

LEADER OF THE PACK

ANSYS HPC Parametric Pack licensing enables the quick solution of parametric simulations.

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The parametric setup and persistent update capabilities in ANSYS Workbench make it relatively easy to transition from one-off analyses to full parametric studies. The greatest obstacle to innovation then becomes the time required to run all the design points. One way to reduce that time is to solve multiple design points simultaneously. This simultaneous solve (first available in ANSYS 14.0) brought significant speedup over sequential execution, but each component checked out its own license. To update “n” design points simultaneously, you needed “n” times the licenses, which made running simultaneous design points cost-prohibitive for many ANSYS users. In addition, design points were prone to failure if not enough licenses were available throughout the update process.

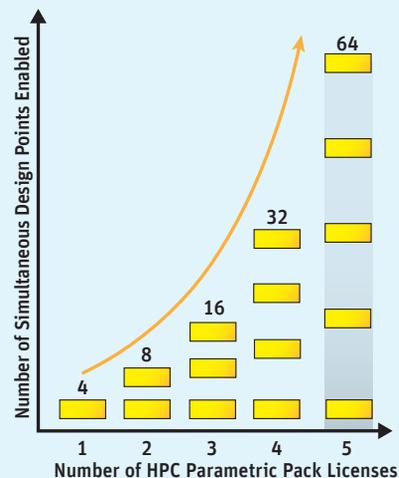
In ANSYS 14.5, enhancements to parametric capabilities, including improved job scheduling, have made it easier to set up and manage parametric studies. The new HPC Parametric Pack licensing at version 14.5 offers a much more affordable and robust solution. This pack HPC solution allows you to run “n” design points simultaneously while drawing on only a single set of base licenses required by the project. The design points can include the execution of multiple products (pre-processing, meshing, solve, HPC, post-processing).

Once you understand how HPC parametric licensing works, you can use it to your advantage. HPC Parametric Pack, licensing requires a series of parametrically varying design points. This licensing cannot be used to run separate models at the same time; instead, it requires that you parameterize your model in ANSYS Workbench and then generate a design-point table with a series of parametric design variants. Fortunately, Workbench makes it relatively easy to parameterize many aspects of your model setup, including material properties, geometric dimensions, mesh controls, loads and boundary conditions.

Workbench makes it relatively easy to parameterize many aspects of your model setup.

Scalable ANSYS HPC Parametric Packs

The HPC Parametric Pack solution is scalable. The first pack allows you to run four design points simultaneously ($2 \times 2^1 = 4$), but each additional pack doubles the number of design points — for example, five packs give you $2 \times 2^5 = 64$ simultaneous runs. Since HPC Parametric Packs also amplify the ANSYS HPC Packs, each simultaneous design point can further take advantage of parallel solver execution. These two dimensions of scalability have the potential to significantly compress execution time.



▲ Scalability of ANSYS HPC Parametric Packs

Even with the ANSYS Workbench advantage, parameterizing a model may still be challenging. If your geometry is not parametric or was badly parameterized in the CAD tool, you can use ANSYS SpaceClaim DirectModeler with its “direct modeling” ability to parameterize or reparameterize any imported geometry. You must also set up the model so that adjusting parameters within the range of interest will not “break” the model by causing the geometry update to fail or by making it difficult for the mesher or solver to converge. Applying best practices, such as clever use of named selections, can make your parametric model more robust. We recommend that you start with only a few parameters and less-complicated models before proceeding to a complex, highly parameterized study.

Once your model is parameterized, you could manually create a table of design points in Workbench to set up different parameter combinations. The design-point table also allows you to cut and paste a predefined design of experiments (DOE) from a third-party tool. If you want more-advanced robust design tools for sensitivity analysis, optimization or six sigma analysis, you could purchase ANSYS DesignXplorer or other third-party design exploration tools.

Step 1: ANSYS HPC Parametric Packs apply only to a model parameterized through the Workbench parameter manager. Once a model is parameterized, a DOE can be imported or created manually, or you can use ANSYS DesignXplorer to create the design points for your project.

HPC parametric licensing is enabled via the remote solve manager (RSM). The RSM already manages the individual jobs and gives you the ability to run design points simultaneously. Conveniently, RSM is also needed to send jobs to remote resources, including commercial job schedulers. ANSYS 14.5 significantly improves the capability, file transfer speed and robustness of RSM. The new wizard makes it much easier to perform setup for your HPC environment.

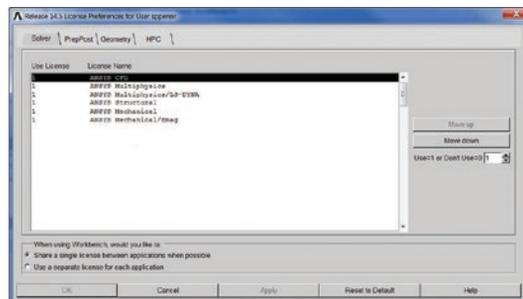
Properties of Schematic: Parameter Set	
A	B
Property	Value
Design Point Update Process	
Update Option	Submit to Remote Solve Manager
Pre-RSM Foreground Update	Geometry
License Checkout	Reserved
Reserved License Set	Select Licenses
Design Point Update Order	Update from Current
Job Submission	Specify Maximum Number of Jobs
Maximum Number of Jobs	4
Component Execution Mode	Parallel
Max Number of Processes Per Job	2
Keep Failed Design Point Files (Beta)	<input type="checkbox"/>
Solve Manager	localhost
Queue	Priority

▲ Remote solve manager setup for simultaneous design points is performed in the parameter set properties.

Step 2: Adjust parameter set properties and switch the Update Option to Submit to Remote Solve Manager. Most users should set Individual Solver Update Options to Run in Foreground to send the entire design-point table to RSM and avoid resubmitting individual solver runs.

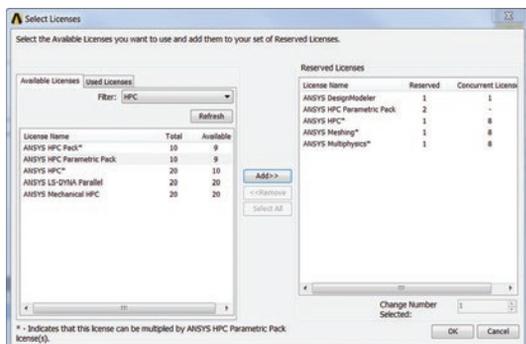
The HPC Parametric Pack actually amplifies a “reserved set” of license keys. It is important to know which keys your project requires; the reserved licensing tools include a Used Keys tab that helps to determine which keys the project needs by showing which keys were used in previous runs. However, some ANSYS products can be enabled by any of a variety of keys. For example, an ANSYS Fluent simulation can use an ANSYS Fluent key or an ANSYS CFD key or an ANSYS Multiphysics key, depending on which is higher on your license preferences list. You can add keys to the reserved set directly from the Used Licenses tab, or you can browse to select your ANSYS CFD key for the reserved license set. ANSYS HPC Parametric Pack keys must be added to the reserved set. Once this is done, you will see the amplification shown in the number of available concurrent licenses. The reserved license set is held for a few minutes to give you a chance to start updating the series of design points. If you don’t do anything, you may need to check if your reserved set is still available. Once you start the update, the reserved set of licenses is held while the series of simulations is running and then automatically released at the end. Holding the set of keys for the duration of the parametric solve prevents others in your workgroup from taking any of the keys you required to complete your parametric simulation.

Applying best practices can make your parametric model more robust. ▶



▲ License preferences determine which keys are drawn first by default, but the reserved set allows you to select the keys you want to use for the project.

Step 3: Adjust parameter set properties to switch the License Checkout to Reserved. You then have the option to Select Licenses to be included in a specific reserved license set.



▲ Select the licenses to be included in a specific reserved license set.

Step 4: Set up the correct reserved licenses and include your HPC keys and HPC parametric keys.

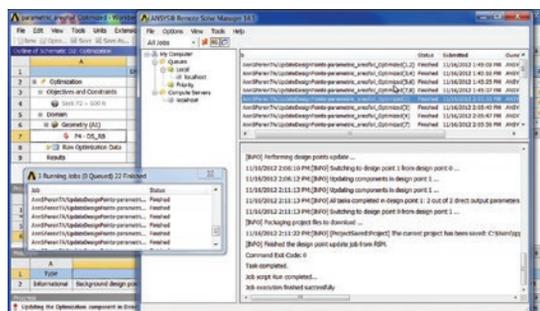
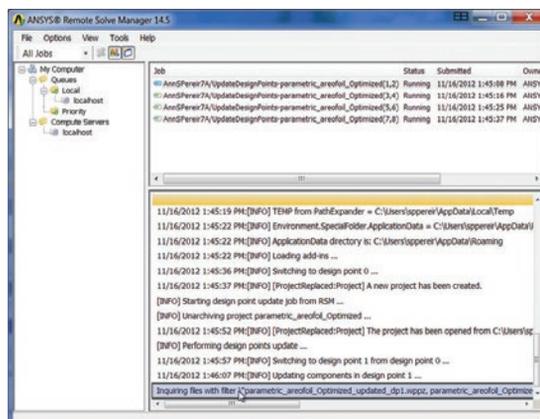
Currently, ANSYS is able only to amplify keys that do not include third-party royalties. Keys for CAD readers, such as the Pro/ENGINEER interface or SpaceClaim, cannot be amplified even though they are used in your project. Similarly, ANSYS DesignModeler, which contains a parasolid kernel under license from a third party, cannot be amplified. When reserving licenses, you can identify keys that will be amplified by the asterisks (*) next to their names.

Because these keys cannot be amplified, the geometry is updated in series as a Pre-RSM Foreground Update before running the meshing and other components in simultaneous mode. This also helps in cases in which CAD interfaces may not be licensed, installed or available on the remote computing resource, and it ensures that all the geometry updates are feasible upfront.

Even so, it is important to include these CAD interface or DesignModeler keys in the reserved license set even if they won't be amplified.

Step 5: Even though keys used for pre-RSM geometry updates are not amplified by HPC Parametric Packs, you must include ANSYS DesignModeler and/or CAD interface keys in the reserved license set. These keys are used upfront during the Pre-RSM Foreground Update.

The remaining process is the same as using RSM without HPC Parametric Packs. Always save your project before submitting to RSM because the process requires the saved files to run in batch mode. If you forget, your hardware reminds you. Once the update is running, you can monitor the progress through the applicable window in Workbench. The first feedback you see is the Pre-RSM Foreground Update that generates all the geometry files in serial. Once RSM starts, a simple RSM queue is shown, somewhat like a printer queue. You can launch the RSM utility to give you much more detail for each job and to follow messages that track the progress of each job. When RSM is complete, the reserved license set is automatically released along with the new ANSYS HPC Parametric Pack keys. ▲



▲ RSM allows you to monitor the jobs and diagnose any problems that arise both early (top) and later in the run (bottom).

Using Other Design Exploration Tools

Using ANSYS HPC Parametric Packs with a third-party design exploration tool requires that the tools be Workbench integrated, drive parametric updates via the Workbench parametric set, and execute the design points through ANSYS RSM. At time of writing, optiSlang from Dynardo GmbH has been confirmed compatible with ANSYS HPC Parametric Packs, and other optimization partners are working on this functionality.