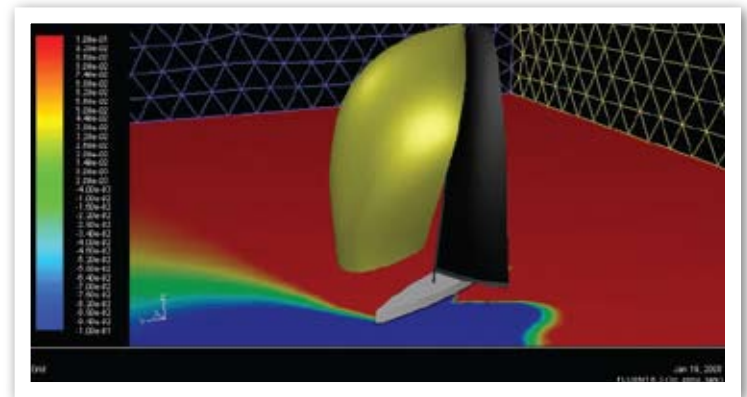


**GridWorks™**  
Enabling On-Demand Computing™



## Managing 30 Teraflops of Compute Power: *PBS Pro at Italy's CILEA Consortium*



In 1974, five universities in Italy's Lombardy region formed a technical consortium called CILEA. Its main purpose was to provide computing cycles for research. Since then another five universities have joined CILEA, and the consortium has many more strings to its bow. The Italian Ministry of University and Research is also represented within CILEA. Its ITC services include a large digital library, e-learning courses, database development, networking, technical support for libraries, universities, and other institutions, and consulting help for its users.

With 30 teraflops of peak computing power, it has ranked as high as 135th among the Top 500 high performance computing centers. PBS Professional keeps CILEA's processors humming.

### Coping with the Growth Curve

Researchers and engineers – 400 registered users – come to CILEA from government, industry and academia with a massive variety of disciplines, projects and applications. If CILEA can be said to have a specialty, it would be computational fluid dynamics (CFD). A team of in-house researchers is collaborating with the Technical University of Milan on a range of CFD projects. An America's Cup contender (anonymously, of course) is optimizing hull designs for racing yachts. And significant work is being done in CFD on the dynamics of the cardiovascular system.

### Accelerating Research with a New HP Cluster

"When we called  
for tenders in  
November 2007,  
we were looking  
for an HPC system  
high computing  
power and a  
large number  
of ncores,"  
says Arlandini.



Compute-intensive projects like these have driven the demand for CILEA's facilities into a steep growth curve. CILEA has responded by doubling its staff to 150 in just the past three years. Building up CILEA's HPC resources to handle the processing tsunami is the responsibility of Dr. Claudio Arlandini, who is also involved in CILEA's major projects as an astrophysicist, researcher, and project manager.

"It is always our goal to be one of the most advanced computing center in Europe," says Arlandini. "We have a policy of continually renewing our computing platforms to stay in the Top 500 list. For that reason we have just put into service a powerful new HP compute server with HPC BladeSystem technology, optimized for HPC environments."

CILEA's new HPC cluster is named after Joseph-Louis Lagrange, a brilliant 19th century Italian mathematician. It is a 208-blade HP cluster with a double data rate (DDR) Infiniband interconnect. Each of the blade servers contains two Intel quad-core 3.16GHz Xeon processors, for a total of 1664 cores.

Lagrange alone gives CILEA 22 teraflops of peak computing power. Combining Lagrange with two AMD Opteron clusters and a 64-CPU HP Superdome SMP system gives CILEA peak computing power of 30 teraflops from roughly 2500 CPUs, all managed by PBS Professional workload management software.

## PBS Professional: Keeping 2500 Processors Busy

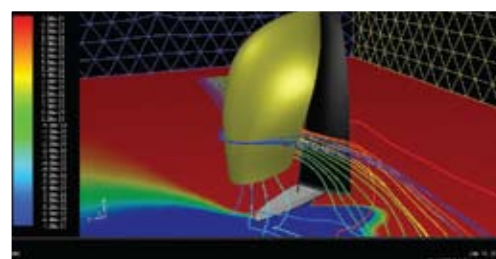
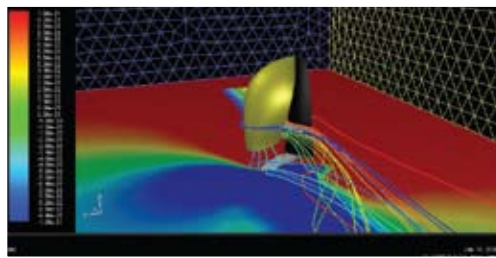
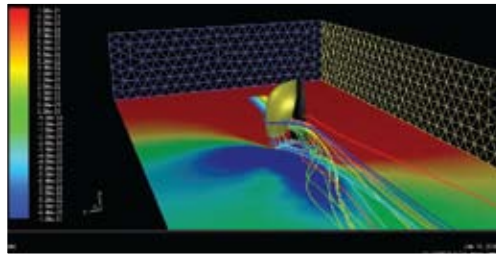
In 2004, CILEA's HPC resources consisted of the HP SuperDome SMP system and a smaller system. The center was using LSF as a scheduler.

"We weren't completely satisfied with LSF, particularly from an economic point of view," says Arlandini. "So when we bought our first cluster, we evaluated all the scheduling systems on the market. In the end we chose PBS Professional, particularly because it had the robustness and flexibility we needed, with an excellent price/performance ratio. In the four years we've been using it, Altair has added interesting features and made it even more robust. We've never questioned our choice of PBS Professional."

CILEA now has PBS Professional licenses for all 2500 processors in its HPC environment. One of the two Opteron clusters is available to the full list of CILEA clients. The other is dedicated to a project of the Italian Laboratory for Bioinformatics that will last until 2010.

Policies, priorities, and filling users' needs are a significant part of managing CILEA's compute resources, and Arlandini leans heavily on PBS Professional to achieve high levels of utilization.

"PBS Professional is powerful and flexible when it comes to scheduling policies, and this has definitely improved in its latest versions," says Arlandini. "It allows us to keep our policies working at maximum levels. All our users are very happy



"Our users are increasingly cycle-hungry. More disciplines are moving into simulation. The average waiting time to run a low-parallelism simulation on our three clusters, with a combined 800 cores, was 24 hours – unacceptable for most of our users, and especially our industrial customers." says Arlandini.

"We looked at several excellent proposals, and finally chose HP because we considered their blade solution technically superior and we have known them a long time."

"We were pleased to work with Hewlett Packard to integrate their latest HPC technology into our environment and greatly increase the computing power we can offer our users."

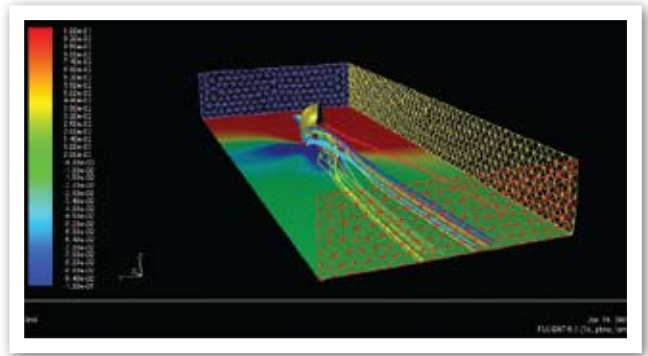
with their share of our compute resources, but without PBS Professional it would be difficult to keep them that way. Our user community is very heterogeneous. Some are expert, some are not, and they come from all kinds of scientific areas.

"I do know they're very satisfied with PBS Professional, because it's very easy to use and the learning curve is very short, even for undergraduates and engineers from small enterprises. And keep in mind that the first time these users sit down to work with our resources, it's usually the first time they've ever sat in front of any high performance computing system."

Most users access CILEA's HPC resources remotely. Expert clients access PBS Professional through an SSH shell using optimized scripts provided by CILEA. For less-expert users, CILEA provides a web interface.

## Growing as a Research Center

When Arlandini first came to CILEA, computer assisted engineering (CAE), primarily for the Italian automotive industry, was its core business. Now Arlandini estimates that 80% of users are in the compute-intensive fields of chemistry, life sciences, and materials science. CILEA's scientific and engineering application experts help its customers to use compilers, parallelize and optimize code, and turn concepts into software. Users can also draw on CILEA's portfolio of third-party open-source and commercial software for studies in engineering analysis, thermodynamics, chemistry, bioinformatics, and other disciplines.



"We help customers develop models and solve simulation problems," says Arlandini. "That's one reason why we have a long-standing partnership with Altair Engineering. We work with them to develop simulations in their RADIOSS and HyperWorks software suites, especially for our faithful customers in the automotive industry."

Looking ahead, a key goal for CILEA is to encourage the use of simulation and HPC techniques in science and engineering.

"We want to expand our influence in industry, and our new HP server and PBS Professional will enable us to do that," says Arlandini. "Small and medium-sized companies are not investing in simulation the way they could. We need to convince them that they need a partner to develop more innovative production cycles, and that we are the right partner."

"To do this I think we need not only PBS Professional – a very easy-to-use tool for non-expert users – but also a number of other Altair Engineering tools. It was very interesting to see a demonstration of the HiQube business intelligence tool. We'll be trying it out in the next few weeks. I think its insights will be very interesting for what we want to do with the Italian industry."