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Five tips for large assembly performance

Improving CAD performance when creating and managing assemblies

As designs become more complex, the number of parts in an assembly often grows. Performance of your CAD tool can suffer as a result – meaning lags or crashes. In this white paper, we examine five top techniques for improving performance when working with large assemblies.

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Improving large assembly performance

"Large assemblies" is a term with varying definitions, and can describe assemblies from 1,000 to 100,000 parts. If the number or complexity of parts in your assembly poses a performance problem to your computer, hardware or network, then you have a large assembly, regardless of the number of parts.

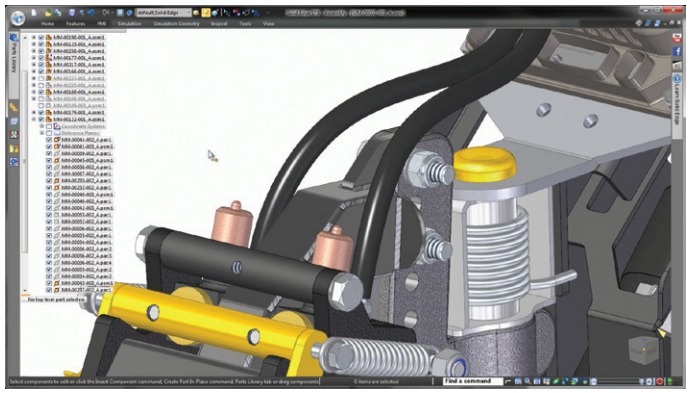
There is no single solution for improving performance of large assemblies, or even to most performance problems. Getting the most out of your CAD solution when working with assemblies of any size takes planning and preparation. By focusing on these five techniques, you can set yourself up for improved large assembly performance:

- Simplify your components
- Optimize your display
- Improve your model
- Take advantage of PDM
- Pay attention to your drawings

Simplify your components

Eliminate unnecessary details

One of the biggest impacts you can have on assembly performance is to simplify parts, especially if they are re-used often. For example, if your model includes a lot of hardware, you likely don't need details – like helical threads, markings on the head, or small fillets of a bolt – to show up in the bill of materials (BOM) or the drawing. If showing head shape and the body of the screw extruded to the correct depth are sufficient, simplify your part accordingly. In many cases, modeling just the head of a screw or bolt is enough representation of a standard part in a large assembly.



Best-in-class CAD systems like Solid Edge® software also support occurrence property options, which allow you to cull components such as bolts and fasteners from upper-level assembly models.

Also consider your analysis needs when determining how much detail to show. Unless you are the bolt manufacturer, you likely don't do in-depth stress analysis on bolts in your assembly, so very few companies really need to represent these parts with a high level of detail. If you do interference checks and mass calculations at the subassembly level, you need to have a fairly accurate representation of your hardware, but you might be able to get away with a very simplified representation of your hardware at the upper level.

Remember that the computer must draw every edge that you create, and if you have hundreds or thousands of screws, a single extra edge on the screw means your computer has to redraw those extra thousands of edges.

The same sort of idea applies for electronics components on circuit boards, purchased motors or pumps with a lot of detail.

Simplify subsystems for in-context design

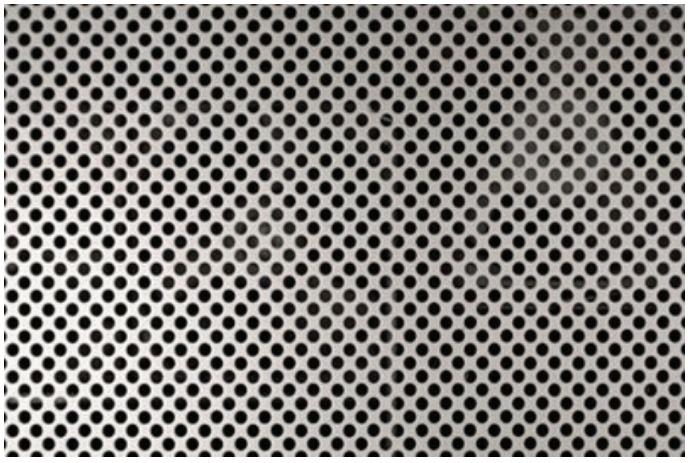
When your assembly includes a subsystem that is either purchased or provided by a supplier, simplifying it to a single part file enables you to design in context without impeding performance. Define cohesive sets of parts, features and constraints as a single functional system, and use this model in your actual design. The time you spend up front will improve both performance and model accuracy.

Align detail and assembly structure level

Plan in advance, and determine what level of detail you need at a given level in your assembly structure. Understand that some types of detail are very expensive computationally.

Large patterns of features or individual parts can cause assembly performance problems. Details like extruded text, company logos and large numbers of textures displayed on-screen are unlikely to be needed at the top level.

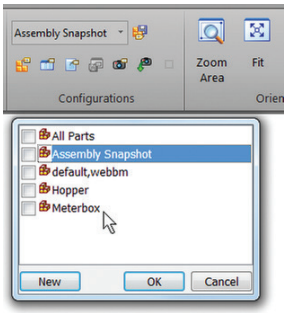
Be particularly mindful of parts downloaded from vendors, as they can contain details like surface bodies, internal features or very small edges that impact performance without adding value.



Large patterns of features can cause assembly performance problems.

Optimize your display

Set display configurations



Display configurations allow you to set the display of parts within an assembly on or off, and to save that state as a named configuration. From there you can continue hiding or showing parts, but it doesn't change the configuration unless you save it. This enables you to go back and reset your display with the same configuration state after you have made several changes.

Configurations enable you to work at the top level with less visual clutter, which of course translates into less work for the graphics card, and better performance.

Define zones

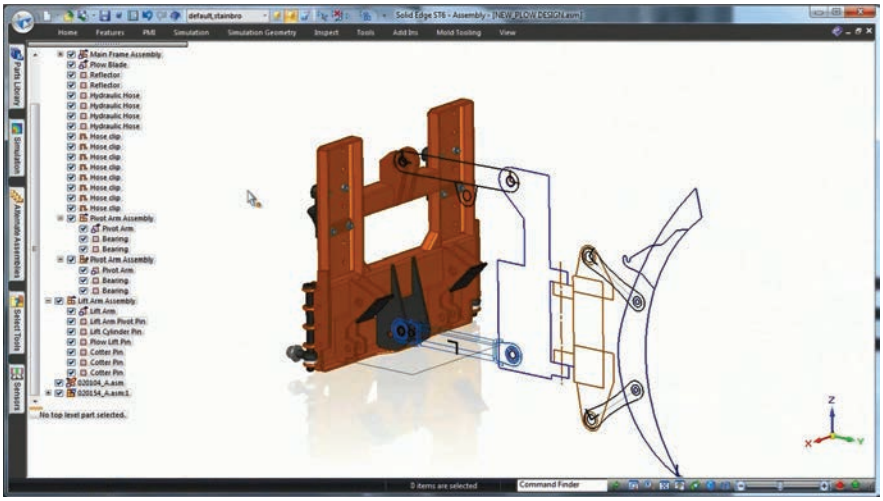
Zones make working with massive assemblies even more manageable, and boost performance by allowing you to define a permanent range box to isolate areas of large designs you are responsible for at a subsystem level.

Intelligent caching allows retrieval of only the parts in the zone, without having to open component files to determine if they lie in the zone or not. This creates a significant performance boost when switching zones or opening a large assembly.

Reduce visual effects in upper-level assemblies

Visual effects can help convey an accurate look and feel, and create a realistic look to communicate with partners, customers and your shop floor. But in upper level assemblies, where system performance becomes an issue, consider the trade-off between parts that look cool and faster modeling capabilities. To optimize upper-level assembly performance:

- turn off reflections
- turn off drop shadows
- turn off cast shadows
- turn off silhouettes
- use shaded (without edges) or single edge color (if you use visible edges)
- use culling
- set sharpness to low
- turn off view transitions
- turn off glow



Improve your model

Beware of massive multibodies

An easy assumption to make is that saving a large assembly as a single part will make it perform faster, since part files won't be distributed across a network. But assemblies have special abilities to re-use information that multibody parts do not. If you have one part with 100 occurrences, the assembly recognizes the repetition, and responds accordingly. But a multibody part treats each body occurrence as a different entity, which has a negative impact on performance. There may be other reasons to create multibody parts, but assembly performance should not be one of them.

Costly assembly operations

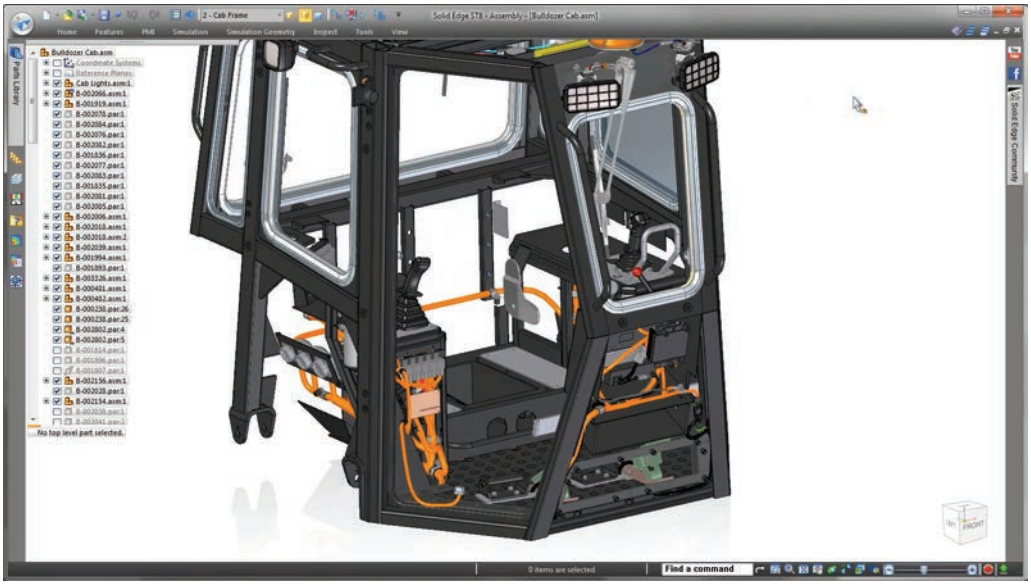
Some things you do in the assembly take up more computational resources than others. Assembly features, for example, require the assembly to make sure the parts are updated, bring the parts into the assembly, position all the parts and then add a feature to the positioned parts, with potential differences between part occurrences. That can really add up.

Interpart relations are also very costly for the same reasons. This is one of the reasons why synchronous parts and assemblies are recommended for better-performing assemblies. You can create relationships between parts in an assembly only when needed, without the associative links.

Consider freezing links when you are done working with an area of an assembly to further improve performance.

Errors

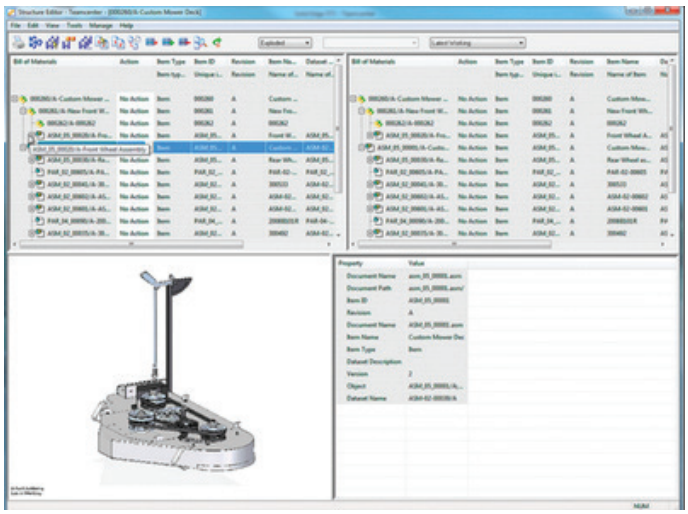
If you have broken links in your assembly, the software is going to spend a lot of time looking for those files. Even broken links in mates, conflicting mates and lost texture files will cause the software to work harder to try to fix the problems. Try to resolve errors as you work instead of allowing them to accumulate. If and when you go back to try to fix the assembly, it is much easier to solve a series of individual small problems rather than try to detangle a layered set of issues.



Take advantage of PDM

Improving the performance of shared files

Another common source of performance problems comes from referencing files stored across a distributed network. The best way avoid performance problems due to networked files is to use a product data management (PDM) system. PDM systems can be more cost-effective than many companies realize, and can result in substantial performance gains.



While the PDM vault is in a central location, when you check files out to use them, they are copied to your local machine. The PDM system can accomplish this in a way that doesn't cause problems with duplication, overwriting or permissions. This gives you the advantage of working on shared files, without the normal disadvantages of sharing files across a network. PDM also helps you avoid complicated rules aimed at avoiding overwriting other users' changes, revision control on solid models and tons of additional and confusing file management problems.

If you're concerned about assembly performance, a simple PDM tool should be a priority.

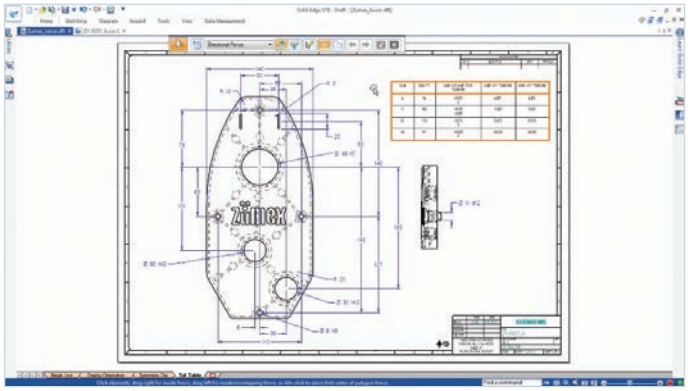
Network speed is a separate infrastructure issue impacting performance - but a PDM solution can greatly improve how your system performs within your existing IT constraints.

Pay attention to your drawings

Avoid interferences and reduce detail

Drawings have a big job when it comes to large assemblies. Multiple views of each assembly, including multiple parts – and potentially cutaway, detail or exploded views – mean that your CAD tool has to manage the display of a lot of different states.

Avoid interferences where possible to keep your drawings performing well. When your solid model has interferences, it causes display issues, which means that your system is spending more time calculating that bad display than it should. Make sure to check for interferences if you see anything amiss in your assembly views.



Detail is great, and enthusiastic new 3D users sometimes get obsessed with how much detail they can create. You can make bolts look very realistic, right down to the grade markings on the head, rounded edges, textures and highly detailed helical threads.

The problem with detail is that it is costly in several ways. First, detail takes a long time to create. Second, it takes a long time to display it every time you need to do so. Too much detail can have a critical impact when it comes to drawing performance. Drawings must calculate every edge, and then decide if they are hidden, shown, grayed out or dashed – for every part, every time it is shown. Excessive detail can make your model look more realistic, but causes performance losses as a result.

Summary

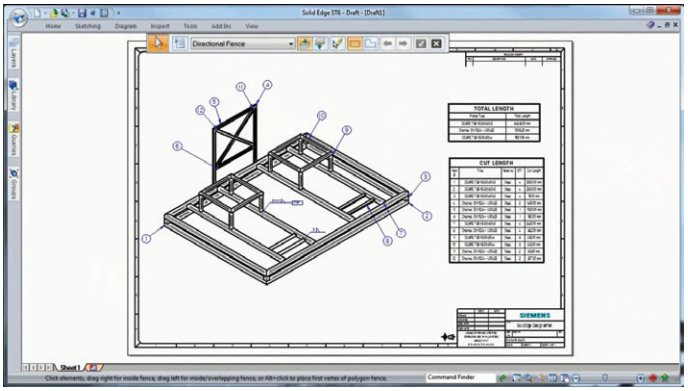
Practice good planning, and consider your purpose

Good performance comes with good planning. Some of the techniques mentioned in this paper might not have as much impact on assemblies with fewer parts, but practicing good habits will prepare you for when a need arises.

Assembly performance isn't all settings and simplification. There is a fair bit of higher-level thinking required to keep a large collection of data light on its feet. File management and link management are important as well.

Part of good planning is keeping the objectives of your work in mind. Each model and associated drawing has a purpose or a set of purposes – whether it is a concept model, inspection drawings or a model that will be used to create a complex injection mold. Once you know the purpose of your assembly, then you can decide how much detail you need.

Practicing these techniques and keeping the purpose of your assembly in mind will help you optimize performance while meeting your goals.



Solid Edge for large assembly creation and management

Good techniques can help improve performance, but they're only half of the equation – without the right tools, your execution will always lag behind. Solid Edge helps users quickly and easily create and manage even the largest assemblies, without lags or crashes. Create an exact representation of all components – including tubes, pipes, wires, weldments and sheet metal – in a complete digital mockup that allows for more accurate design and analysis. Solid Edge helps you quickly detect and fix clash and interference issues, generate assembly instructions, and conduct customer reviews – reducing the need for costly prototypes.

Solid Edge's advanced memory management techniques allow you to quickly create, load and make updates to large assemblies and their associated drawings. Simplification of assemblies, definition of assembly zones, and structure-only navigation free up system memory and allow your graphics display to work more efficiently. With assembly modeling in Solid Edge, you can position complex subassemblies within master assemblies, and switch between simplified and detail views at will, without any waiting.

For more information on Solid Edge for assembly modeling, visit www.siemens.com/plm/assemblies

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