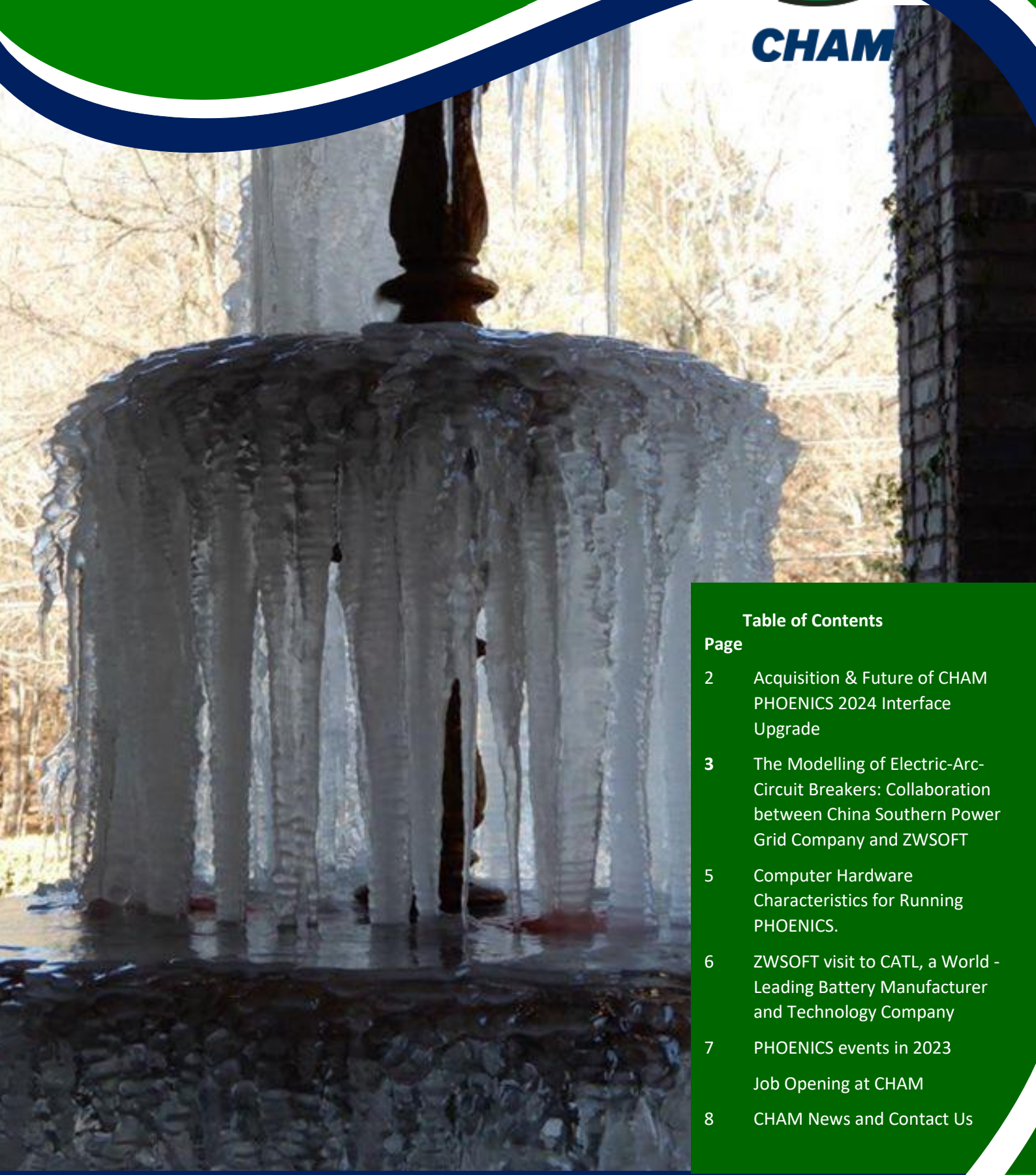
PHOENICS Newsletter



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Winter 2023/24

Acquisition & Future of CHAM by ZWSOFT by Issac Wang of the Guangzhou CFD Team

On October 9th 2023 ZWSOFT Co. Ltd. officially announced the acquisition of UK-based, commercial fluid-simulation software developer Concentration, Heat and Momentum Limited (CHAM) through full equity control.

This acquisition serves as a powerful catalyst for CHAM's development. Leveraging the mature simulation engine of PHOENICS and integrating ZWSOFT's advanced geometry engine, PHOENICS will undergo a rapid transformation. On the software side, compared to previous versions, PHOENICS will feature more comprehensive and efficient geometry processing capabilities. Furthermore, a brand-new GUI will be introduced that is aligned with mainstream industrial software styles, thereby enhancing user-friendliness for industry professionals. On the business side, with the support of ZWSOFT's international business network and extensive corporate service experience, CHAM will join a high quality, comprehensive global service network, achieving a strategic upgrade in the internationalization of business, products, and services. This will greatly strengthen PHOENICS' market competitiveness.

Looking towards long-term development, the addition of ZWSOFT's young and dynamic R&D team, as well as various technical teams will provide enhanced development capabilities to PHOENICS and reinforce the strength of PHOENICS' product development. With robust financial support from ZWSOFT, CHAM will be able to fully leverage its more than 50 years of honed expertise in Computational Fluid Dynamics. CHAM will be facilitated in performing efficient iterations and updates to simulation technologies, and will be provided with stable support for PHOENICS' rapid future growth. Furthermore, ZWSOFT has a multitude of customers from various industries with challenging real-world engineering problems that require CFD solution. CHAM will focus on many of these industry issues in order to further develop PHOENICS steadily in new directions. This will enable CHAM and PHOENICS to confidently move towards a significant position in the global industrial software market in the near future.

PHOENICS 2024 Interface Upgrade by Issac Wang of the Guangzhou CFD Team

Introduction:

Recently, ZWSOFT successfully completed the acquisition of CHAM Ltd, which brings with it new development possibilities and business opportunities for our software products. Through extensive communication with numerous clients and feedback from industry, we have come to recognize that the current user interface of PHOENICS needs upgrading to meet the usability requirements of a majority of users. In order to enhance the user experience and meet industry demands, we are initiating the Interface Upgrade Project for PHOENICS 2024. The core goal of this project is to comprehensively upgrade the pre- and post-processing interfaces of PHOENICS by combining them with the ZWMeshWorks pre- and post-processing platform.

PHOENICS 2024 Interface Upgrade:

As part of this project, we are conducting in-depth user experience analysis and market research to gain a comprehensive understanding of user needs and industry trends. With this understanding, and by identifying the gaps between the current interface design and the design of other engineering software, we will introduce purposeful, advanced design elements and interaction concepts. This will ensure that the new interface design is visually modern, will enhance convenience of use and work efficiency, and align the interface with industry conventions and user expectations.

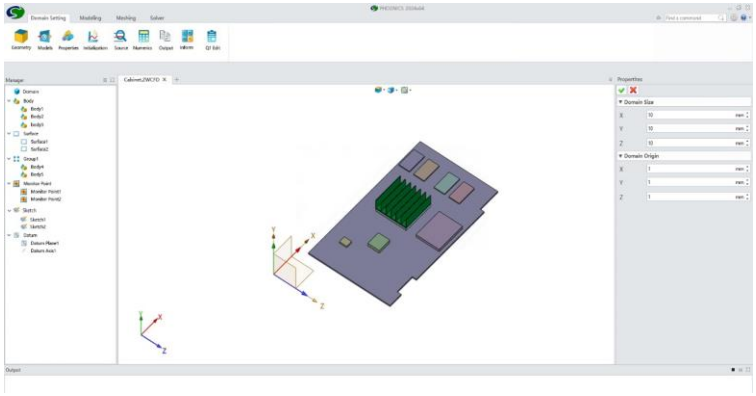
The Interface Upgrade Project is being carried out in multiple stages, covering aspects such as design, development, testing, and training. We plan to collect feedback through testing within a small user group to ensure the stability and user-friendliness of the new interface. Additionally, we will provide training and support to assist users in a smooth transition to the new PHOENICS interface. Through the comprehensive transformation, we anticipate revitalizing the appearance of PHOENICS, meeting user expectations and also enabling PHOENICS to stand out in the highly competitive market. This marks a significant stride on our journey towards innovation and excellence, and we are committed to continuous efforts in delivering an outstanding software experience for our users.

The key objectives of Interface Upgrade Project include:

Modernized Interface:

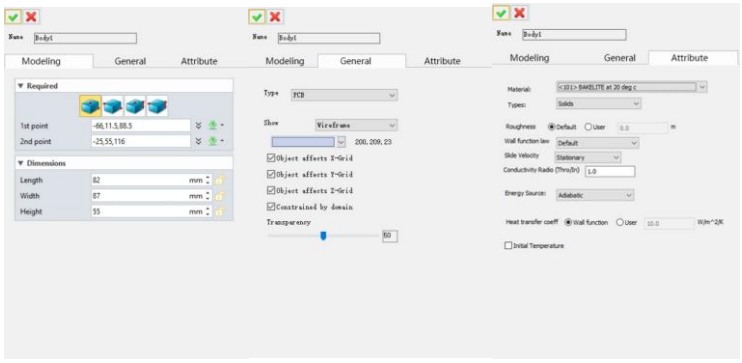
A new Menu Bar is being introduced which is divided into four sections: Domain Setting, Modeling, Meshing, and Solver/Post. Clicking on the different menus will display different functional menus on the Ribbon Bar below the Manu Bar. The Ribbon Bar for Domain Setting includes buttons for Geometry, Models, Properties, Initialization, Sources, Numerics, Output, Q1 Edit, and In-Form. The Ribbon Bar for Modeling includes various geometric model-editing functions, such as Import, Export, Sketch, Extrude, Sweep, and Move, etc., which are inherent to the ZWMeshWorks platform. The Ribbon Bar for Meshing includes buttons for Auto Mesh, Edit Grid, Edit Region, Show Grid, and Grid Information. The Ribbon Bar for Solver/Post includes buttons for Solver, Parallel Solver, and Post Processor.

PHOENICS users will quickly be able to recognize familiar features of the PHOENICS Main Menu in the new interface.



User-friendly Navigation:

Streamline navigation, optimize workflows, improve user efficiency, and provide a more gradual learning curve for new users. For example, settings for simulation objects such as attributes, colours, transparency, affect grid, constrained by domain, etc. will now be set via the new Object Management Tree. The Object Management Tree can be docked so that it can be in view at all times and object settings be accessed more easily and quickly.



Integration of New Features:

Make use of ZWMeshWorks' highly flexible and extensible software framework for seamless integration of new features. The first such feature will be the introduction of a host of geometry modeling and editing functions, including but not limited to sketch editing, extrusion, filleting, array operations, geometric simplification, etc. These commands will be added to the Modeling Menu.

Dual Mode:

Ensure a smooth transition with minimal disruption to users, by providing two modes to choose from: the familiar, classic PHOENICS interface and the new and improved interface.

Through these series of efforts, we believe that the new interface for PHOENICS will provide users with a greatly improved experience while also increasing PHOENICS' competitiveness in the market.

The Modelling of Electric-Arc-Circuit Breakers: Collaboration between China Southern Power Grid Company and ZWSOFT. Xingzhou Wang, ZWSim CFD, Guangzhou, China

1. Introduction

China Southern Power Grid Co., Ltd. (CSG) is responsible for investing, constructing, and managing the electric power grid in the southern region of China. It participates in investments, constructions, and operations of inter-regional transmission and interconnection projects. It ensures power supply services for the provinces of Guangdong, Guangxi, Yunnan, Guizhou, Hainan, and the Hong Kong-Macao region, covering an area of 1 million square kilometers and serving a population of 272 million.

In 2022, the total operating revenue of CSG was 7,646.58 billion yuan, with a net profit of 120.59 billion yuan. The company achieved a sales volume of 12,626 billion kilowatt-hours. For the fiscal year 2022, CSG ranked 89th in the Fortune Global 500.

During the past year, ZWSOFT collaborated with CSG's subsidiary, CSG Electric Power Research Institute (CSG EPRI), on three projects, delivering simulation software for the power industry in applications involving high-voltage power equipment and transformers.

In November 2023, CSG EPRI contacted ZWSOFT's Fluid Simulation Department, seeking alternative software for the simulation of their electric-arc circuit-breaker products.

2. Electric Arc Circuit Breakers

The operation of a typical circuit breaker involves various aspects, such as the motion of moving components, the flow of compressible gas, the electric arcing process in the arc chamber, the formation of a turbulent plasma, and the Lorentz forces and Ohmic heating produced by the magnetic field, and thermal radiation in the arc core, re-absorption and nozzle ablation. The execution of these coupled electrical, fluid and thermal simulations for circuit breakers holds significant importance. Through simulation, an in-depth analysis of the product's heat transfer and electrical characteristics can be carried out, thereby optimizing product performance and enhancing energy efficiency.

Figure 1: A typical circuit breaker

From simulations, engineers can gain a detailed understanding of the heat-transfer characteristics of circuit breakers during operation. This includes the temperature distribution in the arc region, the release of Joule heat, and the heat dissipation process. This assists in identifying potential thermal issues and improving the heat-dissipation design, ensuring the equipment can operate stably under various working conditions.

Simulation also accurately models changes in current and potential, providing insights into the electrical characteristics of circuit breakers under different operating conditions. Analyzing the electrical parameters of the arc enables more precise electrical design, thereby improving equipment performance and stability.

3. CFD solutions

The application can be modelled by PHOENICS as a transient, two-dimensional, axisymmetric, compressible, turbulent flow through an essentially cylindrical geometry with static and moving components. It is a multi-physics application of significant complexity because it involves not only the solution of the Navier Stokes equations, but also the solution of a reduced form of Maxwell's equations; and their coupling through the Lorentz and Joule-Heating source terms. Also, the separation of the two electrodes will form an arc turbulent-plasma with significant radiation, and ablation of the PTFE nozzle walls.

Naturally, the plasma can be treated as an electrically-conducting fluid; and there is also a need to define the initial conditions, and specify the boundary conditions for both the flow and electromagnetic field.

The geometry of the circuit breaker will be represented by the Cartesian cut-cell method (PARSOL) of PHOENICS, whereby CAD files are imported into the background Cartesian, or in this case, cylindrical-polar mesh. This means the mesh generation will be automatic and rapid, when compared to more conventional solvers based on body-fitted meshing. With PARSOL, special treatments are applied to cells which are cut by solid (shown schematically in Figure 2), thus retaining a boundary-conforming grid. Specifically, the method computes the fractional areas and volumes, and employs a collection of special algorithms for computing interfacial areas, evaluating wall shear stresses and heat fluxes, and for computing advection and diffusion near solid boundaries, etc

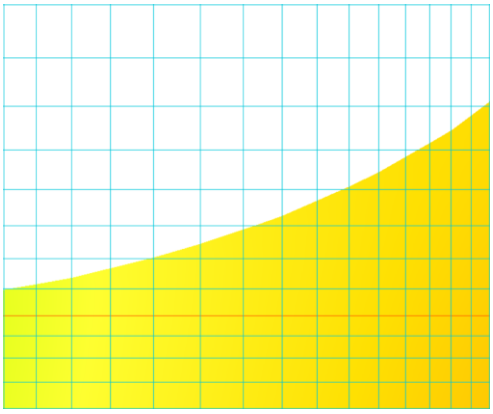


Figure 2. PARSOL: Solid-fluid cut-cells

The moving components of the circuit breaker will most likely be handled by MOFOR, which is a feature of PHOENICS which permits the simulation of flows induced by bodies in motion. It acts by moving, through the fixed computational grid, such momentum sources as will ensure that the velocities at locations within the body have the values implied by the prescribed motion.

4. Conclusions

In the distant past PHOENICS [1-3], has been proven to effectively simulate the coupled electrical-fluid-thermal processes of circuit breakers under various operating conditions, offering robust support for the design, optimization, and safety assessment of circuit breakers. During the present collaboration, as was discussed above the application will be modelled using more modern CFD technology embodied in PHOENICS.

5. References

1. J. D. Yan, M. T. C. Fang J. D. Yan, M. T. C. Fang, Visualization of Arcing Process in an Auto-Expansion Circuit Breaker, *Trans. on Plasma Science*, Vol. 27, No.1, 40-41, (1999).

2.J.D.Yan, M.T.C.Fang, W.Hall, The Development of PC Based CAD Tools for Auto-expansion Circuit Breaker Design, *IEEE Transactions on Power Delivery*, Vol. 14, pp. 176-181, (1999).

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Computer Hardware Characteristics for Running PHOENICS *by* Timothy Brauner

CHAM is often requested to provide recommendations for computer systems to run PHOENICS. What we like to emphasise in our responses is what are the key performance metrics that determine the simulation speed of PHOENICS (and other Finite-Volume Method (FVM)-based codes). Contrary to popular belief it is not the number of cores in the Central Processing Unit (CPU), but rather it is the number of memory channels and supported memory speeds of the CPU that drive CFD performance. More specifically it is the memory bandwidth available to each CPU core. (There are many other hardware characteristics and problem-related factors that affect performance individually and combined, but bandwidth per core is arguably the primary aspect.)

The amount of memory that a system has determines the size of the problem that can be tackled. The memory's speed and composition, along with the number of memory channels of the CPU determine the system's total memory bandwidth. The reason that memory bandwidth is so important is that the Finite-Volume Method has low arithmetic intensity, i.e. it does few calculations per memory operation. The Navier-Stokes equations discretised using FVM result in large sparse matrices that are different per variable, change with every iteration and are thus constantly reassembled. The algorithm streams through the cells and faces of the mesh to build quantities such as fluxes and source terms and to apply boundary conditions, before performing linear algebra with the sparse matrix. These matrices are too large to fit in the CPU's cache and thus their data needs to be streamed from main memory and to the CPU repeatedly. Thus memory bandwidth is what enables the CPU cores to keep crunching numbers.

Recently DDR5 memory has become more mainstream and affordable. Typical DDR5 speeds are in excess of 50% higher than DDR4, so anyone in the market for a new CFD system should benefit from this. Something to look out for when configuring a PC for CFD is that each memory channel must be populated with at least one DIMM (or stick) of RAM. And the number of sticks must be an integer multiple of the number of memory channels.

Computers can be put into 3 approximate categories based on their number of memory channels and theoretical maximum memory bandwidth. Some example bandwidth numbers are given below based on DDR5-4800; these are calculated using the formula for DDR (double data rate), giving speeds in GB/s: (# channels) * (memory speed in MT/s) * (conversion factor = 0.008 (GB/MT)) e.g. 4 channels * 4800 MT/s *0.008 GB/MT = 153.6 GB/s.

1. Desktop: 2 memory channels and a theoretical 76.8 GB/s
2. Workstation: 4-8 memory channels and approximately 153.6 GB/s to 307.2 GB/s
3. High-End Workstation and Server: 8-12 memory channels and approximately 307.2 GB/s to 460.8 GB/s

(Note: MT/s is million transfers per second.)

PHOENICS on the Cloud has access to a variety of different hardware in each of these categories on Microsoft Azure for users to try out or dive right in with. The following are not all available on the cloud, but represent a high level overview of what might be considered current in each category from the two largest CPU makers:

1. Desktop: AMD Ryzen 7000 and Intel Core 14th Gen
2. Workstation: AMD Threadripper 7000 & 7000 PRO and Intel Xeon W-2400 & W-3400
3. High-End Workstation and server: AMD Epyc 7003 & 9004 and Intel Xeon Scalable 4th Gen

Tips for users benchmarking PHOENICS while testing hardware:

- the serial (single-core) solver and the parallel (multi-core) solver are different, the former is based on the Strongly Implicit Procedure (SIP) while the latter is a Krylov Method. Thus a parallel scaling study should not include single core.
- When comparing simulation run times we recommend to run a full simulation to convergence, because simulations typically go through stages of convergence behaviour: establishing the macroscopic fields, iterating out deferred-correction terms, non-linearity and pressure-velocity coupling, and honing the accuracy to more decimal places. These stages typically place different requirements on the solvers.

Recently another characteristic of CPUs has seen some major developments, namely the L3 cache, but that's a story for another post.

ZWSOFT visit to CATL, a World-Leading Battery Manufacturer and Technology Company by Kefan Huang, ZWSim CFD, Guangzhou, China

1.Introduction

On November 17, 2023, Beijing time, a delegation from ZWSOFT consisting of Mason Liu, Executive Deputy General Manager, Jerry Zhang, the Product Manager for ZW3D, and Kevin Xue, the Director of Product Planning, visited CATL (Contemporary Amperex Technology Co., Limited). The purpose of the visit was to explore domestic alternatives for 3D design and CAE simulation software in the industrial product scenarios of CATL.

2.The CATL Company

CATL were established in 2011, and they are one of China's leading manufacturers of power batteries with international competitiveness and presence. The company focuses on the research, development, production, and sales of new-energy vehicle-power battery systems and energy-storage systems; and it is committed to providing premier solutions and services for new energy applications worldwide. CATL achieved a revenue of almost RMB 329 billion in 2022. According to data from SNE Research, the company holds a global market share of 37% in power battery usage, maintaining its position as the world's top-ranked company for six consecutive years. Additionally, in the global energy-storage battery-shipment market, it boasts a market share of some 43%, securing the top spot for two consecutive years.

3.CATL Customer Challenges

Ensuring the safety and reliability of its products has been a consistent concern for CATL. The thermal management and lifespan of electrochemical energy-storage systems are pivotal aspects addressed by the company. By employing CAE simulation software to simulate and model individual cells, battery clusters, battery packs, and containerized energy-storage systems, the company can accurately predict the temperature, flow-field characteristics, performance, and lifespan of its energy-storage systems. This simulation-driven approach enables the optimization of thermal management systems, thereby enhancing the safety and reliability of energy storage batteries in various operational environments.

In addition to these considerations, the perpetual pursuit of cost reduction and efficiency improvement is a fundamental goal for the company. Simultaneously, the domestic substitution of industrial software is a strategic technological investment for the future.

4.CFD Simulation Scenarios

In order to improve the quality of its products and enhance their economic benefits, CATL has put forward more and more CFD simulation requirements, as indicated below.

1. The analysis of temperature and flow-field characteristics within battery modules, battery racks, and containerized energy-storage systems under different environmental conditions (e.g., extremely cold and hot regions) and operational scenarios (e.g., discharging and charging conditions).

2. The design of air-cooling and liquid-cooling systems for battery clusters and containerized energy-storage systems based on CFD simulation results. This includes the selection of air-conditioning and water-pump specifications, optimization of air ducts and liquid-cooling plate designs, and refinement of pipeline layouts.

5.CFD Solutions

This large number of fluid-simulation scenarios prompts a series of functional requirements for CFD software, as listed below.

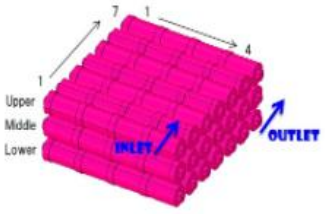
1. Geometric Simplification: Leveraging the powerful geometric capabilities of ZW3D, the preparation of geometric models such as battery cells, battery clusters, and battery packs can be accomplished efficiently, with the ability to export in STL format for PHOENICS CFD simulations.

2. Mesh Generation: Support for the PARSOL cut-cell method to accurately identify geometric boundaries, enabling the efficient meshing of the entire analysis domain through Cartesian meshing ;

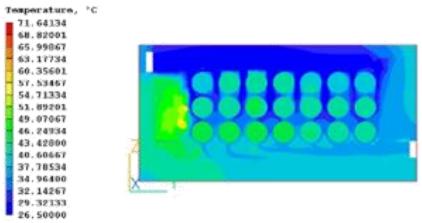
3. Physical Models: This includes: the solution of energy equations to model conjugate heat transfer in air- and liquid-cooling systems; and the use of turbulence models (LVEL, k-ε and variants such as Realizable, RNG, etc., k-ω and variants such as SST, Wilcox, etc.), radiation models (IMMERSOL, P1-T3, including solar radiation), multiphase flow (IPSA, algebraic slip), and chemical reactions, among others.

4. Materials: Support for multiple Newtonian and non-Newtonian fluids, with customization options for phase change materials and material properties that vary with temperature.

5. Heat Sources and Boundary Conditions: Support for volume and surface heat sources, with power varying over time, Log-law and scalable wall functions, fan P-Q curves, porous media, porous plates, velocity flow inlets, pressure outlets, and more.



Model of a Battery Cluster



Battery Cluster ： PHOENICS thermal solution

6.Conclusion

With over forty years of widespread application in both the engineering and academic domains, PHOENICS has proven itself through rigorous market testing. Our technical team possesses extensive experience in customer consultation, model development and engineering computation, and they are ready to provide reliable solutions for our clients at any time.

PHOENICS was shown at several events in 2023 by ZWSOFT and CHAM Japan by Issac Wang of the Guangzhou CFD Team

This Japan-Build exhibition is held annually in Tokyo Japan. Mr Kong was invited to attend this event, which appeals to those with interest in urban development industries, as well as housing equipment, HVAC, and smart building products.

Below you will see photos of the ZWSOFT Exhibition booth.

Job Opening at CHAM

CFD Software Sales Engineer

Overview:

CHAM is a world leading CFD engineering consultant and software development company with its flagship product PHOENICS, which is widely recognised as the world's first commercial CFD software. Committed to providing complete and seamless user experience to worldwide users with its cost-effective solutions, CHAM has continuously satisfied diverse needs of various industries such as HVAC, electronics cooling, combustion, fire modelling, etc.

CHAM is looking for a CFD software sales engineer to support business growth in the UK (and European market). The position will be based in Wimbledon, London. The candidate should be energetic and self-motivated to work successfully as an employee in collaboration with the local team in the UK and the management in China.

Responsibilities:

1. Develop new agents and new clients.
2. Proactively contact or visit potential customers in the target industry, understand their characteristics, and requirements, and facilitate transactions.
3. Report to the company's MD and implement strategies to achieve business goals.
4. Maintain the list of existing active clients and agents, and assist sales administrator in maintaining current clients.
5. Regularly participate in pre-marketing work such as sales data statistics.

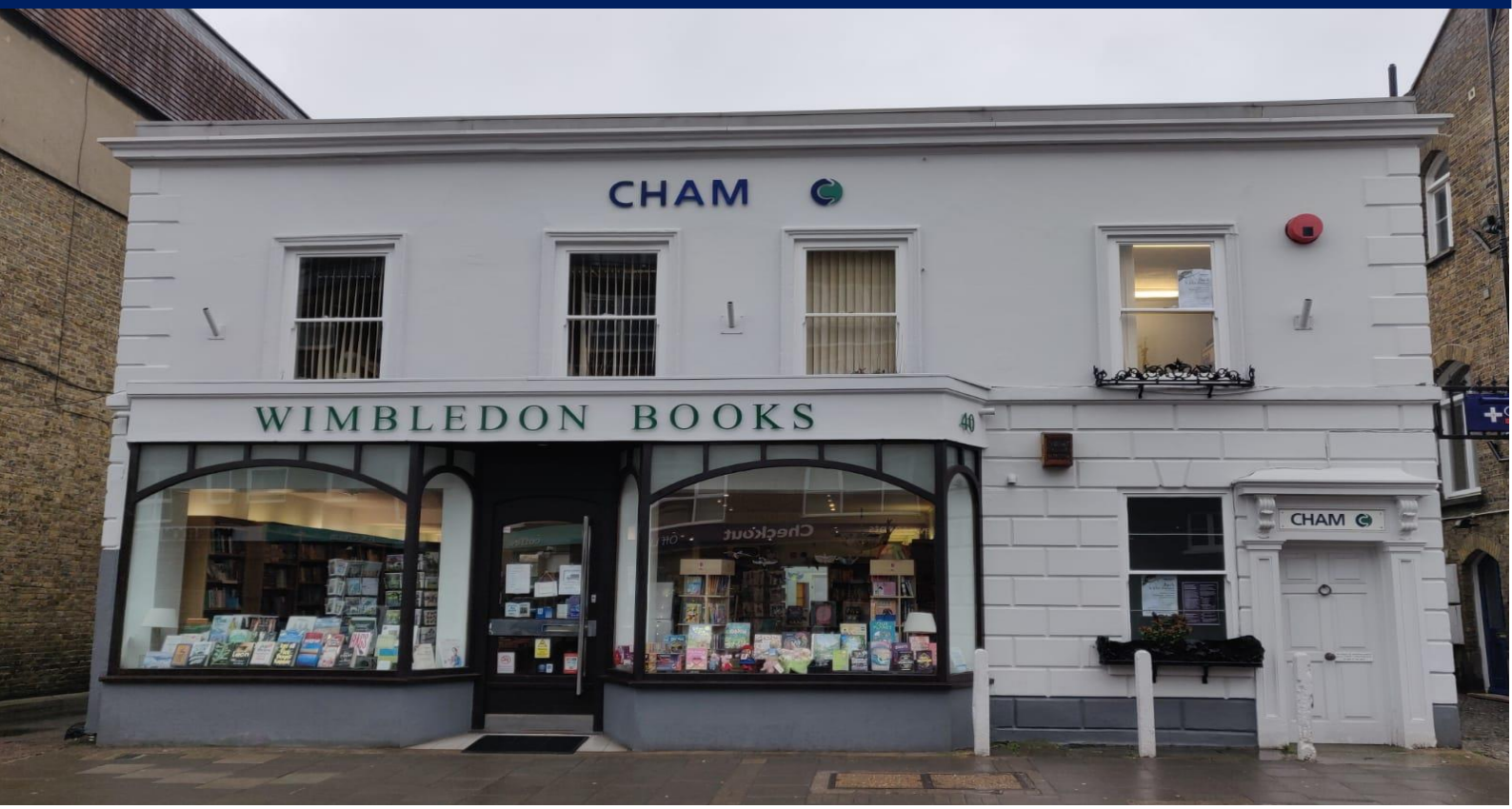
Requirements:

1. Proven 2+ years experience in software sales.
2. Willing to work in a start-up sales position in a challenging environment.
3. Results driven good interpersonal skills.
4. Understand the local CFD software industry and related products.
5. Bachelor's degree or above (business and marketing, engineering mechanics, software engineering or other relevant majors, etc).
6. Good English communication skills, both written and spoken.
7. The right to live and work in the UK

CHAM offers a competitive salary and benefits. Please send your CV with cover letter to HR@cham.co.uk

News from CHAM:

PHOENICS V2022 has now been installed on the teaching platform used at Beijing University of Aeronautics and Astronautics. We at CHAM look forward to an ongoing relationship.



Contact Us:

CHAM's highly skilled, and helpful, technical team can assist in solving your CFD problems via proven, cost-effective, and reliable, CFD software solutions, training, technical support and consulting services. If YOU have a CFD problem why not get in touch to see how we can help with the solution?

Please call on +44 (20) 89477651, email sales@cham.co.uk or check our website www.cham.co.uk. For PHOENICS on the Cloud (PHOENICS-OTC) call us or contact phoenics.cloud@cham.co.uk
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