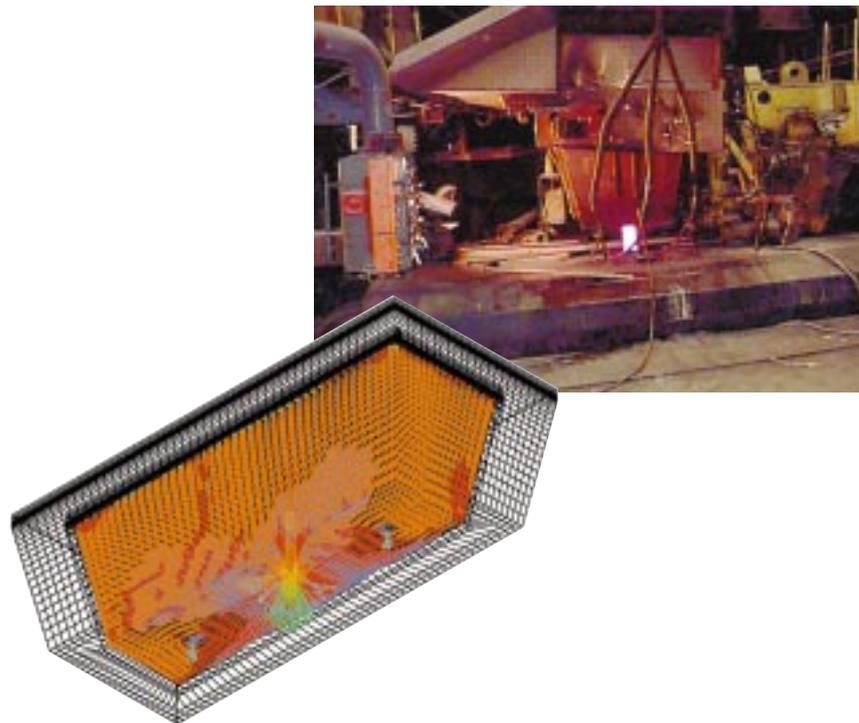




HPCN TTN network

Parallel PHOENICS

faster design through
fluid dynamics simulations
– on standard PCs –



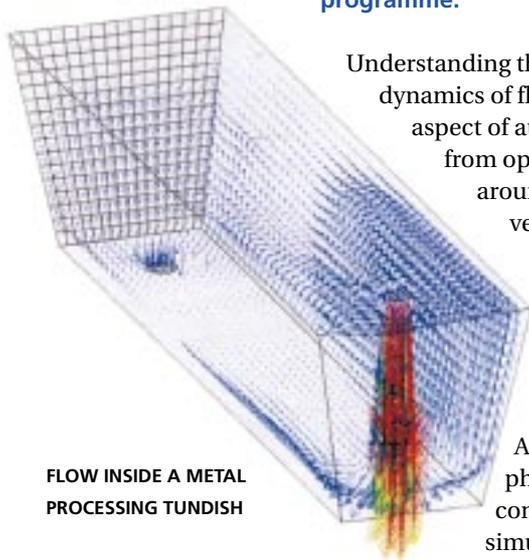


HPCN TTN network

Parallel PHOENICS

faster design through fluid dynamics simulation

Designers in the automotive and other industries can now run fast, accurate fluid and heat flow simulations on small clusters of standard PCs and workstations, using powerful new parallel processing software developed under the ESPRIT programme.



FLOW INSIDE A METAL PROCESSING TUNDISH

Understanding the complex dynamics of fluids is a crucial aspect of automotive design, from optimising air flows around and within vehicles to ensuring the efficiency and safety of fuel, coolant, lubrication and hydraulic systems.

As an alternative to physical modelling, computer-based simulation of fluid or heat flow can greatly increase the speed and flexibility of the design process. It can also encourage innovation by allowing the effects of changes to be tested rapidly at an early stage. Simulation systems based on the mathematical techniques of computational fluid dynamics (CFD) have been available for many years, and are widely used in the design of industrial products and processes of all kinds.

However, achieving useful accuracy and detail in a three-dimensional CFD simulation makes extremely high demands on computing processing power. Even on the most powerful machines, a complex simulation may take several days to complete.

This picture is beginning to change with the introduction of simulation software capable of running on parallel computing systems. These speed things up by linking a number of individual computer processors to work simultaneously on the mathematical calculations, in contrast to the step-by-step sequential operation of a

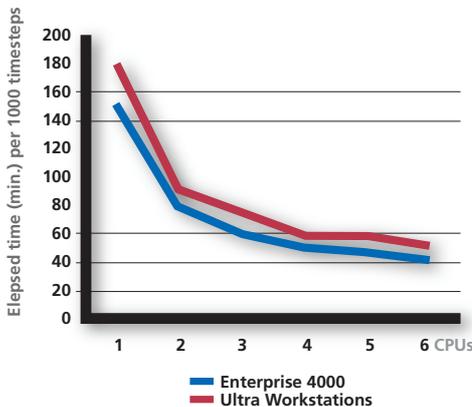
conventional computer. Using parallel processing, it is possible to run complex CFD simulations within realistic time-scales without relying on the raw power of a supercomputer.

Although parallel computers are still too expensive for many companies to consider installing as a dedicated facility, a very attractive solution is to take advantage of the substantial computing capability every company already possesses in the form of its desktop PCs and workstations. These typically lie idle for large periods of time during the night and at weekends – when they could be usefully employed to run a CFD simulation, if the right software were available. And now it is, through a successful development project forming part of the ESPRIT PASHA and EUROPORT programmes.

Parallel processing on the office PCs

The new software is a parallel processing version of the well-established PHOENICS CFD simulation package, which is widely used to model processes such as fluid flow, heat transfer, combustion and chemical reactions. As well as providing greatly enhanced simulation capabilities, parallel PHOENICS is capable of running on clusters of standard office PCs and desktop workstations. It will even run on mixed networks of different machines, taking account of their individual performance levels and managing the data transfers efficiently to create an effective parallel processing system.

With parallel PHOENICS, CFD simulation has become a practical and affordable option for any company. The investment required is minimal, as simulations can be run on the normal office computers at times when they would otherwise be idle. Not surprisingly, the new software is attracting strong interest across many industries. The following are just three examples from among many companies who have tried parallel PHOENICS and reported back with great enthusiasm.



PERFORMANCE RESULTS BY MEFOS ON A WORKSTATION CLUSTER COMPARED TO SHARED MEMORY MACHINE

End users benefit from PHOENICS software



BEHAVIOUR OF A ROOM'S HEATING AND AIR CONDITIONING ON A CLUSTER OF PCs

Air conditioning and heating

Roger Preston International specialises in the design of mechanical, electrical and environment systems in buildings. The company uses conventional CFD to simulate air conditioning and heating systems in buildings, but complex simulations such as these can take several days. Using parallel PHOENICS running on five Windows NT-based PCs, linked by a fast Ethernet network, the company can perform a typical simulation in less than half the previous time.

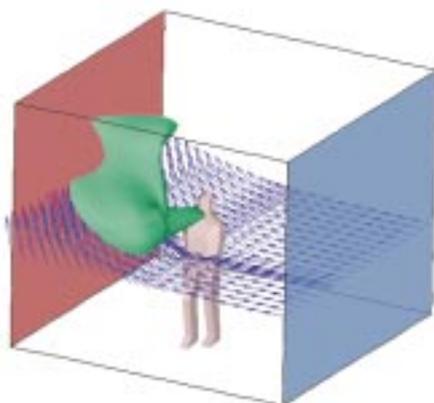
Ruth Williams, Head of Environmental Systems Department at Roger Preston International, said:

„Parallel processing can reduce some cases to overnight simulations, providing faster results and releasing machines for other tasks during normal office hours.“

Cigarette smoke ventilation

Atos is an IT solutions provider which has been using CFD simulation since 1981. The company has found it can simulate heating and ventilation systems very successfully using parallel PHOENICS running on NT-based PCs. In one trial, Atos simulated the behaviour of cigarette smoke in a room, running the simulation on a dual-processor machine and also on two interconnected single-processor PCs. Performance was similar on both systems, reducing simulation times by factors of 1.8 and 1.6 respectively in comparison with the previous system.

Hans-Wilfried Mindt, CAE/CFD-consultant at Atos, commented: **„The test results show that parallel PHOENICS for NT clusters is a good and economical solution when compared with standard parallel machines or UNIX clusters. A speed-up factor of about two, using only two processors, means a run can now be completed overnight instead of taking a whole day.“**



TESTCASE BY ATOS:
PERSON SMOKING IN A ROOM



Steel casting process

A Swedish metallurgical research institute, MEFOS, has a strong interest in CFD simulation and has been running trials of parallel PHOENICS to simulate the behaviour of molten metal in a steel casting process.

PHOENICS simulation on a cluster of three SUN-Ultra2 dual-processor workstations and also on the more powerful SUN Enterprise 4000 Server with six nodes, and found that the two architectures performed about the same.

Henrik Solhed, senior researcher at MEFOS commented on the success of the trials:

„The parallel version of PHOENICS reduces our calculation time by a factor of three to four.“

He says the institute is now moving towards using parallel PHOENICS as a permanent tool.

As is always the case in CFD simulation, the researchers had to find the right balance between accuracy and speed. They found out that a good compromise was to use a relatively coarse grid for the model as whole, for fast simulation, but to employ a finer grid at key areas of the model chamber's inlets and outlets for a more detailed analysis. They ran the parallel

MACHINE \ RUN	1	2	3
PC 1	X	X (DUAL)	X
PC 2			X
# PROCS	1	2	2
CPU-TIME [S]	1182	653	726



HPCN TTN network

The EC initiative HPCN TTN network has the objective of improving industrial competitiveness through the promotion of High Performance Computing and Networking (HPCN) across a wide range of industries. Substantial emphasis is placed on the novel applications of HPCN to problems where it was previously too expensive or immature.

A network of 21 centres across Europe, called Technology Transfer Nodes (TTN), is now serving industry through its experience by encouraging new users to adopt HPCN technology. GMD, the German National Research Center for Information Technology, is part of this network.



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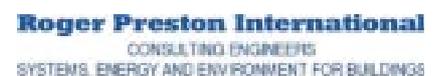
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