

Streamlining made easy with a supercomputer

- SEAT uses the most powerful computer in Spain, and the seventh in Europe, to improve the aerodynamics of its cars
- Optimising aerodynamics improves safety and reduces consumption and emissions
- The goal of this research is to bring simulation and reality together
- Scientists from around the world use the MareNostrum 4 to carry out all kinds of simulations

Martorell, 29/05/2019. 40,000 PCs all working at the same time. That is the capacity of the MareNostrum 4 supercomputer, the most powerful in Spain and the seventh in Europe, and it is located in Barcelona, at the Barcelona Supercomputing Center (BSC). This processing power enables it to perform all kinds of simulations: from how a heart works or predictions about climate change to environmental disasters. In the case of the collaboration project with SEAT, the goal is to harness the MareNostrum 4 supercomputer's computing power, and put all 165,888 processors to use to improve our cars.

6,912 chips in a chapel: The MareNostrum 4 is housed in an old deconsecrated chapel in the North Campus of the Polytechnic University of Catalonia, at 24 degrees of ambient temperature and 36% relative humidity. Oriol Lehmkuhl, a researcher at the BSC on physical and numerical models, is one of hundreds of specialists who use this supercomputer from any part of the world for their projects: **“In my field I study the combustion chambers of aircraft, perform wind turbine simulations, and in the case of my collaboration with SEAT, the impact of wheel hub geometry on the aerodynamics of its cars.”**

Cars that are safer, more comfortable and more efficient: Enhancing the aerodynamics of a car consists in lowering its air drag coefficient. This results in vehicles that are safer and more efficient, with lower consumption and CO2 emissions, and better performance. The key areas of analysis are the front and rear end, undercarriage, tyres and wheels. Until now, in order to improve aerodynamics, life-size clay models were used combining simulations and actual tests in a wind tunnel. **“Working with a wind tunnel is expensive. The clay models deteriorate and constant changes have to be made”**, says María García-Navas, an engineer in SEAT's Department of Development and Aerodynamics. **“Furthermore, the computing power of the BSC's supercomputer enables us to include more parameters and see how air behaves inside the rims when the wheels are moving. The idea is to increasingly narrow the gap between simulation and reality”**, she adds.

From months of study down to hours: The advantage of having 165,888 processors working at the same time is that we can perform studies in record time. **“We introduce the geometry of the wheel converted to grid points, and each point is analysed by a set of processors working in parallel. If they were analysed individually it would take months”**, says Oriol.

The future is measured in petaflops (computer performance measurement): Simulations using the supercomputer opens new avenues for research into aerodynamics: **“In the future,**

we'd like to be able to simulate everything at once: airflow, the structure of the car, combustion and even the person sitting inside. For the moment we cannot, but in 15 years it will be possible with computers that are 1,000 times more powerful. We can begin to imagine it already", says Dr. Lehmkuhl. The BSC is now a candidate to house the MareNostrum 5, which would increase the capacity of the current computer more than 20 times.

The MareNostrum 4, facts and figures

The supercomputer

3,456 nodes
6,912 chips
165,888 processors
13.7 petaflops
78,000 kilos in weight

The facility

180 square metres
24 degree ambient temperature
36% relative humidity
19 tonnes of glass
26 tonnes of steel

SEAT is the only company that designs, develops, manufactures and markets cars in Spain. A member of the Volkswagen Group, the multinational has its headquarters in Martorell (Barcelona), exporting 80% of its vehicles, and is present in 80 countries on all five continents. In 2018, SEAT sold 517,600 cars, the highest figure in the 68-year history of the brand, posted a profit after tax of 294 million euros and a record turnover of close to 10 billion euros.

The SEAT Group employs more than 15,000 professionals and has three production centres – Barcelona, El Prat de Llobregat and Martorell, where it manufactures the highly successful Ibiza, Arona and Leon. Additionally, the company produces the Ateca in the Czech Republic, the Tarraco in Germany, the Alhambra in Portugal and the Mii in Slovakia.

The multinational has a Technical Centre, which operates as a knowledge hub that brings together 1,000 engineers who are focussed on developing innovation for Spain's largest industrial investor in R&D. SEAT already features the latest connectivity technology in its vehicle range and is currently engaged in the company's global digitalisation process to promote the mobility of the future.

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