

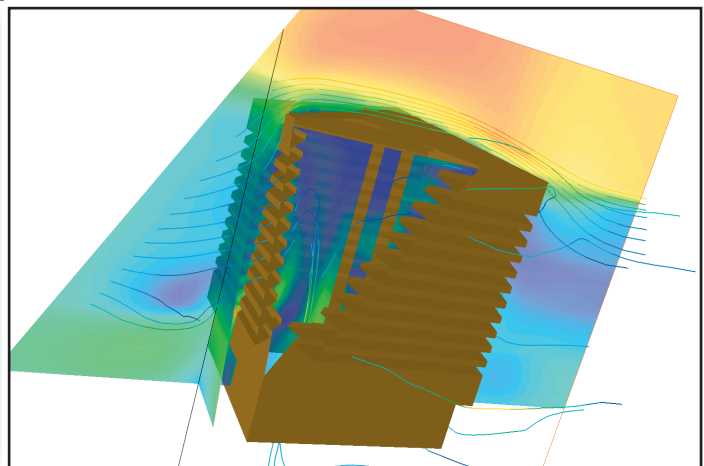
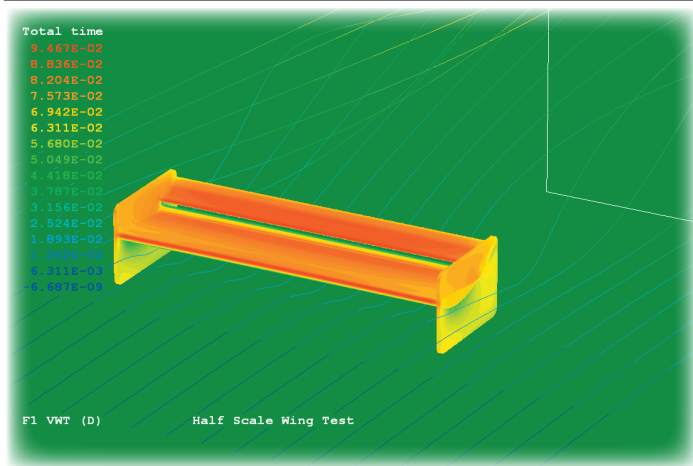
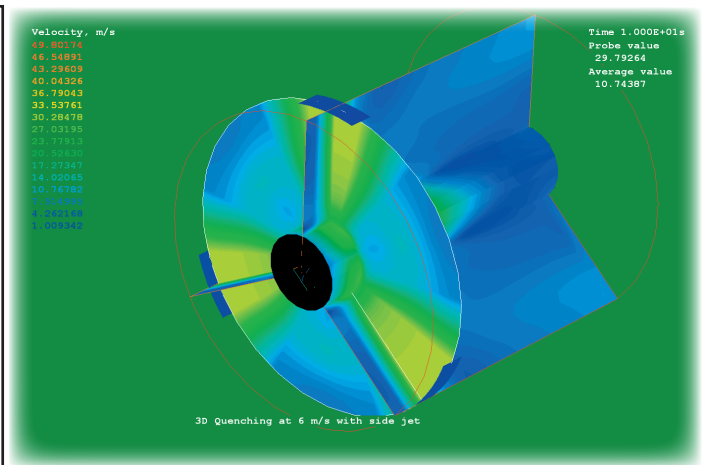
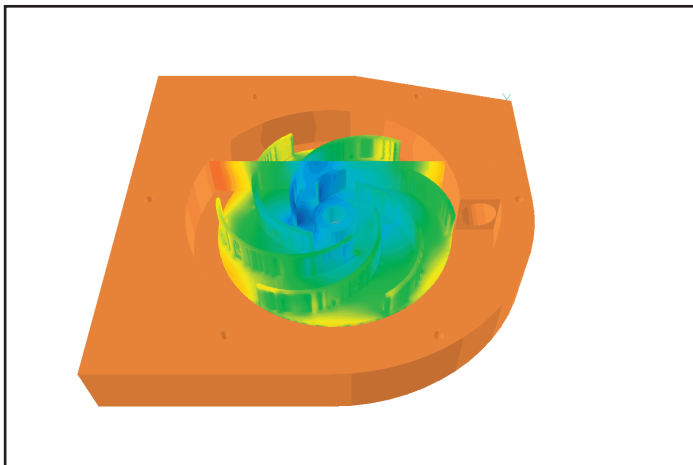


Practical CFD

for

Design Engineers

From the pioneers of CFD.



What is PHOENICS?

PHOENICS, which is owned and developed by CHAM, is a powerful multi-purpose Computational Fluid Dynamics (CFD) software package.

PHOENICS provides an accurate, reliable, cost-effective, and easy-to-use tool to simulate a range of processes involving fluid flow, heat or mass transfer, chemical reaction and/or combustion in engineering equipment and the environment.

With the longest history of validation and a large user base, it is not surprising that PHOENICS has a proven track record in nearly every branch of science and engineering in which fluid flow plays a key role.

Many organisations large and small are using PHOENICS to sharpen their competitive edge in the research and development of products and processes involving fluid flow and heat transfer.

If it flows - PHOENICS can simulate it.

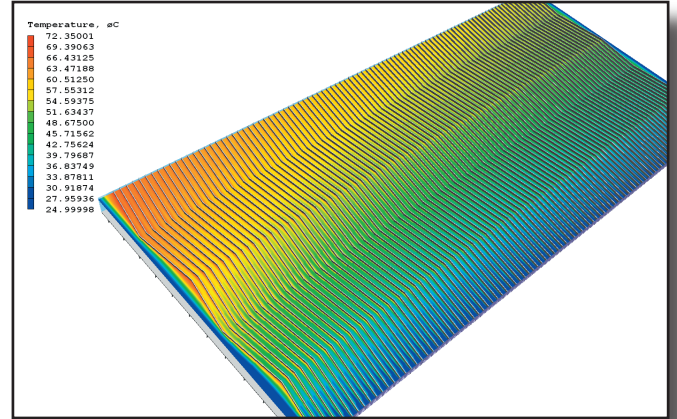
Why use PHOENICS?

PHOENICS offers:

- True Ease of Use
PHOENICS uses an intuitive 3D interactive user environment for pre- and post-processing.
- Proven Performance
PHOENICS boasts an impressive portfolio of applications.
- Unique Array of modelling features
Multi-phase flows; particle tracking; free-surface modelling; chemical reaction, moving grids, fine-grid embedding - part of an extensive battery of modelling features offered by PHOENICS.
- Expandability
User-defined inputs made easy via built-in features such as "GROUND" & "IN-FORM".
- Licensing flexibility
CHAM provides flexible and cost-effective solutions, from short-term to perpetual, whether individual student or multi-national corporation.

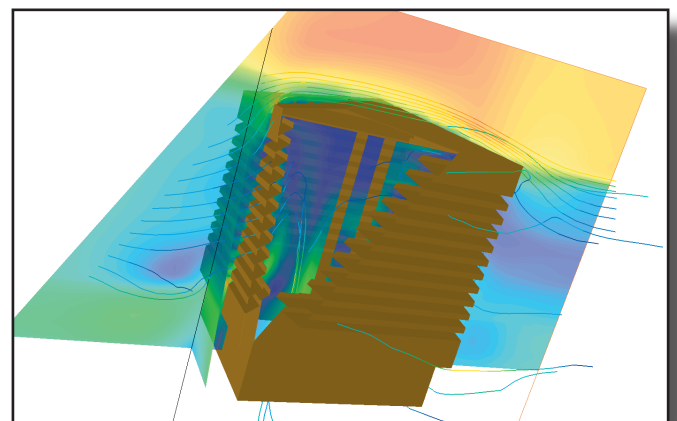
Who uses PHOENICS?

PHOENICS offers unrivalled benefits by way of product optimisation at early stages of the design process, facilitating shorter development cycles, cost reductions, and environmental impact assessment for many industries, including:



Temperature profile of an air/water cross-flow heat exchanger.

- Aerospace
- Automotive
- Building services / HVAC
- Chemical
- Combustion
- Electronics cooling
- Environment
- Fire/Smoke Hazard / Risk Analysis
- Marine & offshore/petroleum
- Medical / Health
- Metallurgical
- Nuclear and power generation
- Process
- Turbomachinery



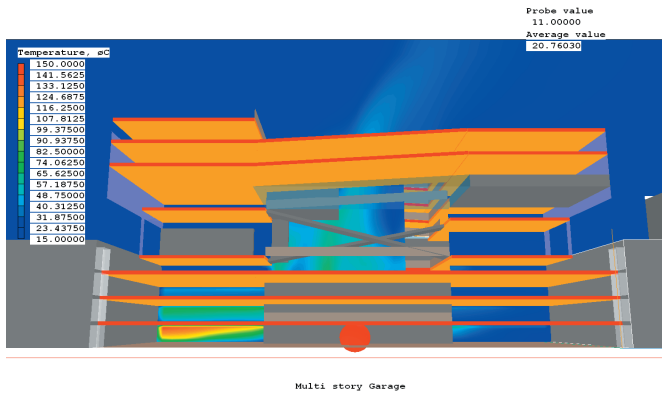
Velocity profile & stream-lines through a roof top vent.

PHOENICS in Practice

Architects & Building Services

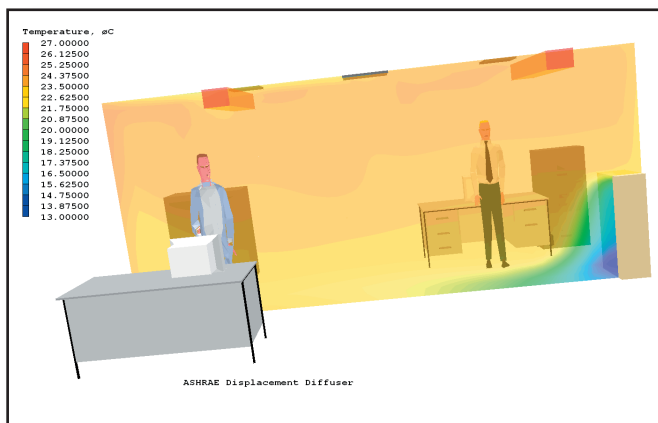
From fire safety to thermal comfort and internal or external flows, PHOENICS FLAIR is the application of choice for architects, designers, HVAC and fire safety engineers.

A wide range of environmental conditions can be assessed in a fraction of the time and at a fraction of the cost to carry out a field experiment or wind-tunnel test.



*Car park fire simulation
courtesy of Van Hooft Adviesburo BV*

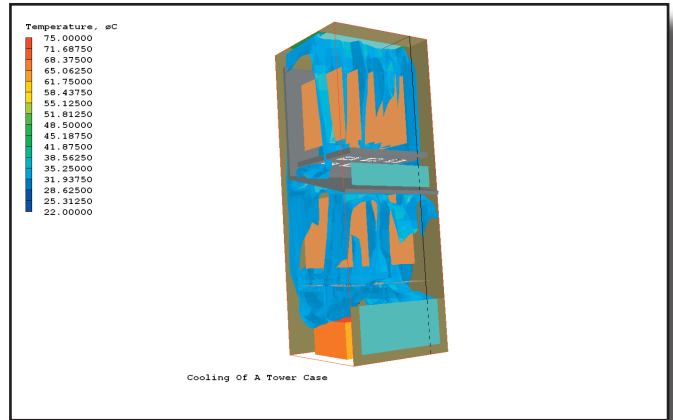
ISO7726 heat parameters for critical, general and partial dissatisfaction, ISO7730 comfort parameters, PMV values, PPD values, PD draught and temperature gradients are catered for.



Temperature distribution in an office.

Electronics Engineers

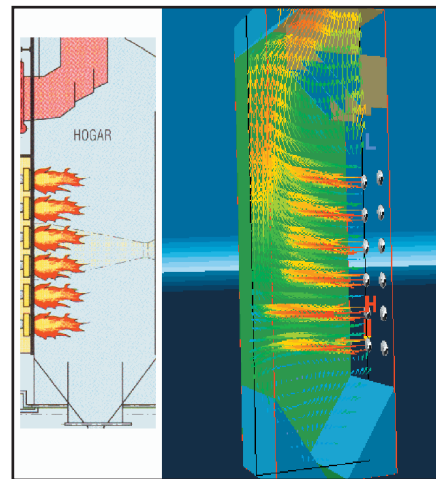
PHOENICS HOTBOX provides electronics engineers with an integrated Virtual Reality environment for modelling the cooling requirements of critical electronic components and assemblies.



Temperature iso-surface of an electronics rack..

Combustion Engineers

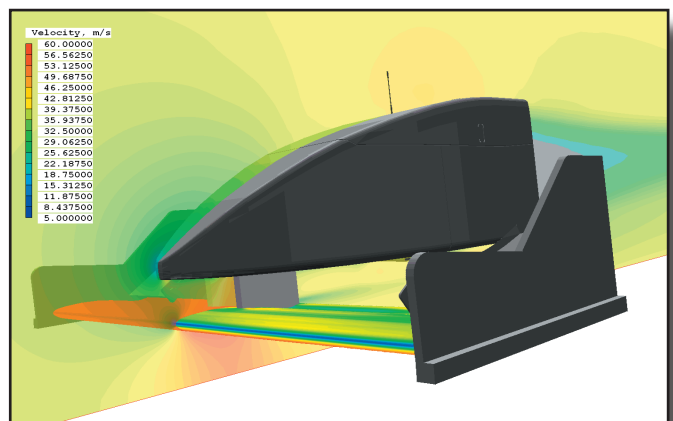
Combustion and Nox models, with a range of diffusion and kinetically controlled models including the unique Multi-Fluid Model for turbulent chemical reactions.



MFM applied to NOx calculation

Transportation Designers

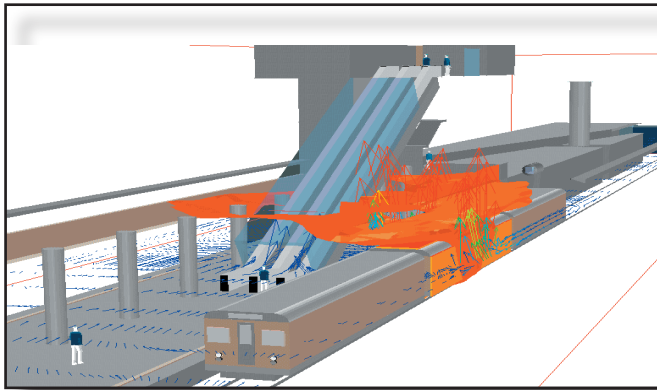
PHOENICS Virtual Wind Tunnel allows designers to evaluate the aerodynamics of a car, van, train or truck. Calculations for forces and coefficients of drag and lift are included.



Velocity profile around a front wing and nose-cone.

Civil Engineers

For tunnels, car-parks and large public spaces such as shopping centres, CFD modelling is often the only practical method for validating design decisions.



*Fire spread in a train station
courtesy of LM FlowConsult & M+N Zander*

Environmentalists

PHOENICS can analyse pollution and thus ensure intelligent design to reduce emissions at the point of generation. For example, PHOENICS can be used to model:

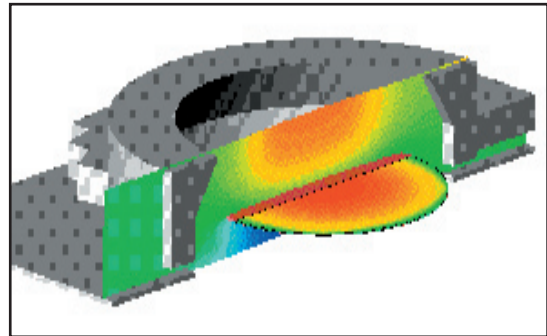
- Sub-surface storage and seepage of pollutants through rock structures,
- Sulphur dioxide emissions produced as a waste product of fossil fuel combustion,
- Discharge of pollutants from power stations and factories into rivers and estuaries,
- Discharge of heat and steam into the atmosphere.



PHOENICS is a tool that can help protect our environment.

Semiconductor Manufacturers

PHOENICS CVD is designed to simulate the behaviour of a wide range of CVD reactors and involves modelling the fluid flow and heat transfer in a multi-component gas, including both the gas-phase and surface chemical reactions and incorporates plasma effects.



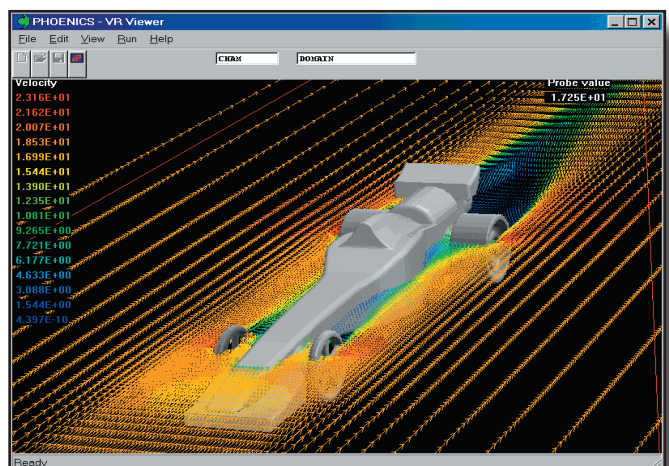
*Jipelec-type CVD reactor used for silicon deposition
from silane*

Students, University Lecturers and Researchers

University Students use PHOENICS as part of under- or post-graduate courses to perform calculations to validate their experimental data. University Professors find that PHOENICS is an invaluable tool to help their students to understand fluid flow, heat transfer, chemical reaction and solid stress. PHOENICS can also be invaluable to researchers as it allows user defined parameters and formulae to be easily entered, allowing new concepts to be evaluated.

Schools

A special variant of PHOENICS, F1-VWT is supplied to schools taking part in the F1 In Schools Challenge to design a miniature CO₂ powered racing car. See www.f1inschools.com



Velocity vectors around a prosed design

Modelling Capabilities

- Problem dimensionality: one, two and three dimensions.
- Time dependence: steady state and transient processes.
- Grid systems: Cartesian, cylindrical-polar and curvilinear co-ordinates; rotating co-ordinate systems; multi-block grids and fine grid embedding.
- Compressible and incompressible flows.
- Newtonian and non-Newtonian flows.
- Subsonic, transonic and supersonic flows.
- Flow in porous media, with direction-dependent resistances.
- Convection, conduction and radiation; conjugate heat transfer, with a library of solid materials and automatic linkage at the solid fluid interface.
- A wide range of built-in turbulence models for high and low-Reynolds number flows including:

1. LVEL model for turbulence in congested domains;
2. K-E models including RNG, two-scale and two-layer models.

- Multi-phase flows of three kinds with a variety of built-in interphase-transfer models:

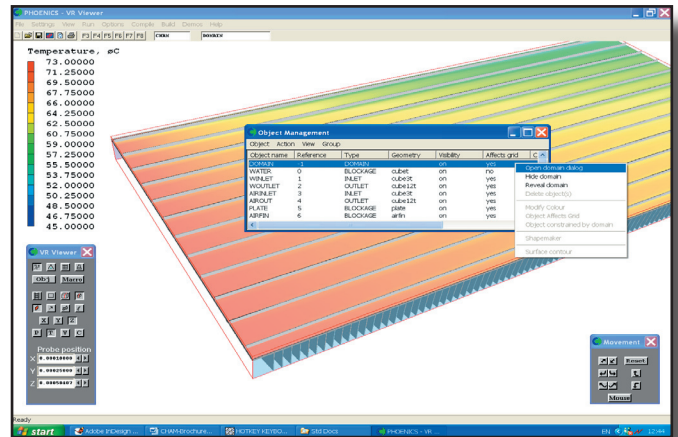
1. Inter-penetrating continua, including turbulence and modulation;
2. Particle tracking, including turbulence dispersion effects;
3. Free-surface flows.

- Combustion and Nox models, with a range of diffusion and kinetically controlled models including the unique Multi-Fluid Model for turbulent chemical reaction.
- Chemical kinetics including multi-component diffusion and variable properties. Built-in interface to the CHEMKIN chemical database.
- Advanced radiation models, including surface-surface model with calculated view factors, a six-flux model and composite radiosity model for radiative heat transfer, known as IMMERSOL
- Mechanical and thermal stresses in immersed solids can be computed at the same time as the fluid flow and heat transfer.

Technical Outline

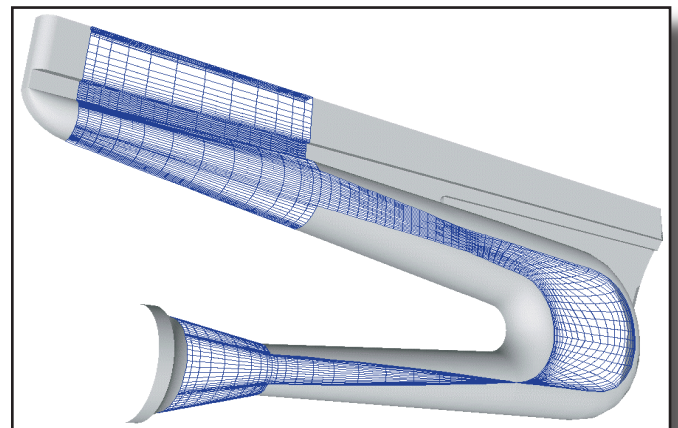
Easy-to-Use Graphical User Interface

The PHOENICS Virtual Reality interface incorporates the VR-Editor and VR-Viewer, a 3D interactive graphics system for visualisation of geometry, solution control and results data.



PHOENICS-VR pop-up menus

- CAD files are imported readily into the VR-Editor for problem definition.
- Built-in, interactive grid-generation.
- BFC grids generated by third party packages can be imported into PHOENICS.



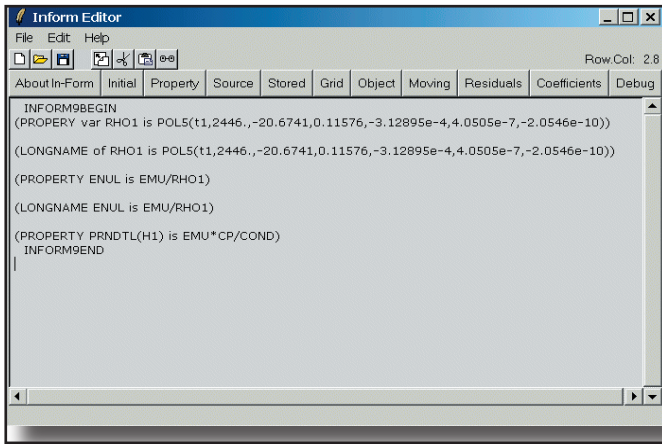
BFC grid file imported from GeoGrid-CSI

- VR viewer post-processor with plots of mesh, velocity vectors, contours, streamlines, iso-surfaces, plotter / printer output, animation and slide show facilities.

Tutorial and Library examples, with over 1000 simulation examples and test cases.

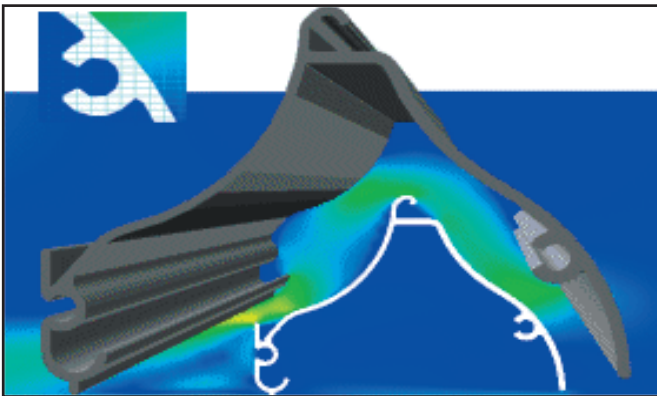
Facet-Fixer - an integrated utility which examines and repairs possibly-defective STL files produced by CAD packages, and creates data files suitable for use with the PHOENICS Virtual-Reality User Interface.

IN-FORM facilitates the addition of new physical and numerical features, the input of problem-defining, solution-controlling and results-presentation data using the VR interface.



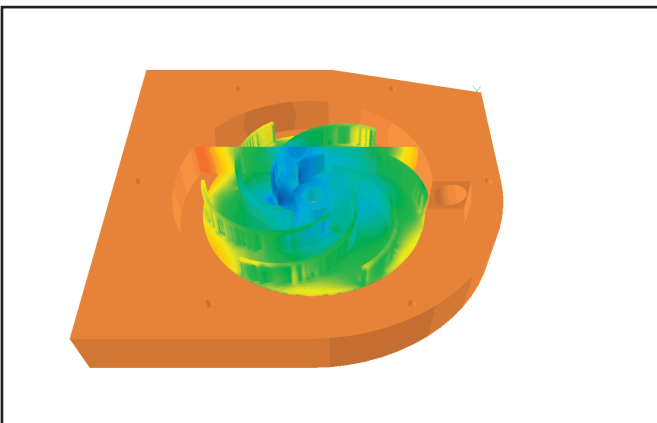
Specification of special property laws via IN-FORM

PARSOL - a partial solid treatment that improves the accuracy of flow simulations for where the fluid/solid boundary cuts some of the cells of a Cartesian or polar-co-ordinate grid.



PARSOL applied to a louver simulation

MOFOR - the moving-body-simulation, permits the simulation of flows induced by bodies in motion, important both in the mechanical industry and in human motion.



MOFOR used for simulating flow induced by moving objects.

Parallel PHOENICS

Parallel PHOENICS is available on multi-processor machines as well as on clusters of single-processors. MPI / PVM is available for parallel machines.

PHOENICS User Conferences

CHAM organises regular national & international conferences, providing a forum for technical interchange by PHOENICS users worldwide. A CD of technical presentations is produced after each event.

PHOENICS users can also exchange their technical ideas via the Internet, using the PHOENICS Users Forum

www.cfd-online.com/Forum/phoenics.cgi

Documentation

POLIS (PHOENICS On-Line Information System) provides an exhaustive source of information, e.g. installation, help, encyclopaedia, applications album, lectures course material, tutorials, etc.

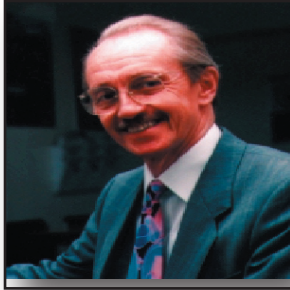
CHAM's Publications Department offers a wide range of PHOENICS-related literature, including: -

- The PHOENICS Journal, now on CD, is a unique technical publication in which users worldwide report their PHOENICS simulations;
- Technical papers;
- Conference publications,
- A newsletter with development news, advice and user contributions.



CHAM

Concentration Heat And Momentum Limited, (CHAM) was founded in 1974 by Professor Brian Spalding. The company is a world leading consultancy and software house specialising in computer simulation of fluid-flow and heat-transfer processes.



Professor Brian Spalding

CHAM's HQ is in Wimbledon, London, UK, with subsidiaries in Japan and Russia, and agencies in over 25 countries worldwide.

Led by its founder, CHAM's team of experienced professionals offers a comprehensive range of services in the field of Computational Fluid Dynamics (CFD). These include:

- Software development;
- Model-building and applied consultancy;
- Software sales;
- Introductory/advanced training courses;
- Technical Support.

Proven Performance & Versatility

PHOENICS predictions have been subjected to many validation tests, which have proved its accuracy against measured data for a wide range of industrial applications. PHOENICS boasts an impressive portfolio of applications, from heating and ventilation to metal casting, and from mould filling to condenser analysis.

SERVICES

User Support

CHAM has a dedicated User Support Team based in the UK, providing expert advice and assistance. CHAM's agents and representatives worldwide also supply technical support, training and consultancy services. Unlimited free technical support is available to all maintained users.

Consultancy

CHAM offers a wide range of cost effective consulting services, which can be tailored to the customer's specific requirements for a broad range of industries.

Training

CHAM runs a series of courses, including the PHOENICS Introductory Series and Special Features of PHOENICS.

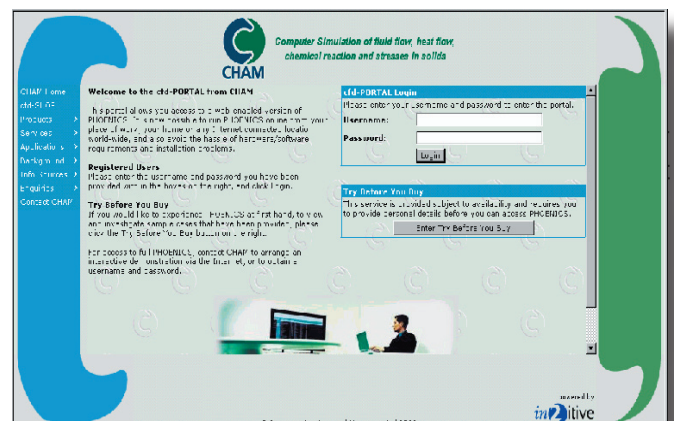
Licensing terms

PHOENICS can be licensed under annual or perpetual schemes. Annual maintenance contracts (which include software upgrades & unlimited technical support) are available for an extra fee. The hardware platform, the options selected, and the period of license dictate PHOENICS licence fees.

Discounts are offered for non-profit research and development activities, with further reductions offered to academic institutions featuring PHOENICS within teaching programmes.

Internet Access

As an alternative or supplement to standard licensing terms, PHOENICS on-line is accessible via the Internet for both demonstration and use via www.in2itive.biz/cham.



PHOENICS is only a click away

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CHAM World-wide

CHAM operates through subsidiaries, distributors & agents in over 25 countries around the world.

www.cham.co.uk/website/new/contacts.htm