



Guided by the light

Cambridge University turns to solar energy and Intel® Solid-State Drives for the development of eco-friendly vehicles

Cambridge University Eco Racing (CUER) is a team developing a solar-powered car to compete in the prestigious World Solar Challenge 2011. Founded in 2007, CUER is developing cutting-edge, energy-efficient, and race-winning vehicles to prove the viability of sustainable energy. The cars are powered only by the sun. To speed up the design process, ensure optimal performance, and gather data for future design refinements, CUER collaborated with Intel and made extensive use of Intel® Solid-State drives.



“On average, we gained an overall 10 times performance¹ increase in terms of computational fluid dynamics (CFD) analysis thanks to the Intel contribution, including the Intel® Solid-State Drives.”

Oliver Smith
HPC and IT Manager
Cambridge University Eco Racing

CHALLENGES

- **Speeding up design:** CUER needed to increase the speed at which it was designing the aerodynamic features of its solar-powered car in order to participate in the World Solar Challenge 2011
- **Robust telemetry:** The race is in Australia and, given the extreme heat and dusty environment, CUER also required an in-car telemetry system that could withstand adverse conditions while capturing important data

SOLUTIONS

- **Blue-chip sponsorship:** Intel supplies access to a high-performance computing (HPC) cluster and workstations that include two Intel® Solid-State Drives (Intel® SSDs) each for faster design performance
- **In-car monitoring and storage:** Replaces in-car hard disk drives (HDDs) with Intel SSDs and instrumentation powered by Intel® Atom™ processors to capture data during the race

IMPACT

- **Large performance leap:** Intel SSDs contributed to a 10 times performance¹ leap for computer-aided design (CAD) software, dramatically increasing the speed at which car components were designed
- **Tough enough for the rough:** The in-car telemetry system, using Intel SSDs, is rugged enough to withstand the harsh operating conditions including temperatures up to 45°C, continuous vibration and a dusty environment
- **Commercial future:** The ability to capture race data will inform the future commercial development of eco-friendly cars, addressing some of the pressing carbon concerns we face today

Alternative worlds

The World Solar Challenge is one of the most prestigious events of its kind and attracts the world's best technical universities and colleges. The challenge takes place in Australia, from Darwin in the north to Adelaide in the south, a distance of 3,000 km (approximately 1,870 miles). Designing and building a car capable of crossing Australia on the silent power of nature requires the most innovative research and development trends in alternative transportation technologies. One of the most exciting outcomes of the Solar Challenge is knowing the technologies being used will most likely find their way into the production cars of tomorrow.

Cambridge University Eco Racing (CUER) was founded in 2007 when a student returned from the Massachusetts Institute of Technology (MIT) having witnessed MIT's solar-powered car. A decision was then made to try and emulate its endeavours and see if Cambridge University could develop its own eco-friendly vehicle. Two years later CUER entered a car into the 2009 World Solar Challenge and came in at a respectable and successful 14th out of 26 entrants.

Since then, the team has been working on developing the car, called Endeavour, for the World Solar Challenge 2011. To achieve this, CUER is heavily dependent on computational fluid dynamic (CFD) analysis to further refine the aerodynamics.

CFD is central to the design, allowing the CUER team to make a model of the design and to test the aerodynamics in a simulated environment. Tom Grimble, design director for CUER, said: “We make use of ANSYS FLUENT* CFD software to find ways of reducing aerodynamic drag and also improving stability. Clearly, we don't want the car blown off the road.”



Three thousand kilometers powered only by the sun

Flash driving

To help the team enhance its design process, Intel stepped in to provide sponsorship. In practical terms, this meant access to an HPC cluster, powered by the Intel® Xeon® processor 7500 series and two workstations powered by the Intel® Xeon® processor 5600 series. The HPC cluster consisted of 16 nodes and 128 physical cores.

One component of the project was replacing hard disk drives (HDDs) in the workstations with Intel SSDs, specifically two Intel Solid-State drives in each workstation.

The 80GB Intel SSDs improved system performance by approximately four times compared to the previous HDDs. For example, saving a CAD mesh with an HDD took just over two minutes. With an Intel SSD, it was just 39 seconds¹. Other storage areas, such as loading a mesh for pre-processing and generating graphics, saw similar performance improvements.

Oliver Smith, IT and HPC manager, CUER, said: "From the design side, on average we gained an overall 10 times performance¹ increase in terms of CFD analysis thanks to the Intel contribution. In some cases, an analysis that might take four weeks was completed in one day. There was a dramatic increase in design resolution and this certainly sped up the development for the car's aerodynamics. The Intel SSDs also performed better than HDDs and contributed to a far faster design process."

The race heats up

As part of the sponsorship, Intel also provided consultancy. This came in particularly useful when it became apparent that any hard drives in CUER's telemetry solution, designed to collect in-car data, would be prone to faults arising from vibration, heat, and sand.

Temperatures during the challenge across Australia could be expected to average 45°C and for much of the race the car would travel through a heat-soaked and dusty environment. The telemetry system provides a critical function in the car. The data it gathers informs future designs and, importantly, captures information that can be used to inform the commercial design of eco-friendly vehicles.

For example, when the challenge begins, the car will have a full battery charge. However, following the start, the car depends on battery charges powered by solar energy during the 3,000-mile race. Batteries are central to the future design and development of eco-friendly cars and CUER needed to capture as much information during the race as possible.

Oliver Smith said: "The car will start with 4KWh of stored power, but after that we need to ensure it is as energy-efficient as possible. Within this context, solar-powered cars are a test bed for energy efficiency and, from this perspective, we are treating the challenge as a technical exercise to establish the viability of the battery management system and other components. As such, a reliable and robust telemetry system is absolutely critical."

Powerful design

To solve the problem of unreliable hard drives, Intel provided small, embedded controllers for in-car control and instrumentation based on Intel Atom processors. The issue of storage was solved by using a laptop that included 80-GB Intel Solid-State drives.

Spotlight on Cambridge University Eco Racing

Cambridge University Eco Racing designs, builds and races solar- and electric-powered cars. Its racing cars showcase cutting-edge, sustainable engineering and demonstrate the incredible potential of electric vehicle technologies. By designing a car to run on solar power alone a step change in vehicle efficiency is required, resulting in new technologies for a low-carbon future.

Tom Grimble said: "The Intel SSD looks very promising and should be able to withstand challenging conditions, which is precisely what we need as we take Endeavour through the Australian desert."

Unlike traditional HDDs, Intel SSDs have no moving parts, resulting in a rugged storage solution that also offers faster system responsiveness. The drives also feature low write amplification and a unique wear-leveling design for higher reliability, meaning they not only perform better but also last longer. With powerful native command queuing to enable up to 32 concurrent operations, the Intel SSDs deliver higher input/output per second and throughput performance than other SSDs – and dramatically outperform traditional HDDs.

CUER's sponsorship with Intel has helped accelerate the design and performance of the Endeavour solar-powered car. As a result, the CUER team is aiming to provide a template for commercial energy-efficient designs of the future and a foundation that may begin to answer some of the pressing energy concerns the world faces today.

Find a solution that is right for your organization. Contact your Intel representative or visit the Reference Room at www.intel.com/references



Copyright © 2011 Intel Corporation. All rights reserved. Intel, the Intel logo, Intel Atom and Intel Xeon are trademarks of Intel Corporation in the U.S. and other countries.

¹ Performance tests and ratings are measured using specific computer systems and/or components and reflect the approximate performance of Intel products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Intel may make changes to specifications, product descriptions, and plans at any time, without notice.

This document and the information given are for the convenience of Intel's customer base and are provided "AS IS" WITH NO WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. Receipt or possession of this document does not grant any license to any of the intellectual property described, displayed, or contained herein. Intel products are not intended for use in medical, life-saving, life-sustaining, critical control, or safety systems, or in nuclear facility applications.

*Other names and brands may be claimed as the property of others.

0611/JNW/RLC/XX/PDF

325709-001EN