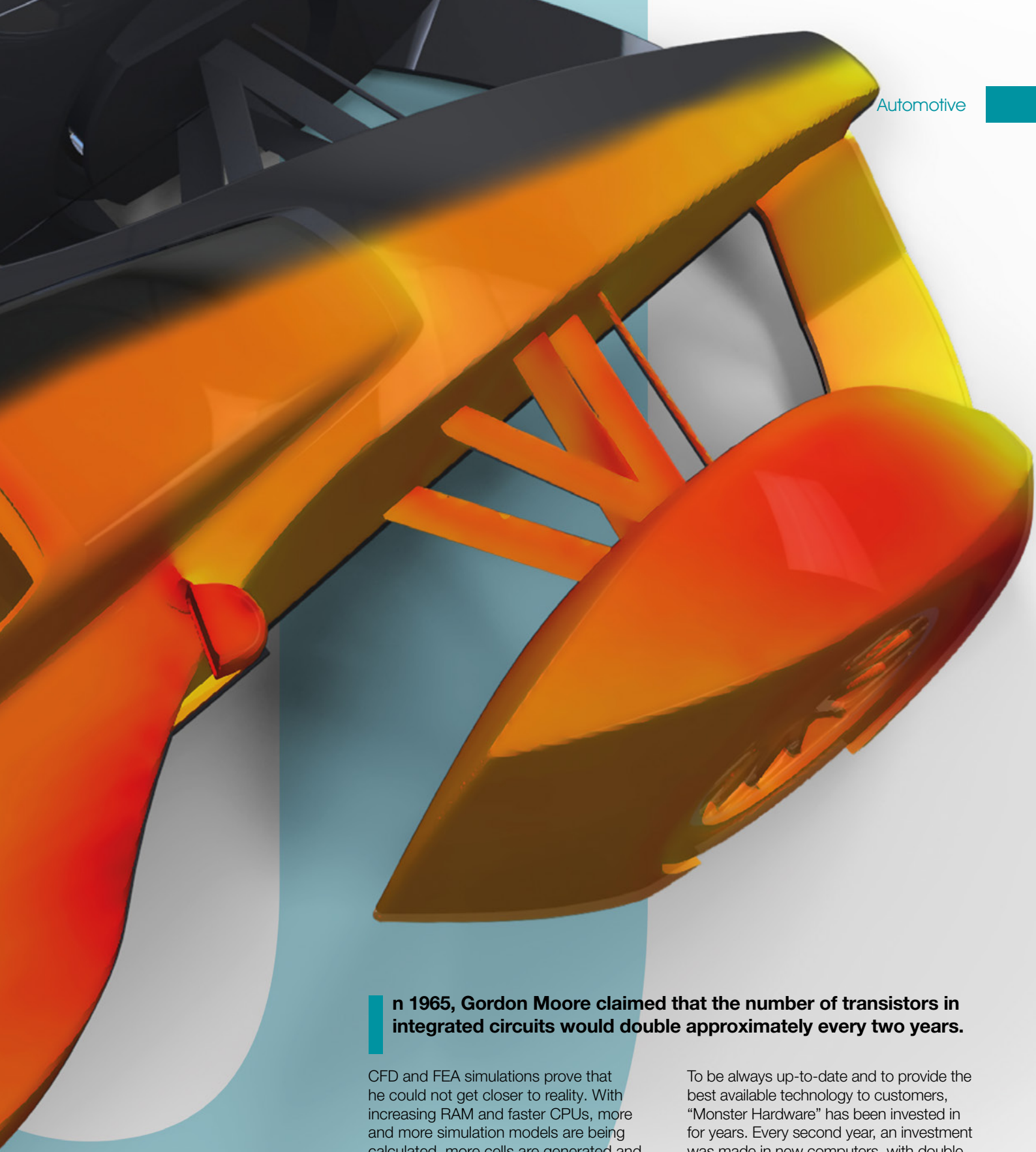
Up in the Cloud

Turbo Charging FloEFD Usage

By Koen Beyers, CEO, Voxdale Bvba

Figure 2b. Formula E, Season 5 Racing Car



In 1965, Gordon Moore claimed that the number of transistors in integrated circuits would double approximately every two years.

CFD and FEA simulations prove that he could not get closer to reality. With increasing RAM and faster CPUs, more and more simulation models are being calculated, more cells are generated and faster computing speeds are expected. On the one hand, the available computing power is used to make innovations more complex and shorten development cycles simultaneously. On the other hand, of course, it's simply because engineers can. Engineering hours are often the highest cost factor, which means that it can be more economical to use the available computational capacities rather than cost-intensive manual preparation work which could save computation time.

To be always up-to-date and to provide the best available technology to customers, "Monster Hardware" has been invested in for years. Every second year, an investment was made in new computers, with double speed, and twice as much capacity, which amounted to about €3,000 per workstation. Even at the end of the millennium it was quite possible that heavy hardware and even tube displays were transported to on-site presentations and customer visits, as affordable and high-performance laptops and projectors with sufficient resolutions were, at that time, future dreams.

Figure 1 shows a state-of-the-art computer from the year 2010. The processor (four

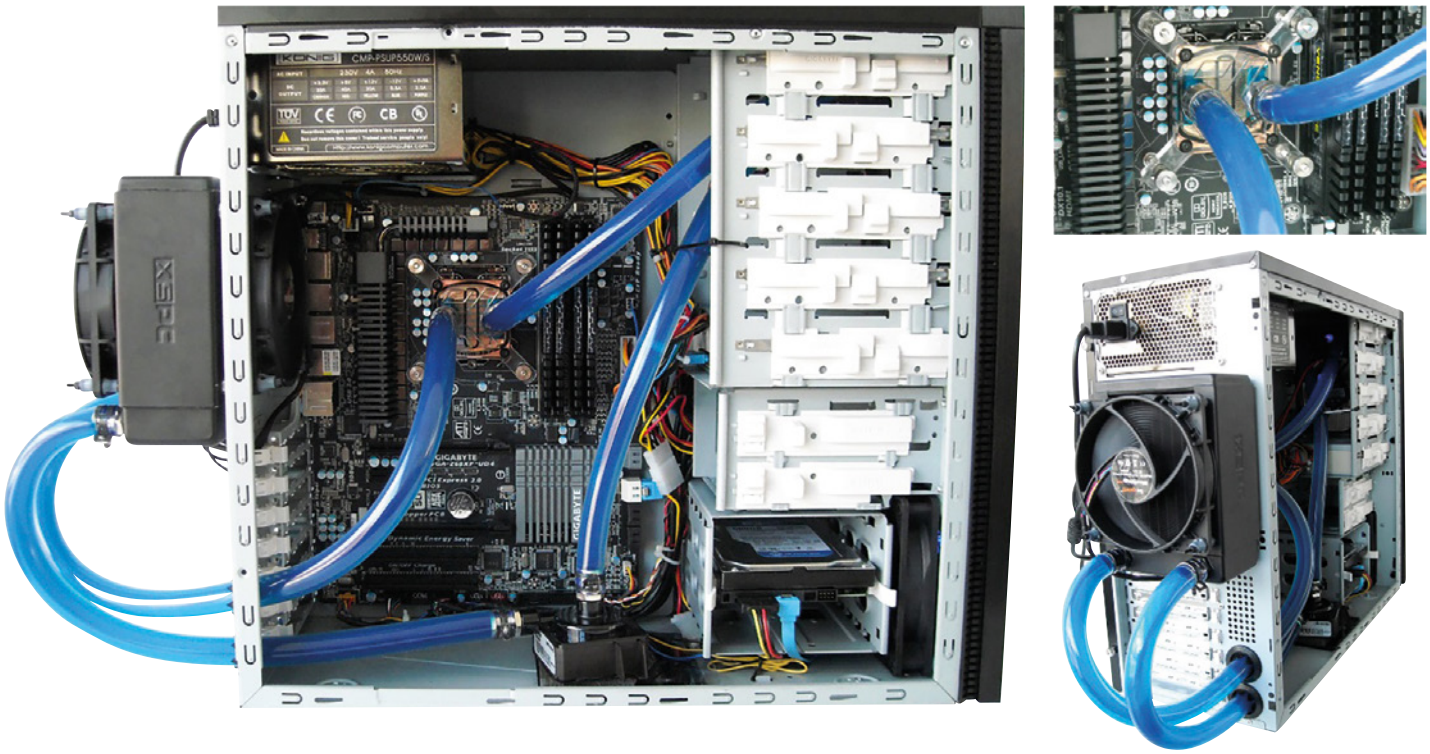


Figure 1. State-of-the-Art Computer from 2010

cores / eight threads) was overclocked up to 4.7 GHz instead of 3.4 GHz and the memory to 1600 MHz instead of 1333 MHz. The computation time for one of Voxdale's Mentor FloEFD example models was reduced to five hours from nine, which were needed before the overclocking. The result was great, the sense of empowerment for the engineers involved was wonderful.

Simulation in the Cloud

Cloud computing is not a revolutionary concept these days. We're all working together through Amazon Cloud, Google Drive, Dropbox, Trello, iCloud, and SharePoint, but the growth potential it brings is "more than exponential", higher, and faster than Moore's Law.

As a design, engineering and simulation company, Voxdale is working with confidential CAD data, with legal and rare software licenses, and with limited resources, it was quite a leap to take. But it was successful. Voxdale's own licenses can be used on virtual machines in the cloud and virtual high performance machines can be configured in just a couple of minutes. Simulation models with, for example, 40 million cells and a study with ten variants are now feasible without any problems. An example configuration consist of a 20 core hardware, at 3.1GHz, with 140GB RAM.

Realization

In this specific example, the Microsoft Azure cloud environment is used. The cloud computing platform, was put into operation in 2010 and is available in 34 regions around the world (status March 2017). [1]

The Azure environment is just like a Windows computer that is accessed by using the "Remote Desktop Connection". Hence, the installation and way of working is just like working on a familiar Windows based system. As a result, the exact same surfaces appear, so the engineering work is done in the usual familiar environment, including the FloEFD GUI and no additional introduction time is required. The simulation process remains the same, only the files are uploaded to the cloud.

Generally, the calculation of CFD simulations requires sufficient CPU power and RAM capacities, but the post processing, which means the results display on the complex CAD model, requires high level graphics card power in addition to RAM.

Therefore, it may be advisable to set up two cloud configurations, with both having the same amount of RAM. The system for the calculation has more CPU capacity, the configuration for the following post processing has less CPU capacity but high-level graphics power instead. The simulation

> "I now have the power at hand to run multiple variants of Formula 3 and Formula E cars without the former fear for hardware capacity.

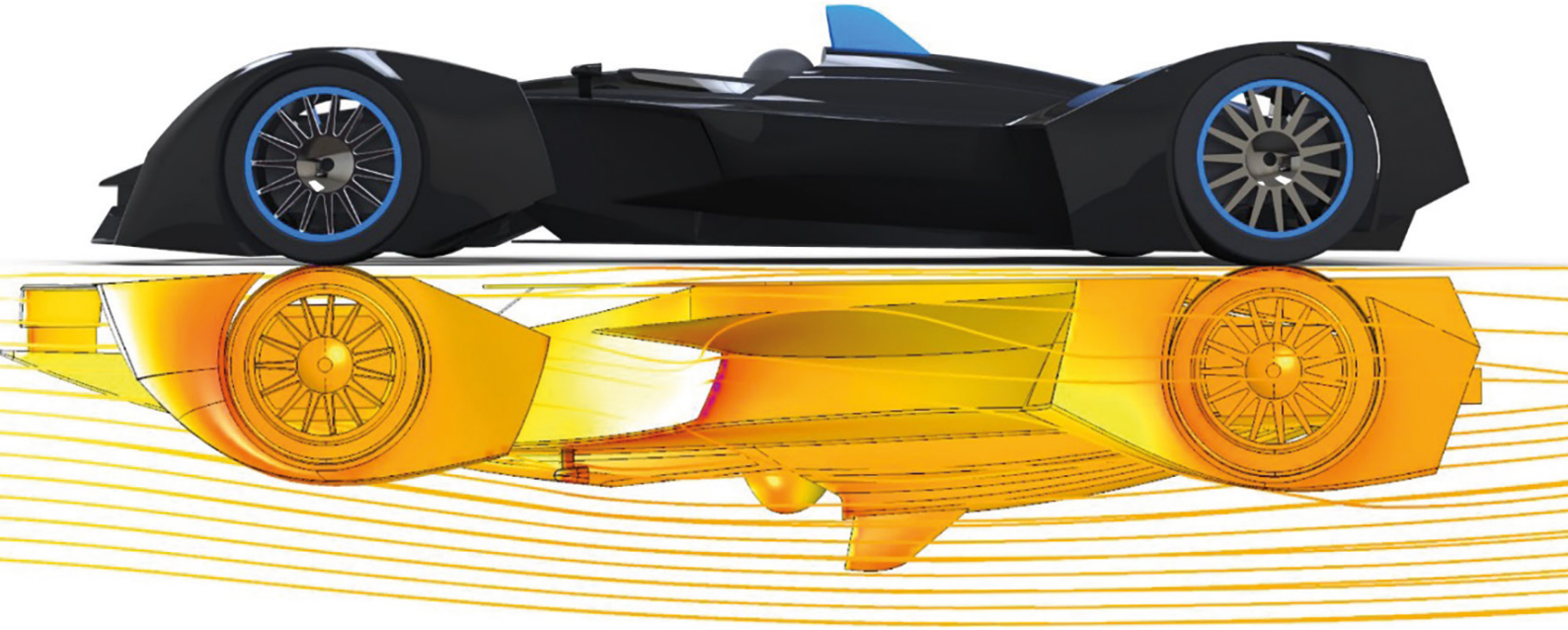


Figure 2a. Formula E, Season 5 Racing Car, approximately 33 million cells

results can be transferred from the virtual machine for the calculations to the virtual machine for the visualization.

The licensing of the software products can be implemented very easily. The Azure environment can be integrated into the domain so that the company's license server can be accessed. Alternatively, if, for example, no corresponding domain is available, the license server can be connected via a VPN connection.

One particular example Voxdale solved on the Azure cloud, had around 35 million cells. For comparison: even on the already well-equipped workstation, it was only possible to run 9 million cells. The FloEFD adapted grid refinement was applied, which automatically refines the grid in high flow gradient regions during the calculation [2]. The calculation time was around 6 days for 1,500 iterations.

The main benefits of working in the cloud in the daily simulation process are:

- The results are stored in the cloud in a safe environment,
- There is no need to continuously invest in workstations,
- Costs are flexible only the actual time on the virtual machine has to be paid, and
- The system stays on stand-by, all software and configurations remain installed for the next use.

Examples

Some impressive benchmarking projects have already been conducted on a cloud basis, including validations for the Bike Valley Full Scale wind tunnel [3]. This technology will reduce the risks of challenging prospective projects while at the same time increasing innovation. We are expecting exciting times for applications in the automotive, aerospace, electronics, performance, process and medical industries.

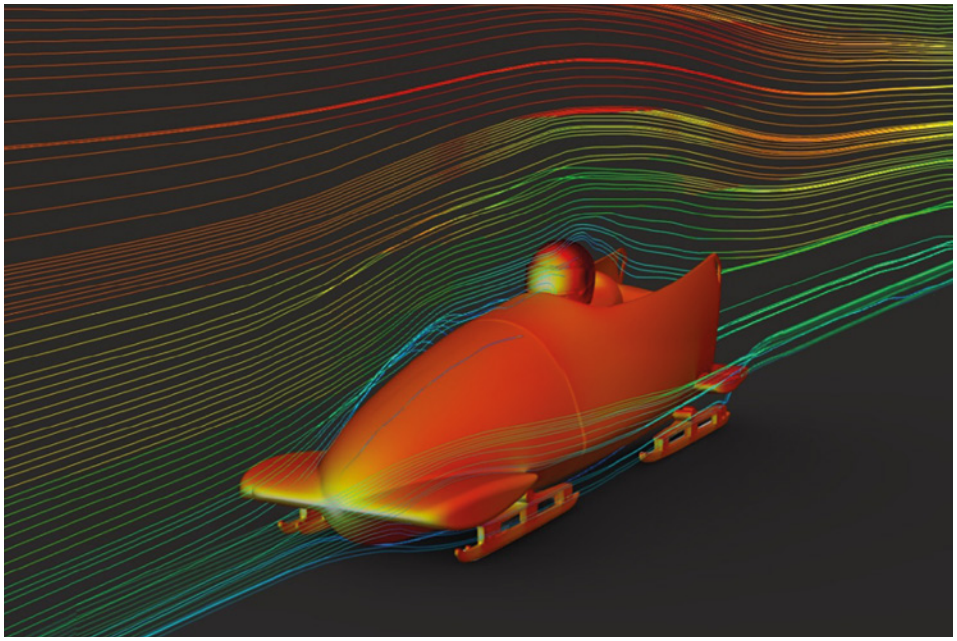


Figure 3. Designing of a super bobsleigh for the 2018 Winter Olympics, using approximately 9 million cells

A Glance into the future

Let us return once more to the situation a few years back described in the introduction above. At that time one would not have thought that large amounts of data, such as complex three-dimensional CAD models and simulations, could be transmitted via mobile phones. Today, on the road, we can transfer technical models, even with large amounts of data, over the mobile network and view them (with a sufficiently large display) on mobile devices, such as smartphones and tablets. Perhaps fixed desktop workstations will also lose their importance in the next few years, and complex technical simulations can be carried out in the cloud from anywhere.

References

[1] https://azure.microsoft.com

[2] SmartCells – Enabling Fast & Accurate CFD http://go.mentor.com/4Ppzz

[3] Calibration of Low Speed Cycling Wind Tunnel – Part 1 http://www.flandersbikevalley.be/wp-content/uploads/2016/02/White-paper-calibration-part-1-final.pdf