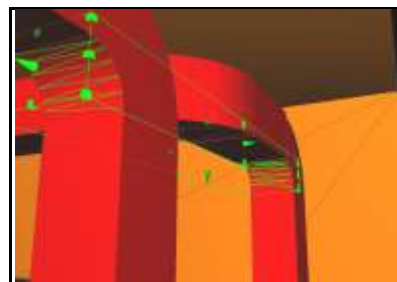
*One floor of a factory*



*A plant room; some work is needed to merge the pipework into a single object and correct the pipes shown here*



*Pipes with incorrect orientation of faces at the bends*



*After correction*

For further information about PHOENICS and CAD, new features, availability, and benefits for you, please contact [Sales@cham.co.uk](mailto:Sales@cham.co.uk)

### 3) PHOENICS Applications

#### 3.1 WATER-cooled Steam CONDensers (WATSCON)

by Andrew Carmichael, CHAM

The WATSCON module in PHOENICS has been updated over the last few months, as part of an Extended Consultancy Support (ECS) contract on behalf of a major power plant manufacturer, to assist in performance-related investigations of a new design of heat exchanger.

The first incarnation of WATSCON was over 20 years ago; developed to assess the performance of a range of industry-standard water-cooled steam condensers. Instead of solving the flow around each of the cooling tubes explicitly, involving time-consuming effort and corresponding computational cost, WATSCON uses a space-averaged approach to achieve its results quickly and efficiently, enabling users to undertake simultaneous variations of multiple design or environmental scenarios.

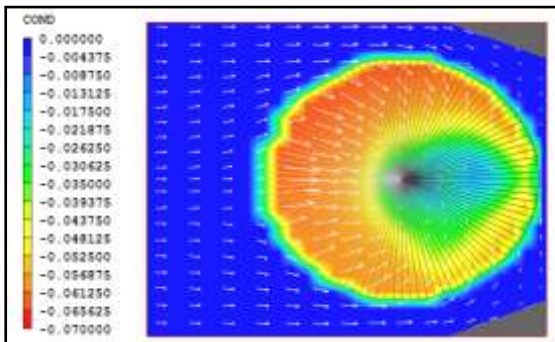


Figure 1 Condensation rate across a cylindrical array of cooling tubes (tube bundle)

Recent work includes updates to both source coding and to its specialised Graphical User Interface (GUI) to ensure that alternate designs are simple to setup and run. Although unavailable at the time of WATSCON Mk1's development, CHAM's PARSOL (PARTIAL SOLid) feature has now been integrated and fully-validated within the new module.

Additions to the original module include:

- Allowance for a two-pass system (coolant is cycled through the steam space twice).
- Option to use alternate water coolant mixtures for varying applications and operational environments.

- Choice of correlations for several of the parameters calculated such as inundation factor or the two-phase multiplier.
- Provision of sensitivity factors applied to both coolant- and steam-side to calculate the overall heat-transfer coefficient.
- Output extensions within the result file, to include a full summary of the input parameters used, detailed information regarding each coolant pass within the system, plus a general overview of the overall conditions within the condenser.

WATSCON is available as an add-on module to the standard PHOENICS product and, in due course, as a low-cost stand-alone SimScene (see Winter Newsletter.)

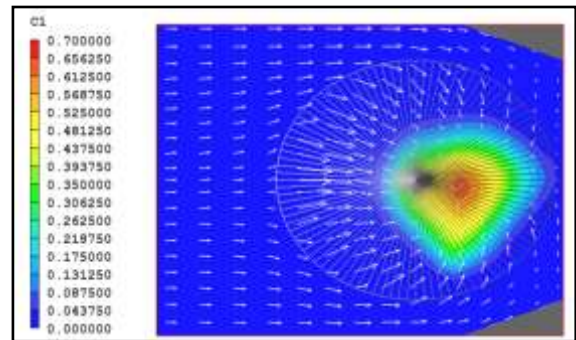


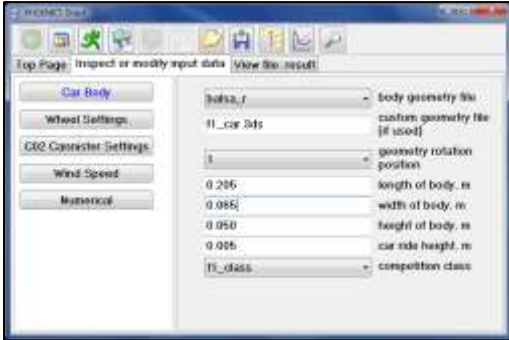
Figure 2 Air concentration in condenser (high spot corresponds to outlet location).

#### 3.2 F1-VWT SimScene

by James Stewart, CHAM

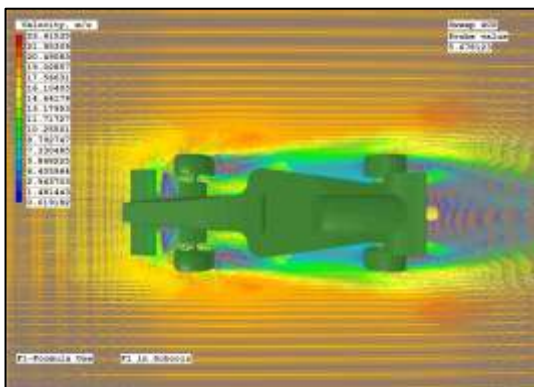
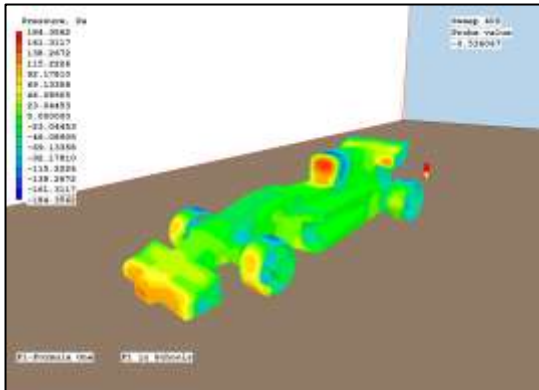


The **F1-VWT SimScene** is a special purpose program devised as a design-stage tool to be used by students competing in the **Formula One in Schools** challenge. The **F1-VWT** provides simple user interfaces to enable the easy setting up of Computational Fluid Dynamics (CFD) studies to analyse the aerodynamic performance of race car designs.



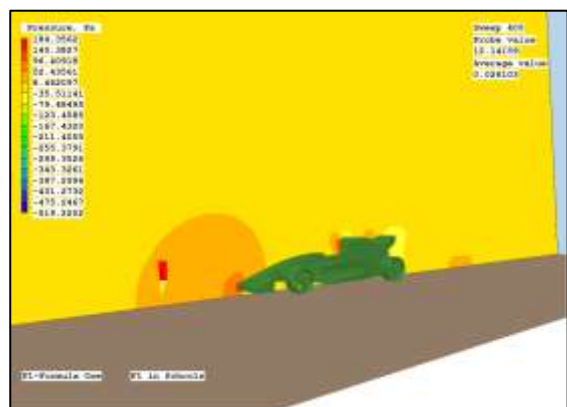
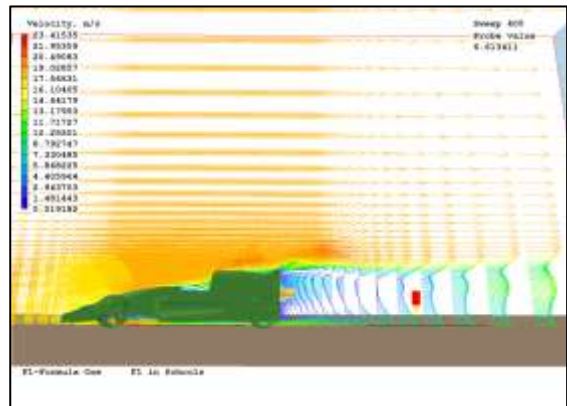
Virtual wind tunnel testing via the *F1-VWT* forms an integral part in the design process of a *Formula One in Schools* project. It provides a cost-effective way of optimising race car design before proceeding to the CAM manufacture stage of the challenge. The *F1-VWT* provides aerodynamic drag coefficients, numerous pre-set visual representations of how the air-flow interacts with the car body and an abundant array of post-processing options enabling users to produce customised visualisations of the flow field.

Images such as those seen below provide a detailed insight into the aerodynamic performance of the car design. The right-hand image illustrates the formation of numerous regions of recirculated flow, e.g. behind the front wing, wheels and back of the car. These areas of turbulent flow result in an increase in the aerodynamic drag force acting on the car.



The information provided by results such as those above can be used to make informed decisions when considering any modifications to be made to the car design. Another CFD simulation can then simply be conducted using the modified model to see what influence any changes have made. A process of design optimisation can thus be undertaken without having to construct a single physical model, hence saving both time and financial resources for the project.

The combination of numerical and visual results can also be used to provide detailed supporting evidence for design choice together with a bright and visually striking marketing display for your *Formula One in Schools* team. Consequently, the *F1-VWT SimScene* not only offers a simple and effective means of optimising car design for ultimate race-day performance, but also provides a depth of numerical and graphical output ideal for boosting the impact of your *Formula One in Schools* team portfolio.



To contribute to this Newsletter please send articles to [cik@cham.co.uk](mailto:cik@cham.co.uk) (in Word format preferably). Thank you.

## 4) Agent Information

**CHAM has a subsidiary Company (CHAM Japan) and nineteen agents worldwide. We will feature members of the extended CHAM family, alphabetically, in this, and following, Newsletters.**

### 4.1 ACADS-BSG: Australia, New Zealand, South East Asia



*Brian Spalding with (left to right) Trevor Kingston, Murray Mason, Wendy Rabone of ACADS-BSG, November 201.*

*Taken when Professor Spalding lectured at Monash University, 9th Australian Heat & Mass Transfer Conference, nr Melbourne.*

ACADS-BSG Pty Ltd has been a CHAM Agent since October 1995. Staffed by two very experienced engineers and three support programmers, ACADS sells PHOENICS in Australia, SE Asia and New Zealand and provides an unrivalled service to the Australasian construction and fire protection industries.

ACADS hosted a PHOENICS User Conference in Melbourne in 2004 and in 2008 held a workshop in Sydney run by John Ludwig. ACADS demonstrates PHOENICS at the bi-annual ARBS (Air conditioning, Refrigeration & Building Services) Trade Exhibitions.

ACADS: 18 High Street, Glen Iris, Victoria  
email: [acadsbsg@ozemail.com.au](mailto:acadsbsg@ozemail.com.au)  
web: [www.ozemail.com.au/~acadsbsg](http://www.ozemail.com.au/~acadsbsg)

### 4.2 ACFDA: Canada & USA



*Dr Vladimir Agranat*

ACFDA, based in Canada, has been an agency since 1996. It is run by Vladimir Agranat who has 25 years experience in managing CFD projects and delivering training courses. The team comprises Vladimir and:

- Dr. Sergei Zhubrin: VP Research & Development, Chief CFD Consultant
- Dr. Evgeny Shalman: CFD Analyst
- Dr. Valeriy Perminov: CFD Analyst
- Michael Agranat: Software Developer
- Kirill Skorupsky: Mechanical Designer

CFD applications covered include nuclear and power engineering, chemical engineering, fire prevention, environmental protection, hydrogen generation, gas-liquid separation.

ACFDA informs PHOENICS Users & prospective users of new PHOENICS applications and releases, newsletters, training courses, presentations and papers. Customized one-on-one PHOENICS courses are given over the internet (no travel involved).

PHOENICS is promoted via technical papers. A recent paper (joint authors SENES Consultants Ltd ([www.senes.ca](http://www.senes.ca))) was presented at the Air & Waste Management Assn's Conference, Raleigh, N Carolina, USA. The paper describes the PHOENICS application for air quality modelling and shows good agreement between PHOENICS predictions and CALPUFF modelling results: <http://aqmodles.awma.org/wp-content/uploads/2012/12/aq-modles-prelim-program.pdf>. Current information is available on the ACFDA website [www.acfda.org](http://www.acfda.org).

ACFDA, Thornhill, Ontario, Canada  
email: [info@acfda.org](mailto:info@acfda.org), web: [www.acfda.org](http://www.acfda.org)

### 4.3 ArcoFluid & ArcoFluid Consulting: France and the USA

ArcoFluid, headed by Dr Jalil Ouazzani who has 30 years CFD experience, has distributed PHOENICS in France since 1996. Dr Ouazzani has moved and set up ArcoFluid Consulting which is representing CHAM in the USA, is based in downtown Orlando and will be run by Dr Ouazzani and Ms Françoise Meynier.



ArcoFluid (USA) will expand the network of CHAM distributors in the USA, work to build the number of

PHOENICS & FLAIR users and to extend the support and expertise available to current and future customers. It will focus on promoting PHOENICS and FLAIR and on projects such as phase separation near critical point, spinodal decomposition of critical fluid, heat and mass transfer in crystal growth, CVD.

ArcoFluid (France) is run by Jalil with Ghali Diouri handling technical matters and Ms Beatrice Polin administration.

USA: 390 North Orange Ave, Suite 2300, Orlando, FL  
 phone: 407 272 1928  
 email: [jalil.ouazzani@gmail.com](mailto:jalil.ouazzani@gmail.com)  
 web site: [www.arcofluidconsulting.com](http://www.arcofluidconsulting.com)

France: 3 Rue du Golf, 33700 Merignac  
 Phone: (33) 556 347 536  
 email: [arcofluid@arcofluid.fr](mailto:arcofluid@arcofluid.fr)  
 web: [www.arcofluid.fr](http://www.arcofluid.fr)

## 5. PHOENICS Applications Provided by Agents

### 5.1 Allocation of gas detectors based on gas dispersion simulations using PHOENICS

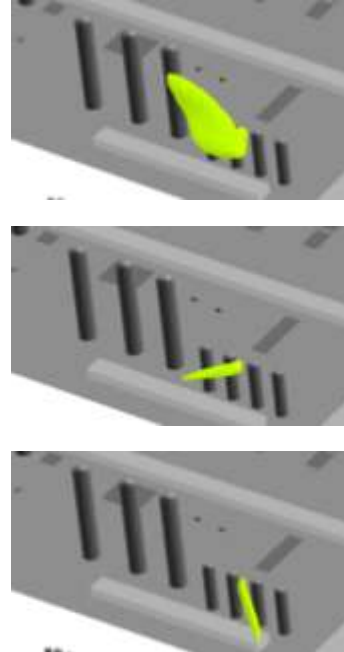
by Fabio Fundo, Safe Solutions, Brazil

In the current technological picture a large number of industrial plants operate with flammable oil products, either for power generation or as feedstock. Use of such material implies risk to an installation. This could occur as a consequence of an accident arising from a leak. Such accidents range from small inventory losses to major setbacks, such as explosions and fires that, depending on magnitude, can cause the loss of an entire installation including the lives of its employees. Because of these possibilities, companies responsible for the operation of industrial plants must perform safety studies to ensure safe operation of the unit.

As it is impossible to reduce to zero the possibility of leaks in an industrial plant, it is extremely important to ensure the efficient functioning of a leak detection system. In this context, one of the main instruments used for the safety of industrial plants is the gas detection system.

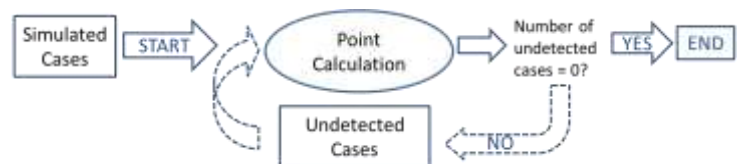
One of the methodologies most used to develop this type of system is based on computational fluid dynamics (CFD) using software like PHOENICS. By this method it is possible to predict the behavior of gases and vapors that may leak, taking into consideration details of existing facilities, equipment and wind direction. Optimum positioning and the total

number of detectors is determined by analyzing results obtained from simulations so that each possible gas cloud with a concentration equal to, or greater than, a preset level is observed by at least one detector.



In this context, Safe Solutions developed the DERFEL methodology, which automates the handling of results of PHOENICS gas dispersion simulations. The DERFEL methodology consists of verifying regions in space in which, for the greatest number of cases (simulations), the resulting gas concentration was greater than or equal to that previously set as a limit.

Starting from this premise points are listed which correspond to regions of higher occurrence of intersections among plumes (simulated in PHOENICS) with gas concentration above established limits. The process is terminated when it is verified that all simulations are observed by at least one detection point, thereby ensuring that all simulated cases are covered.



Safe Solutions developed a tool based on this methodology in which the main output is a table of the coordinates of the points the methodology calculates.

Safe Solutions, Brazil  
 email: [fabio.fundo@safesolutions.com.br](mailto:fabio.fundo@safesolutions.com.br)  
 web: [www.safesolutions.com.br/software/phoenics](http://www.safesolutions.com.br/software/phoenics)

## 6) PHOENICS Diary

2013	Activity
Mar 21	ACFDA & SENES Consultants ( <a href="http://www.senes.ca">www.senes.ca</a> ) presented a joint technical paper describing the PHOENICS application for air quality modelling at the Air & Waste Management Association's Speciality Conference: the Path Forward in Raleigh N Carolina ( <a href="http://aqmodles.awma.org/wp-content/uploads/2012/12/aq-modles-prelim-program.pdf">http://aqmodles.awma.org/wp-content/uploads/2012/12/aq-modles-prelim-program.pdf</a> ). The paper shows good agreement between PHOENICS predictions & CALPUFF modelling results (Abstract in Winter Newsletter).
Mar 12	Shanghai Feiyi held a training course for PHOENICS 2012 in Hangzhou
Mar 22	Shanghai Feiyi held a training course for PHOENICS 2012 in Shenzhen
On going	ACFDA gives customized, one-on-one PHOENICS training courses over the internet (no travel involved) enquiries to <a href="mailto:info@acfda.org">info@acfda.org</a> . Program available at <a href="http://www.acfda.org/docs/Prograam2012_3dyas.pdf">www.acfda.org/docs/Prograam2012_3dyas.pdf</a> . A course was given in Nov 2012 to Professor Valery Perminov, Ecology Department, National Research Tomsk Polytechnic University (NRTPU). ACFDA & NRTPU collaborated on PHOENICS-based modelling tools to train students to analyze behaviour of forest fires, fires in buildings & dispersion of pollutants ( <a href="http://www.wildlandfirecanada.ca/Presentations/Posters/P29.pdf">www.wildlandfirecanada.ca/Presentations/Posters/P29.pdf</a> ).
Mar 21-22	C-h-a-m-p-i-o-n, Taiwan, Advanced Training (HVAC). Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or web: <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Mar 26-27	Shanghai Feiyi training course for PHOENICS 2012 in Heifei, <a href="http://www.shanghaifeiyi.cn">www.shanghaifeiyi.cn</a>
Mar 28-29	Shanghai Feiyi training course for PHOENICS 2012 in Nanjing, <a href="http://www.shanghaifeiyi.cn">www.shanghaifeiyi.cn</a>
Apr 8	Shanghai Feiyi training course for PHOENICS 2012 in Tianjing, <a href="http://www.shanghaifeiyi.cn">www.shanghaifeiyi.cn</a>
Apr 10	Shanghai Feiyi held a training course for PHOENICS 2012 in Beijing, <a href="http://www.shanghaifeiyi.cn">www.shanghaifeiyi.cn</a>
On going	Shanghai Feiyi will be holding training courses for PHOENICS 2012 in other cities including Fuzhou and Nanchang. For full information please see <a href="http://www.shanghaifeiyi.cn">www.shanghaifeiyi.cn</a> .
Apr 16-17	C-h-a-m-p-i-o-n, Taiwan, Basic Training. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
May 14-15	C-h-a-m-p-i-o-n, Taiwan, Advanced Training (Fire, Smoke and Safety in Buildings). Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Jun 6	CHAM is sponsoring a meeting on Data Centre Cooling and Optimisation: Working with the Environment at the Institution of Mechanical Engineers, Broadway House, Tothill Street, London SW1H 9NQ, <a href="http://www.imeche.org/events/S1748">www.imeche.org/events/S1748</a> .

Jun 18-19	C-h-a-m-p-i-o-n, Taiwan, Basic Training. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Jul 14-19	A Symposium will be held in honour of Professor Brian Spalding at the 2013 ASME Summer Heat Transfer Conference, Minneapolis, Minnesota, USA <a href="http://www.asmeconferences.org/HT2013/index.cfm">www.asmeconferences.org/HT2013/index.cfm</a>
Jul 16-17	C-h-a-m-p-i-o-n, Taiwan, Advanced Training (Flow Around Buildings). Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Aug 3-5	C-h-a-m-p-i-o-n, Taiwan, Exhibiting at the CFD Conference of the Republic of China. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Aug 13-14	C-h-a-m-p-i-o-n, Taiwan, Basic Training. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Sep 4-6	C-h-a-m-p-i-o-n, Taiwan, Presenting and Exhibiting at the Semiconductor and Processing Equipment Conference, Republic of China
Sep 17-18	C-h-a-m-p-i-o-n, Taiwan, Advanced Training (CFD in Semiconductors & Optoelectronic Processing Equipment). Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or web: <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Oct 15-16	C-h-a-m-p-i-o-n, Taiwan, Basic Training. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Nov 12-13	C-h-a-m-p-i-o-n, Taiwan, Advanced Training (HVAC). Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or web: <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Nov 15-16	C-h-a-m-p-i-o-n, Taiwan, Basic Training. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>
Dec 17-18	C-h-a-m-p-i-o-n, Taiwan, Presenting and Exhibiting at the National Conference on Theoretical & Applied Mechanics, ROC. Contact: <a href="mailto:sales@c-h-a-m-p-i-o-n.com.tw">sales@c-h-a-m-p-i-o-n.com.tw</a> or <a href="http://www.c-h-a-m-p-i-o-n.com.tw">www.c-h-a-m-p-i-o-n.com.tw</a>



PHOENICS 2012 Training Course in Shenzhen. Courses given by Shanghai Feiyi are free of charge. All PHOENICS Users and potential users are welcome.