

Distributed Computing in Thermal Flow

CPS

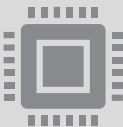
Mar 23, 2023



Overview



- 1. To solve the Increased product complexity, Tighter quality requirement and Higher productivity indexes.***
- 2. HPC is a vital tool for many industries, enabling organizations to tackle complex computational tasks that would otherwise be impossible.***



- 1. In HPC, you can run a solution over multiple cores on a single machine or on multiple machines.***
- 2. HPC mode automatically decomposes the computational workload into smaller domains, transfers the domains to each core, solves each domain simultaneously, and creates a complete solution to the model.***



- 1. In RHSC-ET, user can set Passwordless SSH to run distributed analysis.***
- 2. In RHSC, user can leverage works from SC platform for HPC in thermal simulation.***

Work Flow in RHSC-ET

- User can input the name of the HPC server and the number of CPU cores to be allocated in the table or provide a file in txt format.
- User need to ensure that the host can make a passwordless SSH connection with each HPC server. And completely same structure on all machines*(same type, OS level, chip set, and Interconnects, same MPI installed).
- For the input cores numbers, if it exceeds the total cores, tool will provide warning message and adjust the core to the total cores.

The main software interface has tabs for Model, Assembly, and Simulation. The Simulation tab is active, showing a table of properties and values. The Analysis Settings section is expanded, showing options for Boundary Condition, General Setup, and Advanced. The General Setup option is highlighted with a red box. Below the table, there are buttons for Simulation and Simulation log. At the bottom, there are buttons for 3D PostProcessing, Transient Simulation Result, Thermal Profile View, and HTML Report.

Property	Value
Simulation ...	
Solver	MAPDL
Multiphysics Type	Thermal
Simulation Type	Static
Analysis Settings	
Boundary Condition	Edit...
General Setup	Edit...
Advanced	Edit...
Mesh Settings	
General Mesh	Edit...
Mesh Refinement ...	Edit...
Advanced Mesh	Edit...
Detail Run	
	Edit...

The Analysis Settings - General Setup dialog box is shown. It has a table of properties and values. The Distributed Analysis... option is highlighted with a red box. Below the table, there are buttons for Tech File, Sub Modeling, and Compact Model. A Close button is at the bottom right.

Property	Value
Performance	
Solver Type	Auto
Cores[1~63]	63
Distributed Analys...	Edit...
Convergence	
Power Ratio	0.05
Max Iteration	10
Temperature Diff(C)	0.1
Modularization	
Tech File	Edit...
Sub Modeling	Edit...
Compact Model	Edit...

The Distributed Analysis Settings dialog box is shown. It has options for Distributed Analysis Enabled, Create Config File, and Import Config File. A table of servers and cores is shown. The first server, sjord45, is highlighted with a red box. A yellow callout box points to the first server with the text: "The first sever should be the main server(Invoke ET GUI).".

☒ Distributed Analysis Enabled

☒ Create Config File

+ -

	Server	Cores
1	sjord45	10
2	sjord46	10

☐ Import Config File

Choose one Distributed Analysis config file

OK Cancel

The first sever should be the main server(Invoke ET GUI).

How to Setup Passwordless SSH Login

1. Check for existing SSH key pair

```
ls -al ~/.ssh/id_*.pub
```

If there is id_*.pub, ssh, please backup up the old keys and generate a new one.

2. Generate a new SSH key pair (cd ~/.ssh/)

```
ssh-keygen -t rsa -b 4096 -C your_email@domain.com
```

Example

```
ssh-keygen -t rsa -b 4096 -C "qinglian.li@ansys.com"
```

output

```
/home/yourusername/.ssh/id_rsa
```

```
/home/yourusername/.ssh/id_rsa.pub
```

3. Copy the public key

```
ssh-copy-id remote_username@server_ip_address
```

Example

```
ssh-copy-id qli@sjocpsqa2.ansys.com
```

```
ssh-copy-id qli@sjocpspe1.ansys.com
```

```
[qli@sjocpsqa1 /home/qli/.ssh]$ rm -rf id_rsa.pub id_rsa
[qli@sjocpsqa1 /home/qli/.ssh]$ ssh-keygen -t rsa -b 4096 -C "qinglian.li@ansys.com"
Generating public/private rsa key pair.
Enter file in which to save the key (/home/qli/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/qli/.ssh/id_rsa.
Your public key has been saved in /home/qli/.ssh/id_rsa.pub.
```

Output

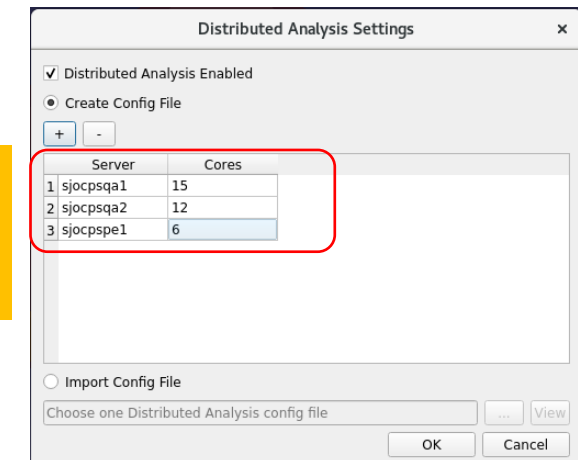
```
6 22:57 id_rsa
6 22:57 id_rsa.pub
6 22:47 known hosts
```

```
[qli@sjocpsqa1 /home/qli/.ssh]$ ssh-copy-id qli@sjocpsqa2.ansys.com
/bin/ssh-copy-id: INFO: Source of key(s) to be installed: "/home/qli/.ssh/id_rsa.pub"
/bin/ssh-copy-id: INFO: attempting to log in with the new key(s), to filter out any that are already installed
/bin/ssh-copy-id: INFO: 1 key(s) remain to be installed -- if you are prompted now it is to install the new keys
qli@sjocpsqa2.ansys.com's password:

Number of key(s) added: 1

Now try logging into the machine, with: "ssh 'qli@sjocpsqa2.ansys.com'"
and check to make sure that only the key(s) you wanted were added.
```

The first sever should be the current login server(Invoke ET GUI).



Work Flow in RHSC

- Only batch mode support now, Passwordless SSH connection before users launch SSH workers in RHSC
- First set the environment variables and SSH launcher.
- Update the command `package_thermal_view` for thermal simulation.

```
from thpkgs_internal import cps
include('../common_settings.py')
include('../scripts/qa_util.py')

central_dir_data = qa_util_cust_data_root + '/rhsc_et/COWOS_STAR'
os.environ['cps_data_path_env']=central_dir_data
os.environ['cps_working_path_env']=gp.cm_get_work_dir_name()
cta_tcl_file = '../design data/cps/test case.tcl'

ll = create_ssh_launcher('ssh_launcher', ['sjord44', 'sjord46'])
ll.launch(12)

options = get_default_options()
```

1. Set design data path

2. Set SSH launcher

3. Enable the HPC in `package_thermal_view`

```
ptv=db.create_package_thermal_view(None, cta_tcl_file, tag='ptv', central_dir=central_dir,
central_dir_new=central_dir_new, hpc_mode=True)
```

- `central_dir` : environment variable in tcl scripts, the path is for design data.
- `central_dir_new` : environment variable in tcl scripts, the path is for working directory.
- `hpc_mode` : enable hpc mode or not, default is False.

 **Ansys**

