Benchmarking 3D CAD workstations

Benchmarking for 3D CAD can be a bit of a minefield. Below we introduce four levels of testing to help you make more informed decisions before investing in new GPUs or workstations.

For a truly fluid 3D design process it is important to be able to smoothly and accurately orient complex CAD assemblies on screen. But when running 3D CAD on an underpowered workstation large models can often jerk about, significantly impacting productivity.

A new workstation, or a CPU / GPU upgrade for your existing machine, can help take the lid off throttled workflows. However, simply presuming new technology will boost 3D performance is not enough. It is important to understand exactly how much faster your hardware investment will be and in what areas you are likely to benefit most. Doing proper research can also help ensure you don’t waste money on expensive hardware that is no more beneficial to your workflow than an alternative that costs a fraction of the price.

The most effective way to assess 3D performance is through benchmarking. This can be a hugely complex process, requiring a deep understanding of the benchmark and how it relates to your workflow. However, there are also some easy and effective ways to test your current machine and compare it against prospective hardware purchases.

Below we run through the four most common levels of benchmarking workstations for 3D CAD. There are pros and cons to each but using a combination of tests can help give you a much more complete picture of 3D graphics performance.

1) WINDOWS EXPERIENCE INDEX

Built into the Windows 7 operating system, the Windows Experience Index should give you a good idea where your machine sits in the grand scheme of things. It’s quick and easy to run and rates the performance of CPU, memory, hard drive and GPU, giving each a score between 1 and 7.9.

The test isn’t hugely accurate, is in no way related to 3D CAD, and should certainly not be used on its own. However, it will give you a decent ballpark figure of performance in seconds. The utility is also available for Windows 8.1, but is hidden and can only be accessed from the command line.

2) SPECVIEWPERF 12

SPECviewperf 12 is a CAD-focused benchmark that uses graphics traces from a number of 3D CAD applications, including Siemens NX, DS SolidWorks, Autodesk Showcase, PTC Creo and DS Catia. The test is free to download and very easy to use.

SPECviewperf is classed as a synthetic benchmark because it does not run inside the actual CAD application. This has the benefit of being able to run on any machine without having to worry about CAD software licenses. However, it is generally regarded to be less accurate than...
application-resident benchmarks as it does not perform the graphics tasks in the context of the ‘real world’ CPU, memory and hard drive operations that occur in an actual CAD application.

The official test includes eight viewsets and takes around 30 mins to run. However, users can also pick and choose individual viewsets most appropriate to their workflow, cutting run times to a matter of minutes. The benchmark was significantly modernized for the release of SPECviewperf 12 in December 2013, and is designed to run on Windows 7 Professional 64-bit.

SPECviewperf 12 is extremely widely used, so there are lots of results for comparison. These can be found on spec.org and a whole host of technology websites. Workstation and professional graphics manufacturers also publish results.

The test is developed by the non-profit organization, SPEC (Standard Performance Evaluation Corporation). AMD, Dell, Fujitsu, HP, Intel, Lenovo, NEC and Nvidia are members.

3) SPECapc FOR SOLIDWORKS, CREO, AND NX
Moving up a level, SPEC develops a number of application-specific benchmarks under the SPECapc moniker: the main CAD-focused ones are for DS SolidWorks 2013, PTC Creo 2.0, Siemens NX 8.5.

Each benchmark runs inside the native CAD application so it properly taxes the CPU, GPU, memory and storage testing with a variety of different CAD models and workflows. It is regarded to be the most accurate ‘off-the-shelf’ benchmark for 3D CAD.

The SPECapc tests give an overall score for graphics, CPU and I/O. It is also possible to drill down into the results to see how the machine performs with individual models and viewing modes - e.g. wireframe, shaded with edges, realistic – and focus on those that match your workflow most closely or where you are experiencing bottlenecks.

Published SPECapc results aren’t as widespread as SPECviewperf. However, DEVELOP3D magazine tests all of its workstations with the SPECapc for PTC Creo 2.0 and SolidWorks 2013 benchmarks so there is data out there for comparison.

The downside of the in-depth SPECapc tests is that run times can be long: typically between one and four hours, depending on the speed of the machine. And, because the tests require that a full license of the CAD software be installed on the workstation, testing multiple machines can be very slow.

It is also important to note that the size or type of models used in the SPECapc benchmarks might not relate that closely to your own. Different models can impact performance in very different ways so the results might not necessarily be relevant to your workflow. The SPECapc tests are designed for Microsoft Windows 7 Professional 64-bit.

4) USE YOUR OWN BENCHMARKS.
While SPECviewperf and SPECapc are very useful and convenient benchmarks for 3D CAD, there is no substitute to creating your own tests.

Tailoring a benchmark to the exact 3D CAD models and viewport viewing modes you use day in day out should yield the most accurate results.

The easiest way to create your own benchmark is to customize an existing one and with a little tinkering you can plug your own CAD models into the SPECapc tests.

If a SPECapc benchmark doesn’t exist for your chosen CAD tool then check out the forums as some CAD applications, such as Autodesk Inventor, have hidden benchmarking tools built in.

You can also download a free utility called FRAPS, which runs on top of any CAD application. With FRAPS, as you move the CAD model around on screen it displays the ‘frame rate’ in real time.

There are limitations to this basic test. Because it relies on human interaction it can be difficult to rotate the model the same way every time, which is important for consistent results. If possible write a script that moves the model along a set path.

Custom benchmarks can take time to set up and they also suffer from there being no comparative results in the public domain. It will be down to the individual to procure and test a wide range of different machines and graphics cards. This can be massively time consuming and is not always possible without big expense.

Most importantly, if you create a custom benchmark check you get consistent results with the same kit. If the results can’t be repeated again and again within a few percent of each other the benchmark is invalid.

BEYOND GRAPHICS: A FINAL NOTE
The role of the GPU is changing and high-end GPUs in particular can now be used as powerful co-processors, helping cut solve times in ray trace rendering and simulation software.

If your chosen software supports GPU compute through a programming framework like OpenCL this needs to be taken into consideration when benchmarking.

Adapt your benchmarking process to your workflow, testing concurrently for GPU compute and 3D graphics if that is how you intend to work.

PREPARING YOUR MACHINE FOR BENCHMARKING
Before each test turn off power save, disconnect from the network, reboot and then let the machine settle for 15 mins. Consistent results are essential if you want to get a truly accurate picture of performance.

Also, before you start testing make sure you have the most up to date graphics driver or one that is certified by your CAD software developer. Over the lifetime of your graphics card, optimizations can lead to big performance improvements, so it is important that you are getting the most out of your hardware, particularly if comparing to a brand new machine.

It is important to understand exactly how much faster your hardware investment will be and in what areas you are likely to benefit most.