Chapter 6 - OpenROAD GUI

Course authors (Git file)

Section 1

Analysing desings with the GUI

View layout

Viewing Layout Results

The `make gui_final` command target successively reads and loads the technology `.odb` files and the parasitics and invokes the GUI in these steps:

- Reads and loads `.odb` files.
- Loads `.spef` (parasitics).

The figure below shows the post-routed DEF for the `ibex` design.

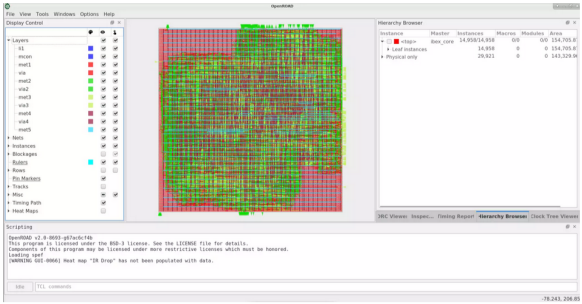


Figure 1: View layout

View objects

Visualizing Design Objects And Connectivity

Note the `Display Control` window on the LHS that shows buttons for color, visibility and selection options for various design objects: Layers, Nets, Instances, Blockages, Heatmaps, etc.

The Inspector window on the RHS allows users to inspect details of selected design objects and the timing report.

Try selectively displaying (show/hide) various design objects through the display control window and observing their impact on the display.

Figure 2: View objects

Clock tree

Tracing The Clock Tree

View the synthesized clock tree for `ibex` design:

- From the top Toolbar Click `Windows` -> `Clock Tree Viewer`

Figure 3: Clock tree

Heat maps

Using Heat Maps

From the Menu Bar, Click on `Tools` -> `Heat Maps` -> `Placement Density` to view congestion selectively on vertical and horizontal layers.

Expand `Heat Maps` -> `Placement Density` from the Display Control window available on LHS of OpenROAD GUI.

View congestion on all layers between 50-100%:

In the `Placement density` setup pop-up window, Select `Minimum` -> `50.00%` `Maximum` -> `100.00%`

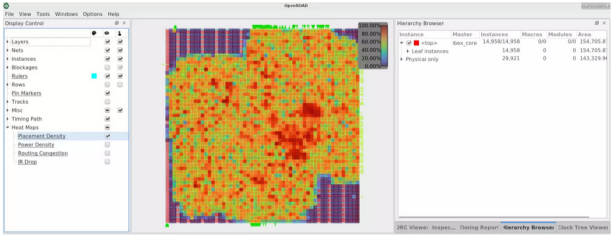


Figure 4: Heat maps

Timing report

Viewing Timing Report

Click `Timing` -> `Options` to view and traverse specific timing paths. From Toolbar, click on the `Timing` icon, View `Timing Report` window added at the right side (RHS) of GUI as shown below.

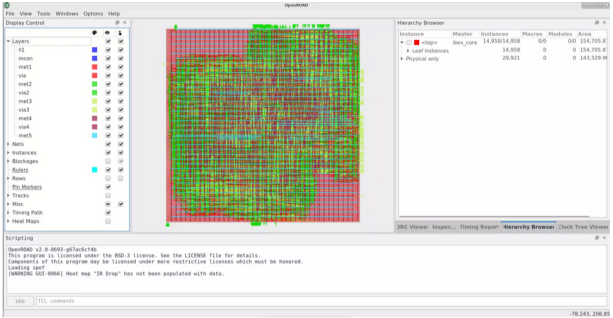


Figure 5: Timing report

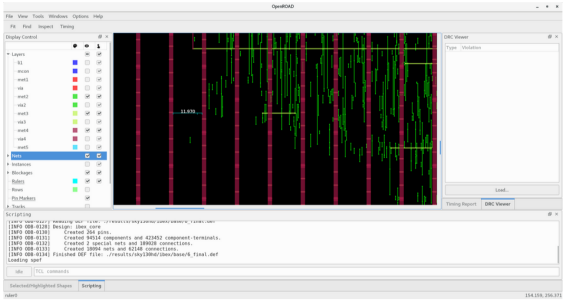
Rulers (measure distances)

Using Rulers

A ruler can measure the distance between any two objects in the design or metal layer length and width to be measured, etc.

Example of how to measure the distance between VDD and VSS power grid click on:

`Tools` -> `Ruler K`



Distance between VDD and VSS layer is `11.970`

Figure 6: Rulers

TCL command interface

Tcl Command Interface

Execute OpenROAD-flow-scripts Tcl commands from the GUI. Type `help` to view Tcl Commands available. In OpenROAD GUI, at the bottom, `TCL commands` executable space is available to run the commands. For example

View `design area` in the `Tcl Commands` section of the GUI:

```
report_design_area
```

Try the below timing report commands to view timing results interactively:

```
report_wns
report_tns
report_worst_slack
```

Figure 7: TCL interface

Area report

Area

View design area and its core utilization:

```
make gui_final
```

In the `Tcl Commands` section:

```
report_design_area
```

View the resulting area as:

```
Design area 191262 u^2 30% utilization.
```

Figure 8: Area report

Timing slack report

Timing

Users can view flow results using the command interface from the shell or the OpenROAD GUI to visualize further and debug. Learn more about the GUI.

```
make gui_final
```

Use the following commands in the `Tcl Commands` section of GUI:

```
report_worst_slack
report_tns
report_wns
```

Note the worst slack, total negative slack and worst negative slack:

```
worst slack -0.99
tns -1.29
wns -0.99
```

Figure 9: Timing slack report

Power report

Power

Use the report command to view individual power components i.e. sequential, combinational, macro and power consumed by I/O pads.

In the `Tcl Commands` section:

```
report_power
```

The power output is as follows:

```
---------------------------------------------------------------------------
Group                  Internal  Switching    Leakage      Total
                          Power      Power      Power      Power
---------------------------------------------------------------------------
Sequential             5.58e-03   6.12e-04   1.67e-08   6.19e-03  19.0%
Combinational          9.23e-03   1.71e-02   4.90e-08   2.63e-02  81.0%
Macro                  0.00e+00   0.00e+00   0.00e+00   0.00e+00   0.0%
Pad                    0.00e+00   0.00e+00   0.00e+00   0.00e+00   0.0%
---------------------------------------------------------------------------
Total                  1.48e-02   1.77e-02   6.57e-08   3.25e-02 100.0%
                          45.6%      54.4%       0.0%
```

Figure 10: Power report