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Chapter 1   Introduction

The LightTools Distributed Simulation Module allows you to distribute a simulation over multiple computers. To accomplish this, all interactive operations a user performs on a controller computer, such as opening files, modifying models, analyzing data, are duplicated on computers running worker sessions of LightTools. (See Terminology on page 2 for descriptions of the distributed simulation terminology.) The state of the model is constantly synchronized with each of the workers. During a simulation, each worker traces a portion of the total rays. The rays are assumed to be indep

Terminology

The following terms are used describe how the Distributed Simulation Module works.

- Distributed simulation – A process that uses multiple computers to perform a Monte Carlo ray trace of an optical model.

- Controller – An interactive session of LightTools the user interacts with to perform modeling, simulation, and analysis.

- Host - A computer on which one or more worker sessions of LightTools run.

- Worker – A session of LightTools that performs a portion of the simulation,

Assumptions

The following assumptions are made during for a distributed simulation process.

- The system is based on the Intel Message Passing Interface (MPI).

- The controller and workers have a common version of MPI installed.

- The controller and workers have a common version of LightTools installed.

- The controller and workers are on the same subnet of a single domain.

- Continuous load balancing is updated after each simulation to test the ray trace speed of each worker. The fraction of the simulation rays sent to each worker is based on the previous simulation. It is suggested that you start a distributed simulation with a small number of rays to initiate the load balancing and then perform a larger simulation to balance the performance of the selected workers.

- Each worker is able to access a common LightTools system (.lts) model and any required external files with the controller through a universal naming convention (UNC) shared folder.

- The operation requires a floating license. The controller checks out the typical licenses needed for the model, and each worker checks out a worker license from a pool of Distributed Simulation Module licenses.

- Each worker session is licensed for use to 16 CPU threads; to use all the cores to achieve optimal performance on a 48-core host, three distributed simulation instances of LightTools are needed for three instances of the workers to run on the workstation, each requiring its own license.

- When a simulation includes a large set of rays, exporting receiver rays and saving the model with ray data can require an extensive amount of time.

- The Glass Map is not supported.

- The LightTools SOLIDWORKS Link Module is not supported.

- Ray data can be saved during a distributed simulation but can be opened only when running in single simulation mode upon restoring the .lts file.

- External utility programs may lose synchronization depending on the API functions they call.

- LightTools utilities should connect only to the controller, not the workers.

- The UDVS Logger (which is currently single-threaded) is not supported.

- Support for user-defined optical properties (UDOPs), and other user-defined DLL components is limited to "well-behaved" DLLs; some implementations may cause LightTools to hang.

For details about installing LightTools, see the *LightTools Installation Guide*, which is available to download on SolvNetPlus and the Synopsys website (https:// www.synopsys.com/optical-solutions/support/support-install-lic-overview.html)

Installing MPI

You must install MPI on the controller and all worker host computers. The MPI executable is provided on the SolvNetPlus website on the same Downloads page as the product software.

1. Navigate to the folder where the file w_mpi-rt_p_2018.2.185.exe is located.

2. Double-click the file w_mpi-rt_p_2018.2.185.exe and follow the prompts, accepting the default settings.

3. Open a Windows command prompt as administrator.

4. Enter the command:

    hydra_service -install

5. Run MPI by entering the following command in the command prompt.

    mpiexec -n 2 hostname.exe

   When prompted, enter your user name and Windows password. (See *How to Make MPI Remember Your Credentials* on page 8.

   If the setup is correct, the name of your computer id displayed twice as output.
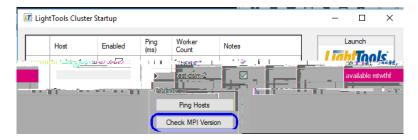
How to Make MPI Remember Your Credentials

You can register your username and password with MPI so you don't have to enter it every time you run LightTools. This information is stored in the registry as encrypted data.

1. From a command prompt, enter:

    mpiexec -register

2. Enter the domain and username (e.g., DOMAIN\username)

3. Enter your Windows password, and confirm it.

Querying the MPI Version

To query the MPI component installed on the controller, click the Check MPI

The MPI version number is displayed in the message window.

Chapter 3   Starting and Stopping a LightTools Distributed Simulation

To run a distributed simulation, you first define the location of the LightTools executable, controller, workers, and some command options.You can do this using the LightTools Cluster Startup dialog box or from a command prompt, as described in the following procedures.

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Starting a Distri buted Simulation

Follow these steps to open the LightTools Cluster Startup dialog box and define and start a distributed simulation session.This dialog box provides a table for specifying hosts and workers, options for specifying controller inputs, diagnostic tools, and a message window.

1. Click the Windows Start menu and select LightTools > Start Distributed Simulation.

    The LightTools Cluster Startup dialog box is displayed, shown in the following figure.

2. Specify the hosts and workers in the table at the top of the dialog box.

To specify the workers, you provide a host name and a worker count. You can also control which host is enabled and add notes. The columns for specifying workers are:

– Host: Enter the host name or IP address of the computer on which one or more worker sessions will run. To delete a host, select the row and press the Delete key.

–   Enabled: Indicates whether or not the workers on this host participate in a distributed simulation. This option is turned on (checked) when you add a host to the list. You can turn it on or off to select a subset of known hosts to participant in the simulation.

–   Ping (ms): This is not an input field. This field displays the results when you click the Ping Hosts button in the Diagnostics section of the dialog box to test the availability of hosts. It shows the time used to connect to each host (in milliseconds); if the host cannot be found, it displays the status failed, which indicates that you can disable it for the next simulation.

–   Worker Count: Controls the number of worker sessions that will run on the host. By default, one session will run, but you can enter a value to increase this e

3. Specify controller inputs.

Below the table of hosts and workers is a section for defining controller-related inputs for the simulations.

– Network Path to lt.exe: The distributed simulation is designed to share the same version of Lig e

– Additional Arguments to lt.exe: Allows you to enter command line options to use when LightTools starts.

4. Verify that the hosts are availa

Depending on the results of the host verification, you can enable or disable hosts for the distributed simulation.

5. When you are ready to open a model for the distributed simulation, click the Launch LightTools button.

When you start a simulation, the process is distributed according to the parameters specified in the LightTools Cluster Setup dialog box. The process generates the

The entry should look something like:

```
%SystemRoot%\system32\csrss.exe ObjectDirectory=\Windows
SharedSection=1024,20480,768 Windows=On SubSystemType=Windows
ServerDll=basesrv,1
ServerDll=winsrv:UserServerDllInitialization,3
ServerDll=winsrv:ConServerDllInitialization,2
ServerDll=sxssrv,4 ProfileControl=Off MaxRequestThreads=16
```

The third number in SharedSection controls the size of Desktop Heap Memory for non-interactive sessions. Increase this value to 8192 or greater. After changing this registry value, reboot.

Stopping a Distributed Simulation

If LightTools becomes unresponsive, you can terminate the distributed process using the following options in the LightTools Cluster Startup dialog box.

- Kill Launched Process Terminates the last command issued when a problem is encountered; for example, if you click

Troubleshooting

- pmi_proxy not found   error - If you try to run a cluster and get the error pmi_proxy not found on <host>. Set Intel MPI environment variables, it may be because your computer or the host computer has an environment problem.

  – mpiexec -V shows the version. Use this to verify that the same version is installed on all hosts.

  – Problems may be resolved by uninstalling and reinstalling MPI.

- MPI installation should add mpiexec