PHOENICS News

PHOENICS – Empowering Engineers Summer 2017

This Edition

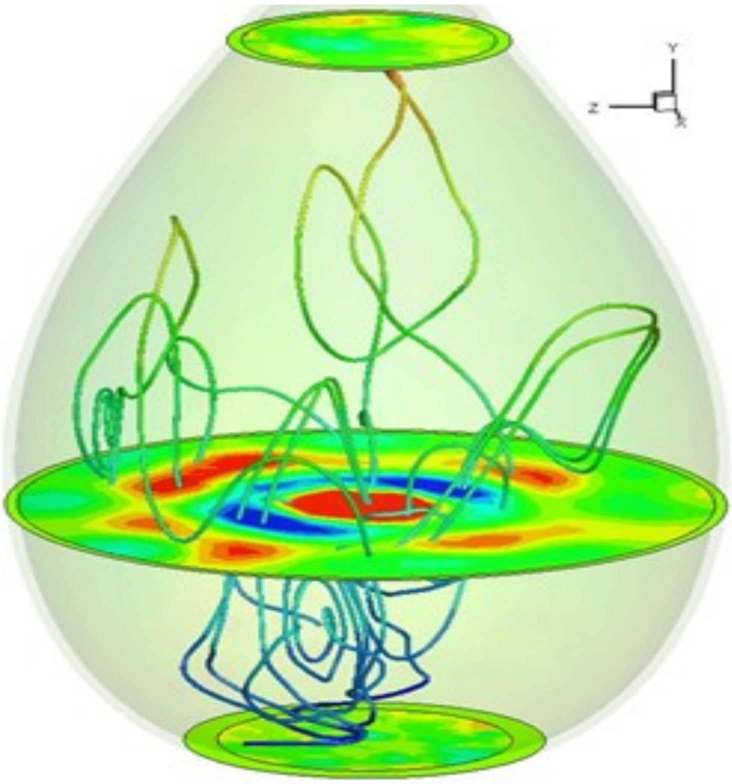
This Newsletter contains articles from PHOENICS Users, one of which outlines a somewhat unusual application of PHOENICS—modelling vineyards and wine production, and another of which describes the insertion of a new feature into the code. There is also an outline of PHOENICS being used as a teaching tool at the Moscow Power Energy Institute.

If you are a PHOENICS User and would like to submit an article we would love to hear from you (news@cham.co.uk).

If you do not use PHOENICS and would like more information please contact us on sales@cham.co.uk

"After using CHAM on a high profile project we had, they proved to be nothing less than exceptional in the service they delivered. They also continued to support us after the service was complete which was much appreciated. This is a company that I would recommend and use again knowing that I would get a friendly welcome"

Will, Brymor



Movement of Wine in an Ovoid Tank (see page 3)

PHOENICS News Contents Pg

Physics Applied to Wine and Vineyards Using PHOENICS

Romain Guillaument, contact@celsius.ph
Celsius, 36 Rue Lucie Aubrac. Bordeaux. 33300 France.

In this article, we present the modelling of a microclimate in a vineyard, the thermal current in a winery and the movement of wine in an ovoid tank.

We are working to see if the physics of fluids allow predictions of the zones in which heat, or frost, critical to the plants, will fall.

When studying a plot, we first ascertain the topography to create a three-dimensional map. We also collect all historically known climatic data, and calculate preferential displacements of the masses of air according to the relief.

For the winery, we try to work in parallel with the architect to model the thermal environment according to use (visits, daily work, air conditioning, etc). This makes it possible to master wine-making processes and reduce energy expenditure.

Until now, the selection criteria as to how to choose an ovoid tank to store wine, or whether it was better to choose an elliptical one, or an amphora, were based mostly on empirical knowledge.

PHOENICS is equipped with methods to account for the energy equation in several cases. To resolve the problems, we inserted different obstacles (tank, winery, topology and vineyard).

We used the sunshine model to simulate the energy of the sun on the domain. We used the "wind" object as a boundary, blockages for the material objects and the object "foliage" for the vegetation.

The method is applied successfully to:
1) Microclimate 2) Winery 3) Tank

Outlook

Numerical simulation is a modern, flexible tool which can be used to modify curvature quickly and understand physical mechanisms at work within tanks.

This tool can also anticipate climate change for vine growing, and estimate pesticide drift.

It may take account of other phenomena, such as chemical kinetics, fluid-fluid interactions, fluid-particle interactions and hydraulics; and may also be used to optimize processes such as bottling and filtration.

PHOENICS Simulations: Microclimate in a Vineyard

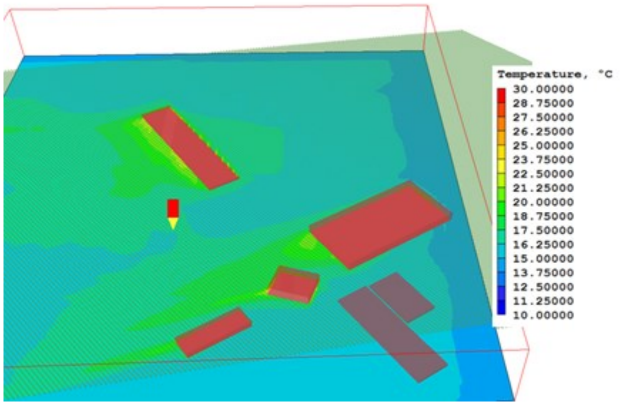


Figure 1 a) Temperature simulation on the plot, at 6 am, wind ENE, 1m/s, initial temperature 15°C, moderately dense foliage

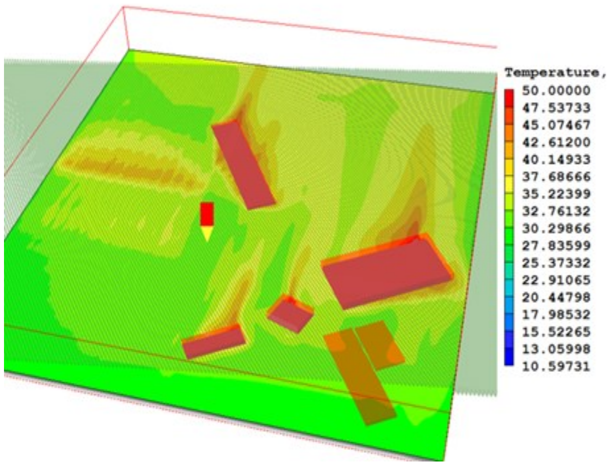


Figure 1: b) Temperature simulation on the plot, at 6 am, wind ENE, 1m/s, initial temperature 15°C, moderately dense foliage

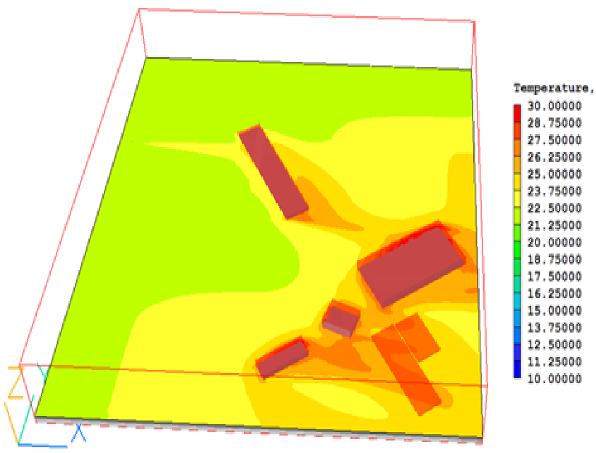


Figure 1: c) Temperature simulation on the plot, at 6 am, wind WNW, 1m/s, initial temperature 22°C, moderately dense foliage.

PHOENICS Simulations continued: Thermal Current in a Winery

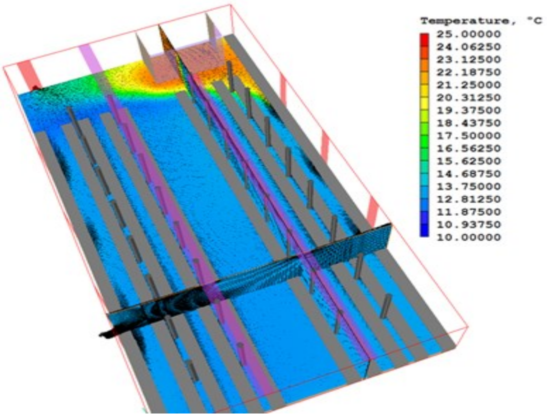


Figure 2 (a)

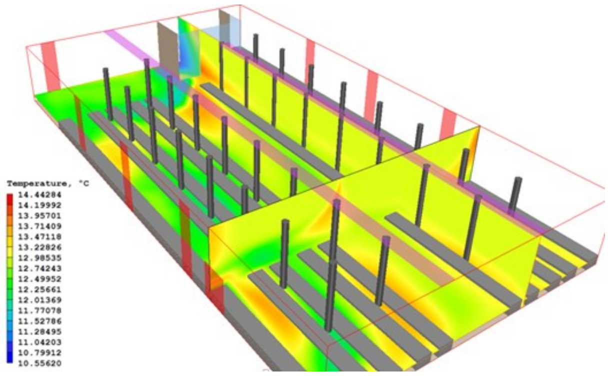


Figure 2 (b)

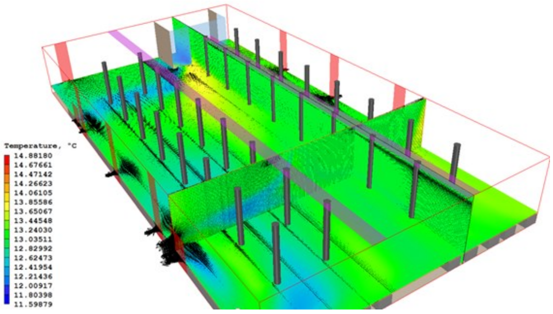


Figure 2: (c)

Figure 2:

a) *Visits impact on the winery, external temperature 23°C, winery temperature 15°C, air conditioning temperature 13°C.*

b) *Work office impact on the winery, external temperature 20°C, winery temperature 15°C, air conditioning 13°C.*

c) *Daily work impact on the winery, external temperature 23°C, winery temperature 15°C, air conditioning temperature 13°C.*

PHOENICS Simulations continued: Movement of Wine in an Ovoid Tank

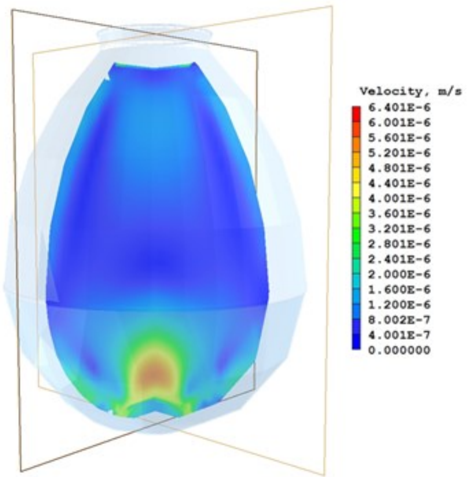


Figure 3(a)

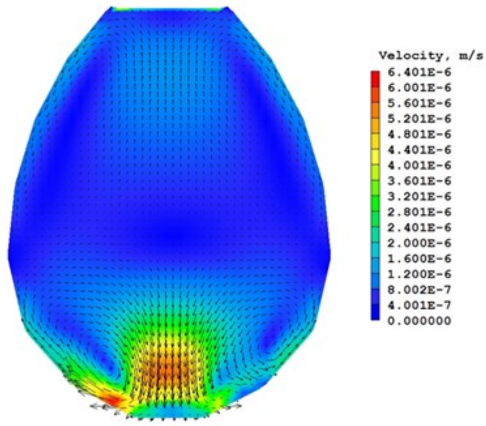


Figure 3 (b)

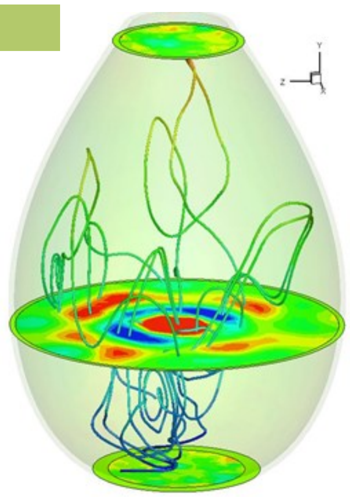


Figure 3 (c)

Figure 3:

a) *Two slides to show the velocity in an ovoid tank 3D.*

b) *A slide on this X axis to show the movement of wine.*

c) *3D visualization to show streamlines.*

VOF PLIC Method Development in PHOENICS

Jalil Ouazzani *Arcofluid, 3 Rue du Golf. Merignac. 33700 France. Arcofluid@arcofluid.fr*

In this article, we present the implementation in 2D Cartesian of the VOF (PLIC) method with surface tension in the PHOENICS code.

The PHOENICS code is equipped with several methods to account for multiphase flows (IPSA (Euler-Euler) technique, ASM (Euler), GENTRA (Euler-LaGrange), SEM (TVD VOF), HOL (height function)). The VOF-PLIC is analogous to the SEM method. The two methods differ in the way they obtain the colour function. SEM obtains it by solving a hyperbolic equation with high order schemes whereas the PLIC method uses geometrical reconstruction. The PLIC method presents better preservation of mass by limiting numerical diffusion and maintains sharp interfaces during fluid transportation.

Introduction of a VOF PLIC in PHOENICS is made through the Ground subroutine. At the beginning of each time step, and only at the first sweep of the SIMPLE algorithm, we call a VOF-PLIC subroutine in Group 19 of Ground to compute the colour function using velocities computed by PHOENICS. Then, we compute surface tension based on Brackbill's approach and physical properties of the fluids. Accuracy is maintained by using the GALA option of PHOENICS. When GALA is set to true, the pressure-correction equation is driven by residuals derived directly from volume flow rates.

The method has been applied successfully to three example problems:

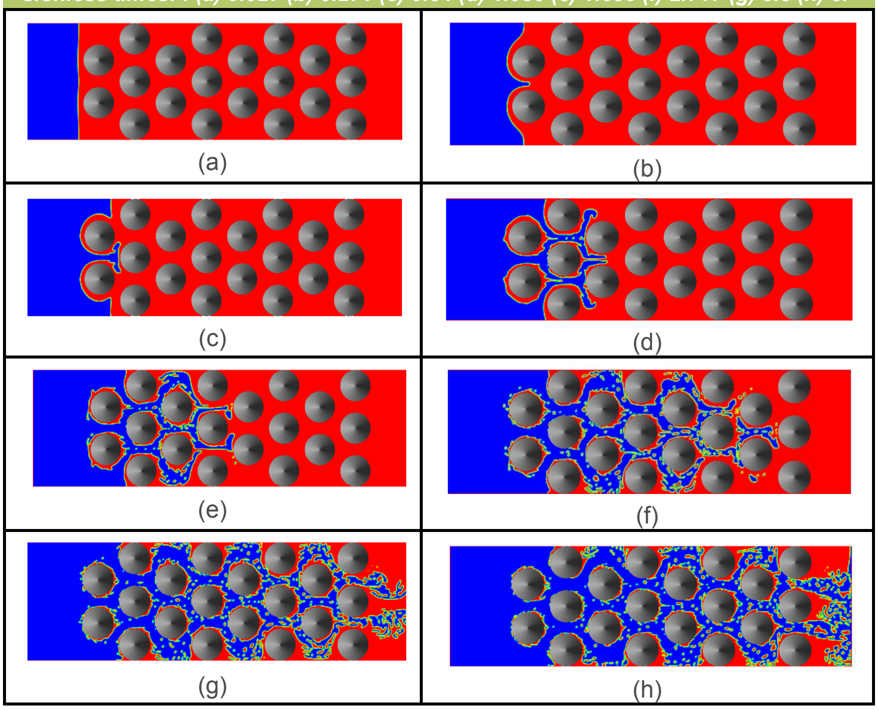
- Falling Droplet (Figure 1 to the left).
- Flow of CO_2 in water through cylindrical pillars in a microchannel (Figure 2 below)
- Ascending air bubble in water (Figure 3 next page (5)).

The colour function represented in the Figures is between zero and one. The interface between the two fluids is at 0.5. The VOF PLIC method preserves the interface and ensures conservation of mass. These problems are resolved using the continuum surface force (CSF) approach proposed by *J.U. Brackbill, D.B. Kothe, C. Zemach, A continuum method for modeling surface tension, Journal of Comparative Physiology 100 (1991) 335–354.*

To obtain the Fortran subroutines, please contact CHAM UK: www.cham.co.uk

CO_2 Flow in Water through Cylindrical Pillars in a Microchannel

Figure 2 PHOENICS using the VOF-PLIC method with surface tension of CO_2 (blue) flowing in a micro-channel full of water (red). Snapshots at different dimensionless times: : (a) 0.027 (b) 0.271 (c) 0.54 (d) 1.086 (e) 1.635 (f) 2.717 (g) 3.8 (h) 5.



Unsteady Hydrodynamics of a Water Droplet in Paraffin Oil

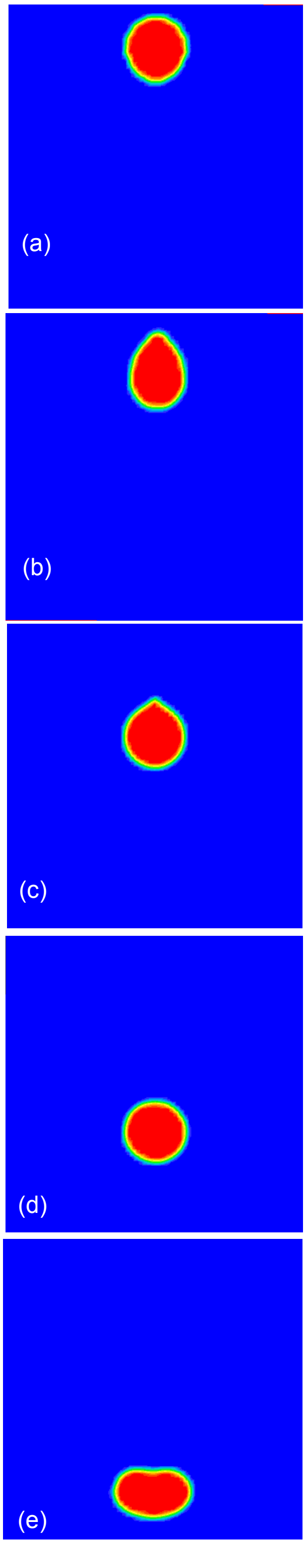


Figure 1: PHOENICS simulations in a 1x1 cm^2 box: unsteady hydrodynamics in droplets of pure water (red) in a continuous paraffin oil phase (blue). Snapshots at different times: (a) 0.022s (b) 0.111s (c) 0.333s (d) 0.666s (e) 1s. Colloids and Surfaces A: Physicochem. Eng. Aspects 365 (2010) 70–78

Ascending Air Bubble in Water

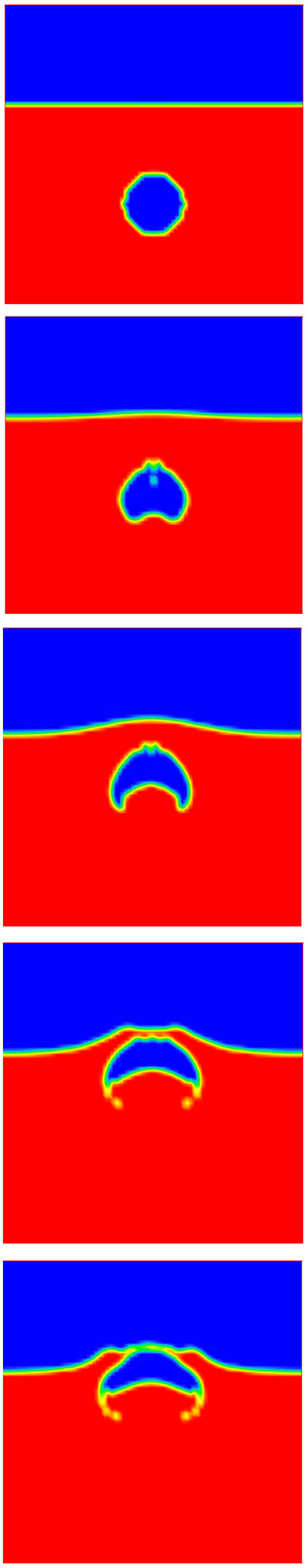


Figure 3: PHOENICS simulations in a 1x1 cm2 box of the rise of an air bubble in a water pool under buoyancy. Air is in blue and water in red. Snapshots at different dimensionless times: (a) 0.0011 (b) 0.022 (c) 0.045 (d) 0.068 (e) 0.0742.

PHOENICS Use in the Moscow Power Energy Institute (MPEI)

Docent Alexey Ginevsky, ginevskyaf@MPEI.ru.

Several MPEI teachers use PHOENICS in the educational process. In recent years I have lectured and conducted classes using PHOENICS with students in the Low Temperature Department. The Spring course is entitled 'Numerical Methods in tasks of Low Temperature Techniques' and contains basic information about numerical methods in hydrodynamics and heat exchange. It comprises:

1) Grids: All grids used in numerical modelling are described (structured Cartesian, polar, structured BFC, partially unstructured, Cartesian with cut-cells, fully unstructured, adaptive, etc).
2) Differential equations: The control-volume method implemented in PHOENICS is discussed for approximations of equations of hydrodynamics and heat exchange.
3) Hydrodynamics equations: Methods of pressure-velocity coupling including SIMPLE, SIMPLEST, SIMPLER and PISO are discussed. Convergence methods using various relaxations (explicit, linear and false-step) as implemented in PHOENICS, are described as well as other relaxation methods such as implicit linear and "diffusion".
4) Linear equations solution methods: Modern methods are reviewed including multi-frontal methods as iteration methods, applying various approaches for structured and unstructured grids.
5) Solution methods for concrete physical tasks of hydrodynamics and heat exchange: This is based fully on PHOENICS and moves from simple to complicated, from conductivity tasks to calculations of flows with natural convection. Students learn PHOENICS interfaces and calculation methods. Phase transfer tasks, which calculate freezing fronts, are discussed.
6) Turbulence models: PHOENICS contains many turbulence models so students are able to compare solution processes using different ones. Models including LVEL, K-E, etc are described. Particular attention is paid to wall functions. The multi-fluid turbulence model exemplifying the population model is discussed. Students learn how each model can be activated.
7) Models of Two-phase Flows: PHOENICS models IPSA and ASM are presented as models of continuous media. There is also an historical review of numerical models of flows with free surfaces.

Students learn the interfaces to the VR-Editor and VR-Viewer and the Q1 file structure and undertake some tasks. At the end of the semester, each student is given an individual task the solution of which decides the course mark. These tasks include calculating: flow and heat transfer in a pipe bundle, air flow and heat exchange when cooling a room using air conditioning, and air pollution from cars moving around the campus building. Most students cope successfully with the tasks set.

In the Autumn semester, students take a course entitled "Physical Basics of New Technologies". They learn new techniques for CFD modelling related to the application of PHOENICS-Direct methods and opportunities, and study:

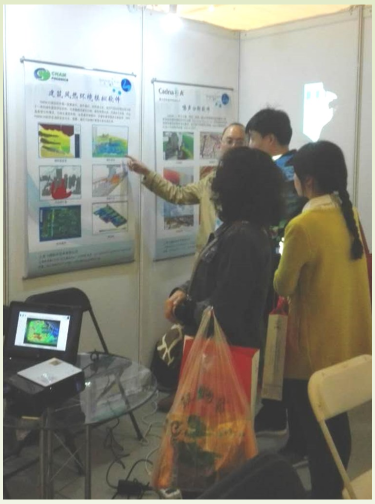
- basic programming in PIL (PHOENICS Input Language);
- application of InForm to calculate auxiliary values;
- methods of parameterization of Q1 files;
- how to use the PQ1 Editor to create SimScenes;
- using the Connected-Multi-Run (CMR) PHOENICS-Direct feature for automatic calculation development

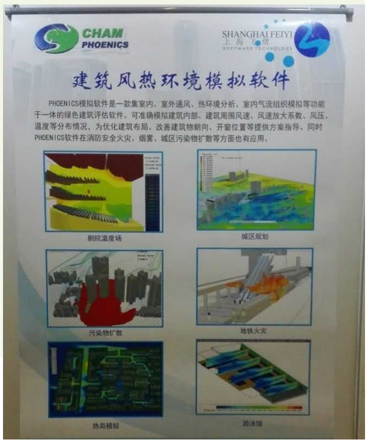
The purpose is to learn PHOENICS-Direct technology to a level where students are able independently to develop SimScenes using CMR. As in the Spring semester, students are set individual tasks. To solve these they must develop the CMR algorithm and demonstrate its efficiency as applied to their own examples. The tasks are quite testing for some students but most are successful.

Shanghai Feiyi

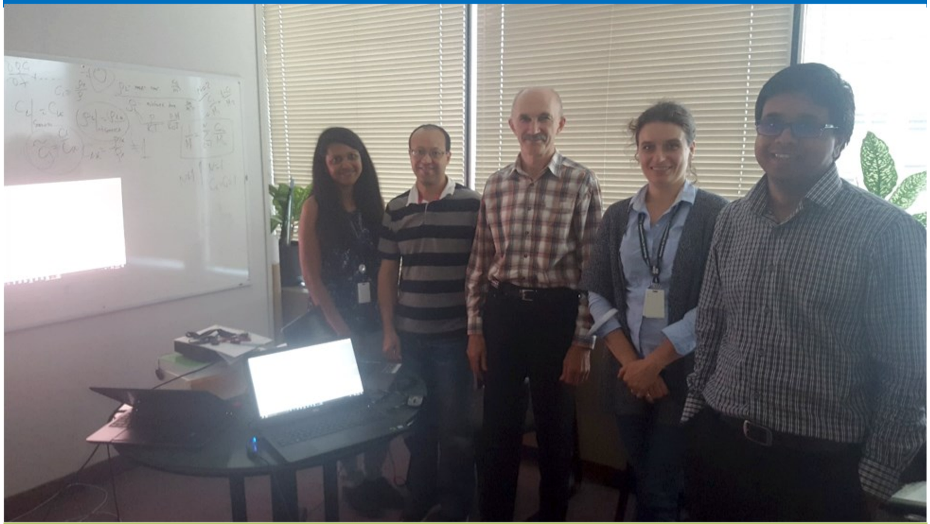
Shanghai Feiyi will hold a User Meeting in Shanghai in August 2017.

Photographs from the Green Building Conference 2016.





News from CHAM Agents



Left to right): Niki, Ferid, Vladimir, Barbara and Ahammad during the last training session June 22 2017.

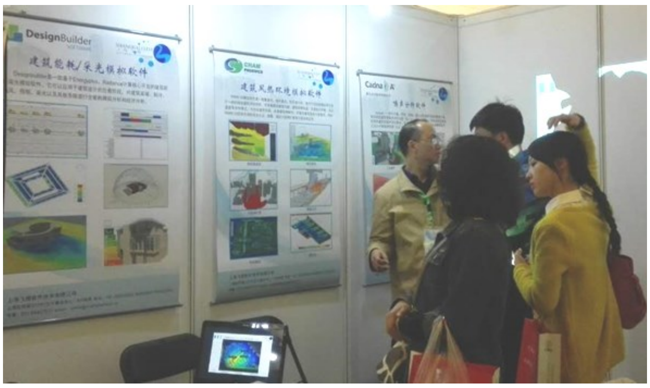
PHOENICS CFD Training at MOECC

In 2017 the Ontario Ministry of the Environment and Climate Change (**MOECC**, https://www.ontario.ca/page/ministry-environment-and-climate-change) purchased a perpetual PHOENICS Computational Fluid Dynamics (CFD) licence and an advanced customized PHOENICS training course.

The training sessions were delivered to 18 MOECC engineers and researchers from various departments by Dr. Vladimir Agranat, of Applied Computational Fluid Dynamics Analysis (ACFDA, www.acfda.org), CHAM's North American Agent.

Principal PHOENICS Users at MOECC are Air Pollution Control Engineers from the Standards Development Branch: Ferid Chabchoub, Barbara Sylvestre-Williams and Ahammad Ali. Two students, Niki Shah and Samantha Chu, help with CFD analyses.

MOECC will apply innovative CFD technology for developing environmental standards and guidelines to assist current environmental regulations. Over the past few years, CFD methodology has been added as a modern, physics-based and robust modeling tool to more traditional dispersion modeling tools such as AERMOD, CALPUFF, etc. due to an insufficiency of the latter in various challenging environmental studies (complex geometries, close-field studies, two-phase flows, chemically reacting flows, etc.).

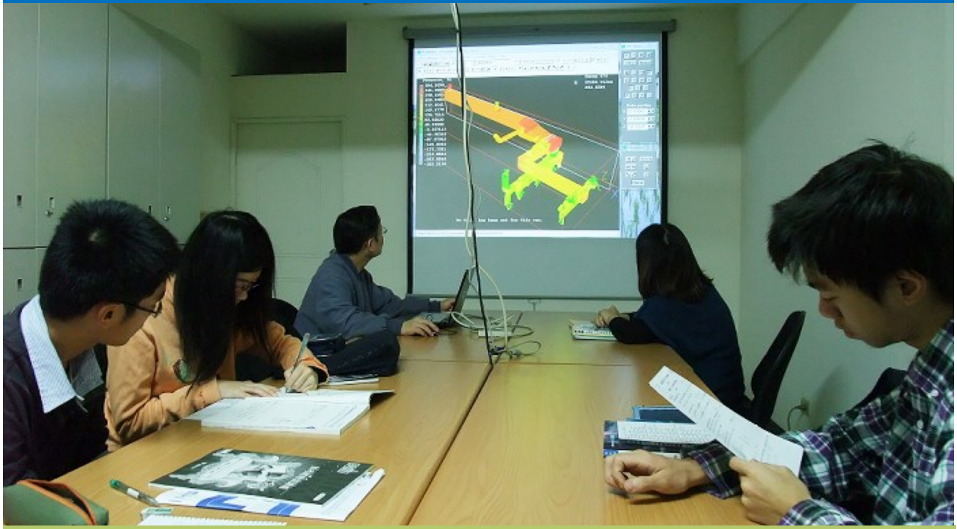


CHAMPION Taiwan: PHOENICS Training Course Information 2017

Jan	15-16	Flow & Chemical Reaction & Plasma in Semi-Conductor or Opto-electronics Industries Processing
Jul	13-14	Basic Training
Aug	17-18	HVAC & Building or Environment Flow)
Sep	21-22	Basic Training
Oct	19-20	Electronics Cooling
Nov	16-17	Basic Training
Dec	14-15	Flow & Chemical Reaction & Plasma in Semi-Conductor or Opto-electronics Industries Processing)

PHOENICS, and CHAM, Empowering Engineers

News from CHAM Agents continued



CHAMPION basic training course in March

News from CHAM

WindSim User Meeting

John Ludwig from CHAM visited Tønsberg, SW of Olso, Norway, during the last week of June in support of the 2017 WindSim User Meeting. WindSim develops and provides software, also called WindSim, which is used for wind energy applications worldwide; and for which PHOENICS is the CFD engine.

There were 41 attendees comprising WindSim users and representatives from its agents.

John outlined some recent features of PHOENICS, including the new scaleable wall functions and the forthcoming availability of the Kw-SST turbulence model.

Nikos Simisiroglou from WindSim presented some nice validation examples of a wind-turbine farm which he had originally done, with PHOENICS, at Uppsala University and later ported into WindSim. More details and published papers will follow. An early version of the work appeared in the Winter 2015/2016 Newsletter.

One session was devoted to forest modelling. WindSim's forest model uses the same momentum and turbulence modifications built in to the PHOENICS FOLIAGE object.

As ever, the first day of the user meeting ended with a flotilla of sail boats on the nearby fjord which was a lot of fun.

News from CHAM continued

Rhino User Group Meeting

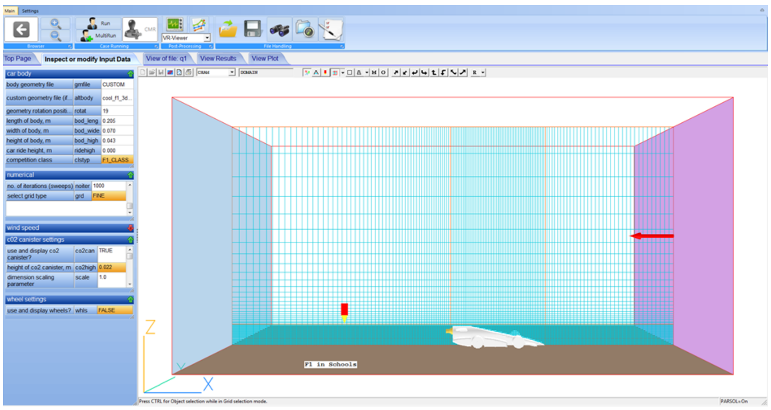
CHAM's Andrew Carmichael and Tim Brauner attended the Rhino UGM 17 hosted by SimplyRhino in London. The event was a success, drawing in over 100 Rhino users and suppliers to hear various presenters from the jewellery, architecture, design and software industries showcase how they used Rhino and its plugins to complete ground-breaking projects.

Andrew, CHAM's Engineering Manager, presented RhinoCFD, highlighting its capabilities to users in the architecture, naval and jewellery industries and outlining how the software could aid them in future projects. Many of those present had heard of RhinoCFD and enquired about the possibilities of testing the software which is possible, free, with RhinoCFD Lite, downloadable from www.food4rhino.com

F1 VWT

CHAM continues its involvement in the F1 in Schools Challenge (www.f1inschools.co.uk) by announcing the 7th incarnation of its F1 VWT (Virtual Wind Tunnel) based upon the latest PHOENICS Direct SimScene model.

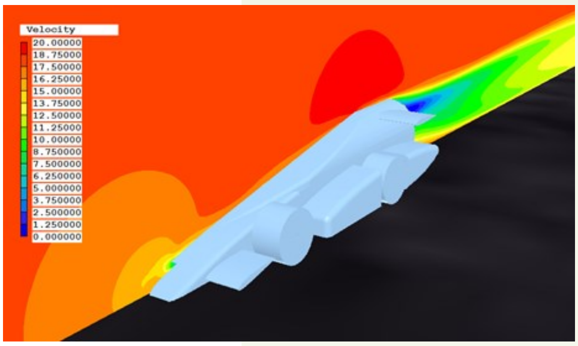
The Mk7 release offers three categories of car design – Entry, Development & Professional - and embodies the rules applied to each class.



The Main Menu now includes a live graphical update making it simpler to import customised CAD from the file select menu.

Other features, such the inclusion of wheel spin in the simulation, CO2 cannister emission can be activated. As before, the Mk7 release contains macros for pre-selection and generation of results images. Mk7 is freely available to all recipients of Mk6 and at very low cost to users of Mk5 and earlier releases.

Contact F1_VWT_help@cham.co.uk or Denford Limited at 01484 728000.



Contact Us

Give us a call for more information about our services and products

Concentration, Heat & Momentum Limited
Bakery House
40 High Street
Wimbledon Village
London SW19 5AU,
England

+44 (20) 8947 7651

Email:
sales@cham.co.uk

www.cham.co.uk

Staff

We welcome Dr Timothy Brauner who has joined CHAM as a Project Engineer thus strengthening our Applications Team.

We have an opening for a Development Engineer (junior level) with CAD knowledge , expertise in C++/C#, and an interest in developing plug-ins.

If you are interested please send your CV to hr@cham.co.uk or see www.cham.co.uk.