Lab 5 Temperature observation

I. Purpose

In this Lab, you will learn how to observe the thermal distribution in each simulation. Hope you will enjoy using our tool!

II. Introduction

● Unidirectional Coupling and Mutual Coupling [1]

As mentioned before, the tile geometry and power model are based on Intel's 80-core chip in our co-simulator. During network traffic simulation, a power trace is generated based on the power model of the NoC. The power trace and physical floorplan are used as inputs of the thermal simulation. The straightforward simulation approach is the unidirectional-coupling simulation: HotSpot runs after Noxim finishes, as shown in Figure 1(a). Unidirectional-coupling simulation gathers the entire temporal and spatial power trace of the chip from Noxim, and then computes the transient temperatures and the steady temperatures in HotSpot. The problem of unidirectional-coupling simulation is that network simulator cannot get any temperature information before thermal simulation. The overall temperature trace from tstart to tfinish is computed after the network simulator generates the overall traffic and power traces from tstart to tfinish. Therefore, unidirectional-coupling simulation cannot be used for verifying thermal-aware designs or dynamic thermal management techniques for 3D NoC.

The mutual-coupling co-simulation scheme has to be incorporated for verifying thermal-aware design or dynamic thermal management techniques. The change of workload on NoC instantly effects the following small period power distribution and traces of the network, and consequently the following small period of temperature distribution and traces. The network simulator computes a period of traffic and converts it to a power trace. The period is usually set from 10^{-4} to 10^{-2} second. The transition temperatures are computed right after simulations of the short period network traffic. Figure 1(b) shows the mutual-coupling co-simulation scheme. We begin the integration at program level, and use Noxim as caller to call the program interface of HotSpot to feed, compute, and feed back the temperature for each small period of time. HotSpot takes the architecture-level temperature distribution as the input for initial condition, and uses

the small period of the architecture-level power trace P and the chip floorplan as inputs to generate the short-term architecture-level thermal profile T. The overall simulation forms a looped mutual coupling between Noxim and HotSpot.

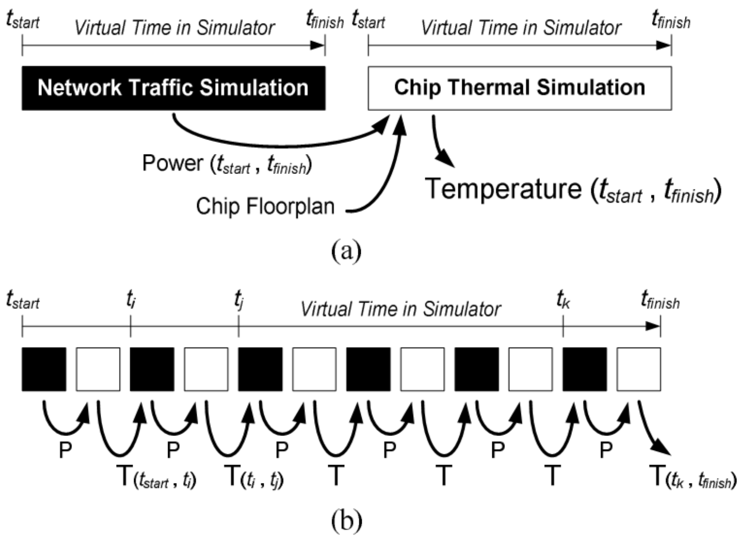

Figure 1 Simulation for NoC traffic and temperature: (a) unidirectional coupling and (b) mutual coupling.

III. Procedure

1. Execute a single simulation

```
% cd <INSTALL DIRECTORY>/bin
% noxim -pir 0.02 poisson -sim 50000 -warmup 10000 -size 2 10 -buffer 8
-traffic random -routing xyz -dimx 8 -dimy 8 -dimz 4
```

2. Open the log file of temperature
   a. All temperature log file is store in the <INSTALL DIRECTORY>/results/TEMP
   b. In this directory, files which prefixed “TEMP” contain all temperature information of router, process element and memory. Open the TEMP- file and observe it.

```
% vim results/TEMP/TEMP_routing-0_sel-0_pir-0.020000_traffic-0.txt
```

   c. The file format is hard for us to read and observe, try to open the file which prefixed “Router”. Those files logs only the router temperature. Copy the whole text and then paste it to the Matlab. The temperature of the routers will automatically plot and save.
   d. You may adjust the range of color bar and customize the colormap property. The figure should like the figure 2.

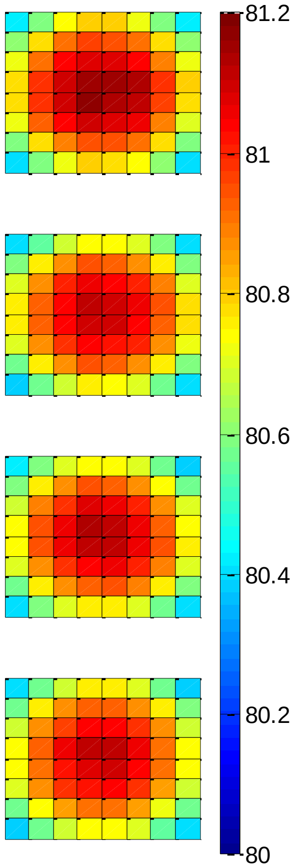

Figure 2 The temperautre

IV. Problems

Please plot the temperature distribution with the setting below:

- Traffic: random, transpose1
- Routing: XY,west-first
- Selection: random
- Packet size = [2 10],Buffer size = 8
- Simulation time:50000
- Warm-up time:10000

V. References

[1] Kai-Yuan Jheng, Chih-Hao Chao, Hao-Yu Wang, and An-Yeu Wu, "Traffic-thermal mutual-coupling co-simulation platform for three-dimensional Network-on-Chip," in Proc. int. Sym. VLSI Design Automation and Test (VLSI-DAT), pp.135-138, April 2010.