

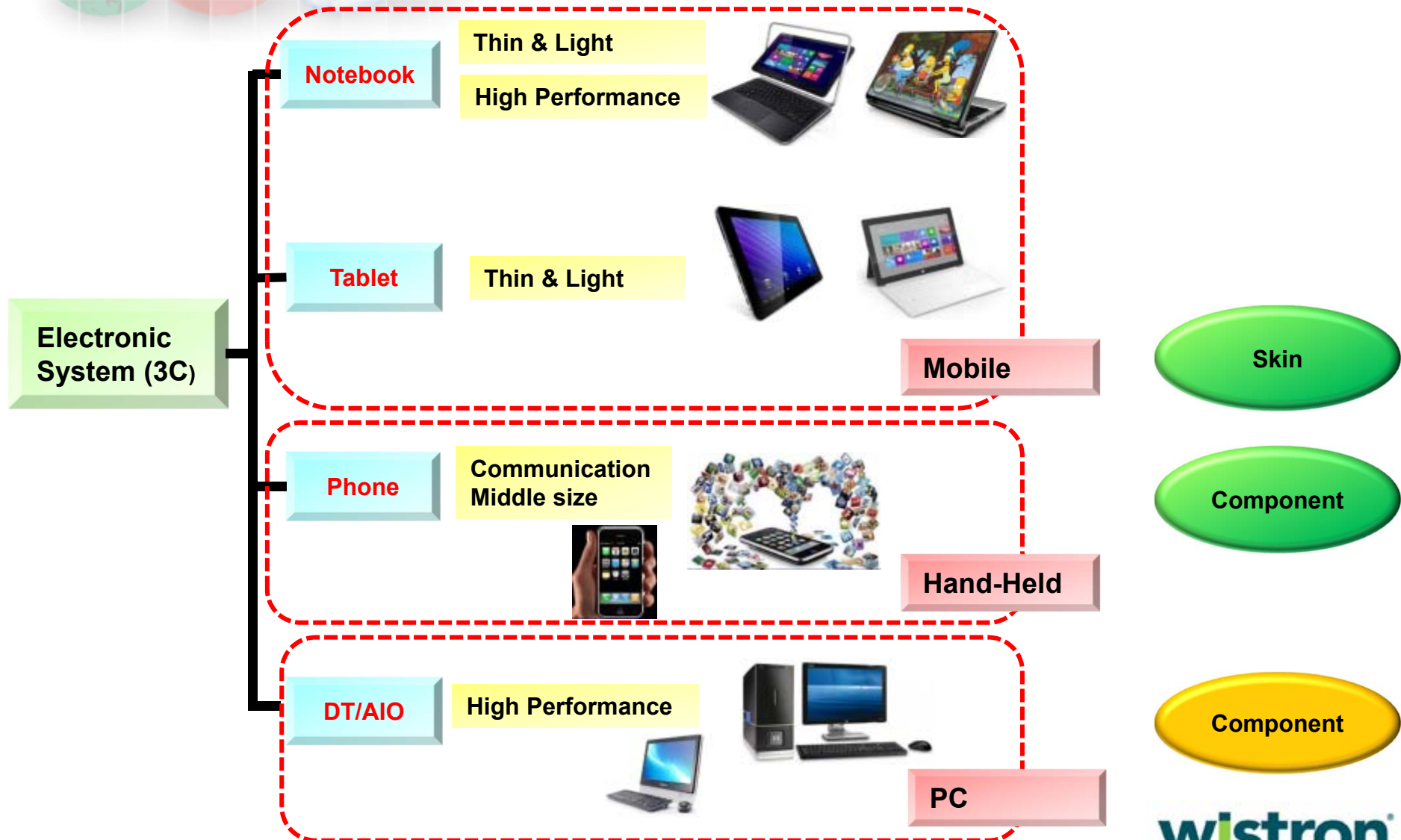
Mentor Graphics U2U user conference

CFD Accuracy Enhancement of Electronic System

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Date : 2014-11-03*

wistron

Product Line



Skin Temperature Accuracy Improvement

Improvement check
(Introduction on last page)

Heat transfer

$$Q_{conduction} = kA(\Delta T/\Delta x)$$

- W, K

$$Q_{convection} = hA(T_s - T_\infty)$$

- Impedance

$$Q_{radiation} = \epsilon \sigma A(T_s^4 - T_\infty^4)$$

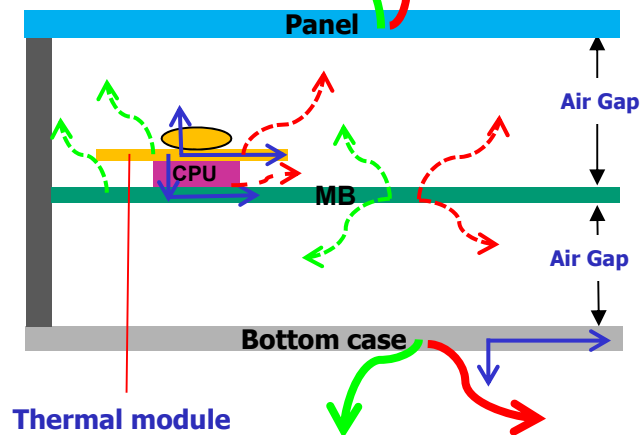
- Emissivity

往系統外熱傳

往系統內熱傳

往系統外熱傳

往系統內熱傳



Skin
Temperature
Accuracy

Library

Database Collection

- NB/DT/AIO/Tablet.
- Parts parameters (W, K)

System Impedance

Calibration & fine-tune

- Flow resistance study.
- P-Q calibration.
- Add extra flow resistance.
- Opening calibration.

Radiation

Study & ϵ collection

- NB/DT/AIO/Table
- Collect ϵ

Mesh Quality

Study & SOP

- Setting for boundary layer.
- Optimum between Accuracy & Solving time.

Library Collection(I)

[-] Wistron Library 20140923

[+] DT_AIO_RPOS
[-] Notebook Library
[-] Tablet Library

[-] DT_AIO_RPOS
[+] CPU
[+] HDD
[+] MB
[+] Memory
[+] PCH
[+] PSU

[+] Notebook Library
[+] CPU
[+] Camera
[+] GPU
[+] HDD
[+] MB
[+] Memory
[+] Mini PCI Card
[+] North Bridge
[+] PCH
[+] Second Part
[+] South Bridge
[+] System resistance
[+] Thermal Module



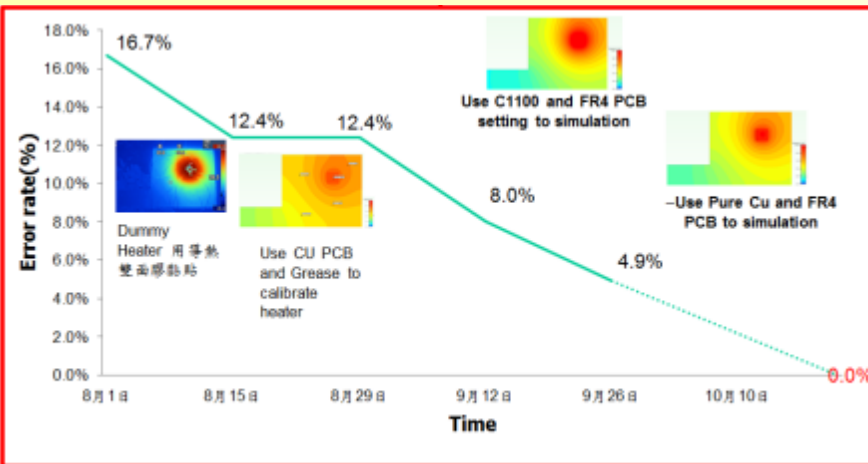
[-] Tablet Library
[+] CPU
[+] EE component
[+] External Card
[+] LCD
[+] MB



Library Collection(II)

PCB

1. The temperature distribution of MB will impact distribution of skin temperature.
2. Estimated Kz from Theory & Experiment(Follow ASTM 5470測試規範)



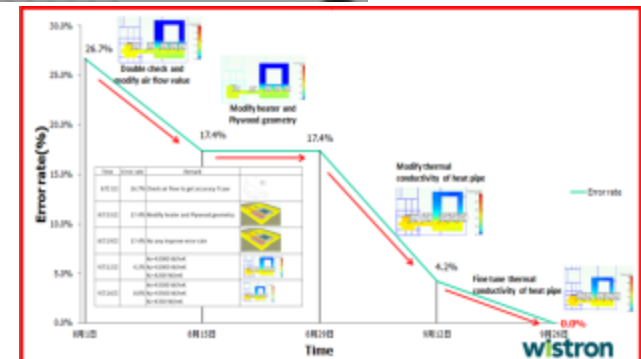
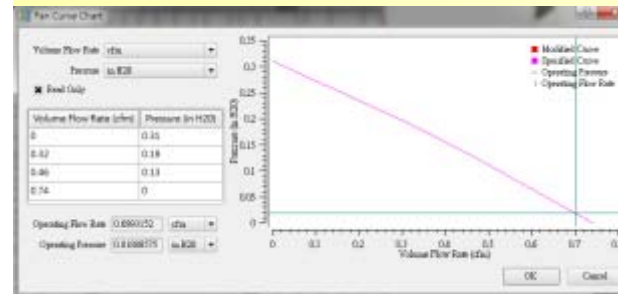
Error rate decrease from 16.7% to 4.9%

Thermal Module

Heat-Pipe

Fan PQ

1. Modified PQ Curve in free air condition. (Refer Intel's document)
2. Calibrated conductivity of heat pipe
 - a. The error come from soldering & different structure(Powder/composite/groove)

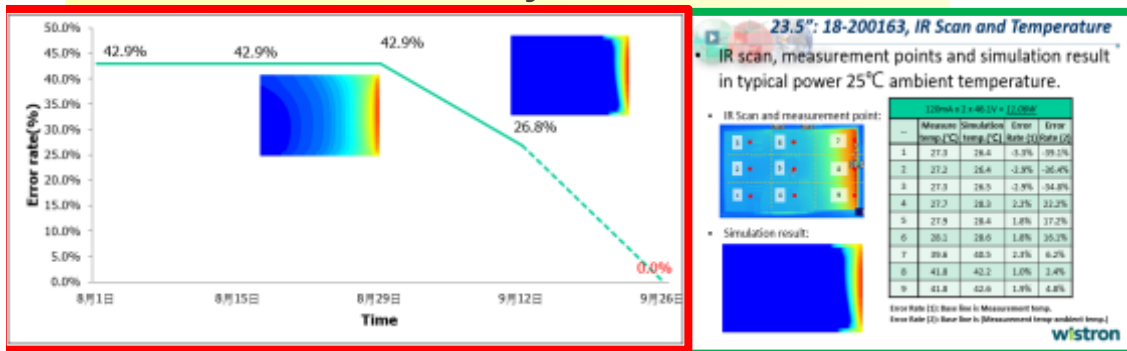


Error rate decrease from 26.7% to 4.2%

Library Collection(III)

Panel

- Decompose
 - confirm Z-stacking of different vendor
 - backlight power & LCD power
- Calibrate conductivity of LCM

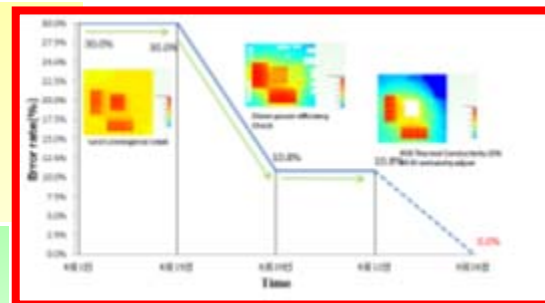


Error rate decrease from 42.9% to 20% (Still on-going)

Memory

- Confirm Input power
 - different vendor & capacity
 - different stacking type
 - UMA/DIS
 - different scenario

Error rate decrease from 30.0% to 10.8% (Still on-going)



Error rate decrease from 25.0% to 5.9%

VRM

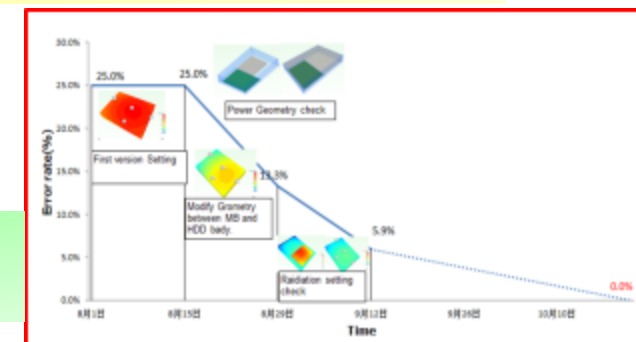
- Decompose
 - Calibrated conductivity of chock/mos
 - Analyzed by "Taguchi-method"



Error rate decrease from 13.8% to 6.9%

HDD

- Confirm Input power
 - different vendor & capacity
 - different scenario
 - UMA/DIS



System Impedance

Negative Pressure

Enclosure
500Wx500Hx600Lmm
Thickness 5mm
No slip Wall, roughness = 0

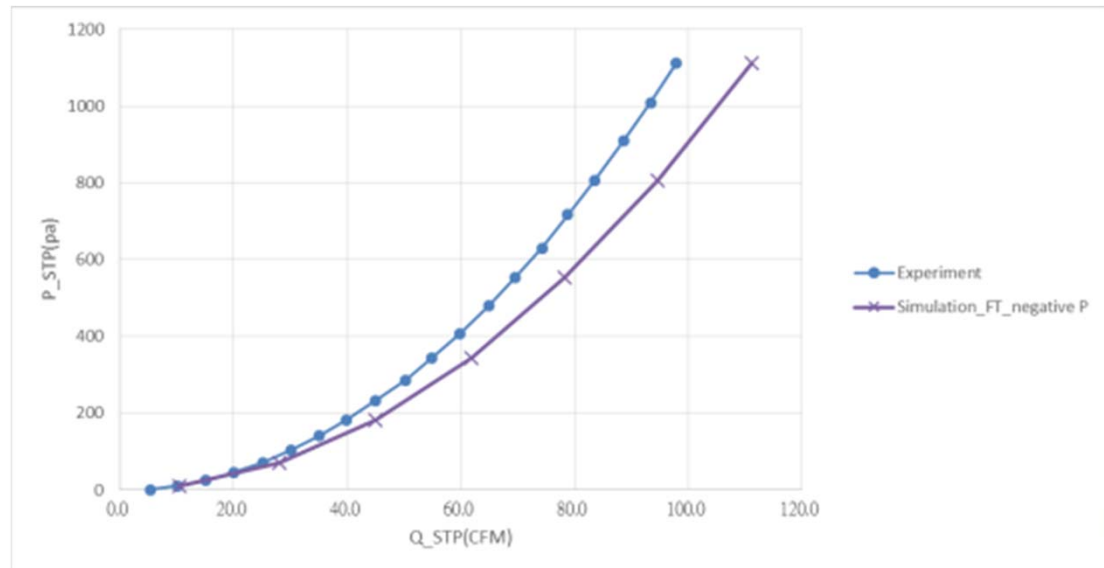
Square Hole
40Wx40Hmm

Environment Pressure
1atm

Solution Domain: 500Wx500Hx1000L mm
Symmetry Boundary set on $\pm Y$ and $\pm X$

Study items:

1. Check Setting of Numerical tunnel
2. Studying outlet vent
3. Studying inlet vent
4. Studying whole thermal module.



Radiation – Calibrate emissivity

★試算表

長度(mm):	90
寬度(mm):	90
表面溫度(degC):	45
環境溫度(degC):	25
熱輻射:	0.8
* 垂直 * 水平朝上 * 水平朝下	
自然對流(W):	0.8518366
熱輻射(W):	0.8997215
確定	
熱對流係數(h):	5.258251
扭距數(Ma):	17.59789
雷利數(Ra_L):	1174463

★試算表

Theory

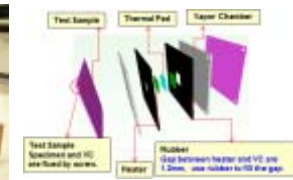
$$Q_{total} = Q_{\cancel{convection}} + Q_{convection} + Q_{radiaion}$$

$$[Q_{rad} = \epsilon \sigma A (T_s^4 - T_a^4)]$$

$$[Q_{conv} = hA(T_s - T_a)]$$

(Ta:室溫 Ts:試片溫度)

理論公式整理成的試算表做分析



由理論公式及概念設計實驗治具

目標
求得未知試片放射率?

分析Convection & Radiation各面熱傳量(Q)
並理論分析結果比較

Numerical(FT)

1. 輸入W, Ta.
2. Tuning ε直到實驗的試片表面溫度與模擬結果一致.

Step2

建立CFD model

Experiment

Step1

【輸入固定功率, 量測試片表面溫度】

$$Q_{total} = \epsilon \sigma A (T_s^4 - T_a^4) + hA(T_s - T_a)$$

★SOP

★Golden model



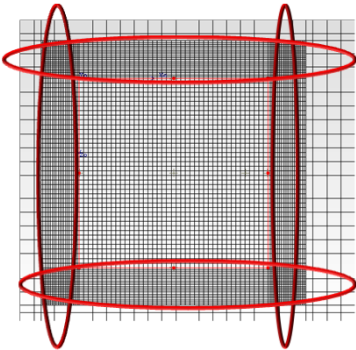
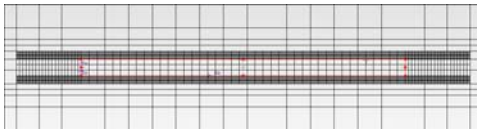
★SOP



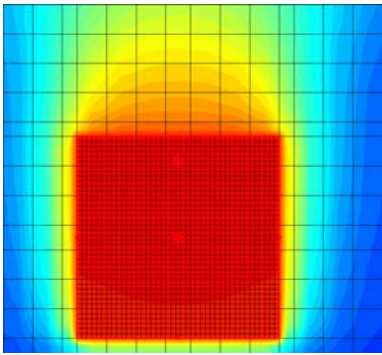
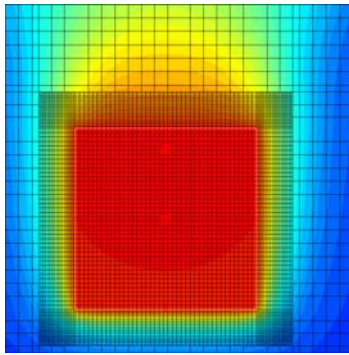
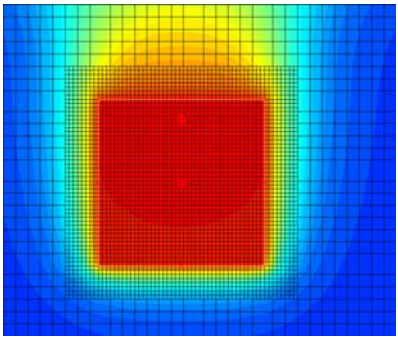
Mesh quality

Mesh quality

It will help to show boundary effect, if make suitable grid setting on boundary of object or heat source.

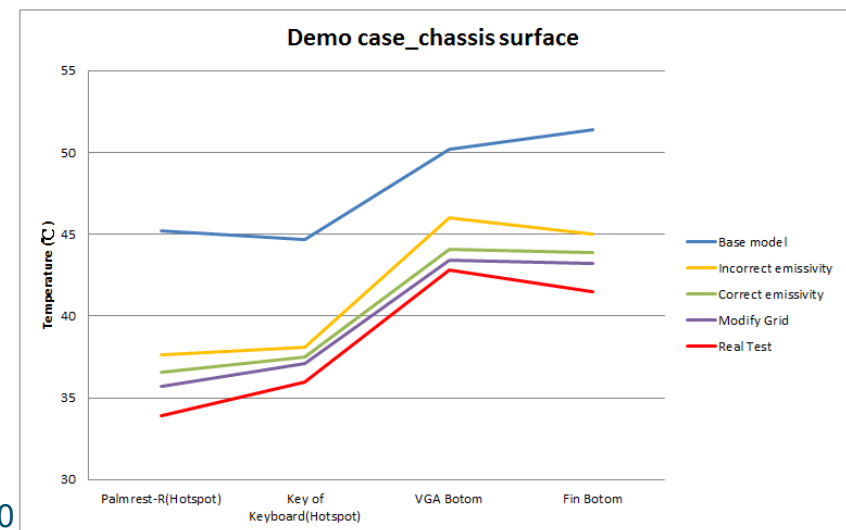
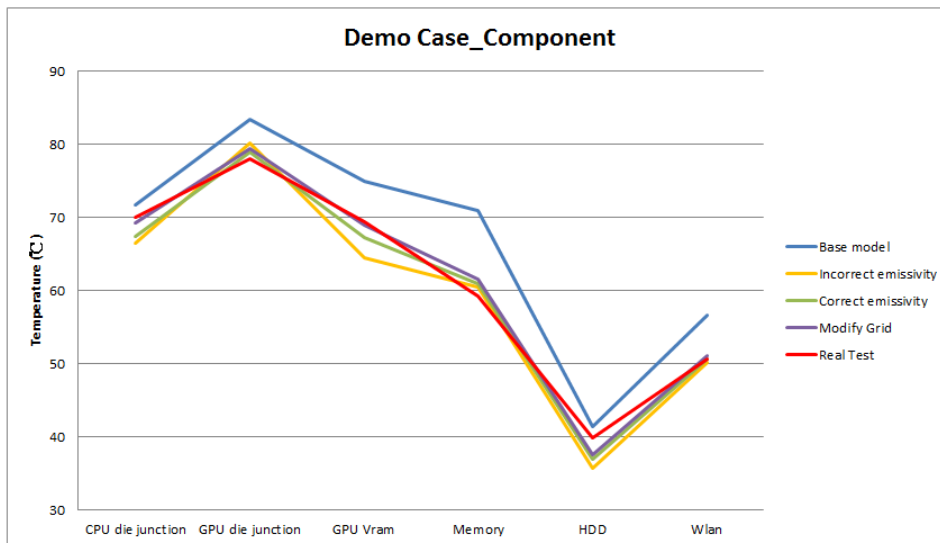


Heater Calibration: Real test=103.6°C

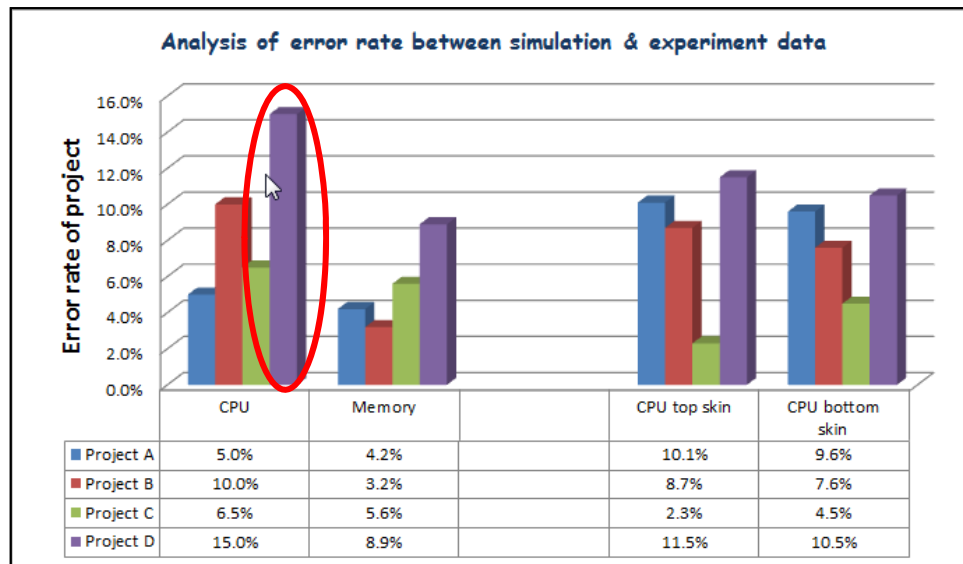
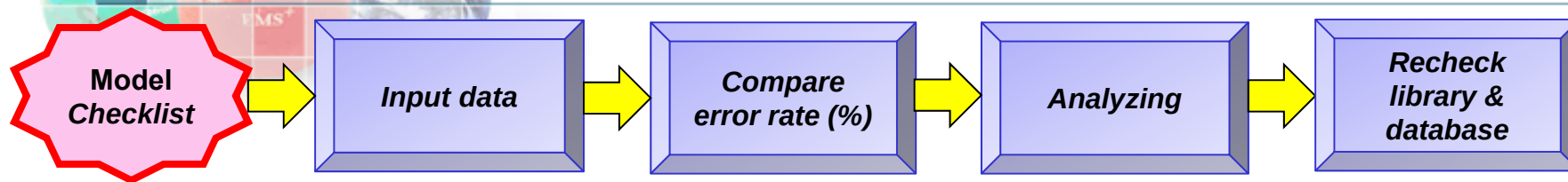
1		2		3	
No boundary mesh	Error rate(%)	Boundary mesh (0.2 mesh size)	Error rate(%)	Boundary mesh (0.5 mesh size)	Error rate(%)
106.2°C	2.5%	103.9°C	0.2%	104.3°C	0.8%
					

Demo Case

		Base model		Incorrect emissivity		Correct emissivity		Modify Grid		Real Test
System Radiation		OFF		ON		ON		ON		-
Power	System total	36.65		36.5		36.65		36.65		36.3
Component	Scenario	3DMark13	Error	3DMark13	Error (%)	3DMark13	Error (%)	3DMark13	Error (%)	
	CPU die junction	71.6	2.3%	66.4	-5.1%	67.4	-3.7%	69.2	-1.1%	70.0
	GPU die junction	83.3	6.8%	80.1	2.7%	78.8	1.0%	79.3	1.7%	78
	GPU Vram	74.9	8.1%	64.4	-7.1%	67.1	-3.2%	68.9	-0.6%	69.3
	Memory	70.8	19.8%	60.4	2.2%	60.9	3.0%	61.5	4.1%	59.1
	HDD	41.3	3.8%	35.7	-10.3%	36.9	-7.3%	37.4	-6.0%	39.8
	Wlan	56.6	12.1%	50.1	-0.8%	50.5	0.0%	51.0	1.0%	50.5
Skin	Palmrest-R(Hotspot)	45.2	33.3%	37.6	10.9%	36.6	8.0%	35.7	5.3%	33.9
	Key of Keyboard(Hotspot)	44.7	24.2%	38.1	5.8%	37.5	4.2%	37.1	3.1%	37.9
	VGA Botom	47.8	17.3%	44.0	7.5%	43.5	3.0%	43.0	1.4%	44.6
	Fin Botom	51.4	23.9%	45.0	8.4%	43.9	5.8%	43.2	4.1%	41.5



Process about improving accuracy



Ex: CPU temp. have larger error rate occurs on project D

Analyzing: CPU (new platform) in project-D & create by CPU spec.

Recheck: According calibration SOP & build new CPU model in library

Parameters (ProjectD)

Keycomponent	Conductivity(k)	Emissivity(ε)	選擇New Create & others請註明
CPU	New create	Library	MTK CPU(create by CPU spec.)
Memory	Library	Library	
UCASE	New create	Database	Specical ID
LCASE	New create	Database	Specical ID

Create new CPU model in library

Refer to "Calibration SOP"