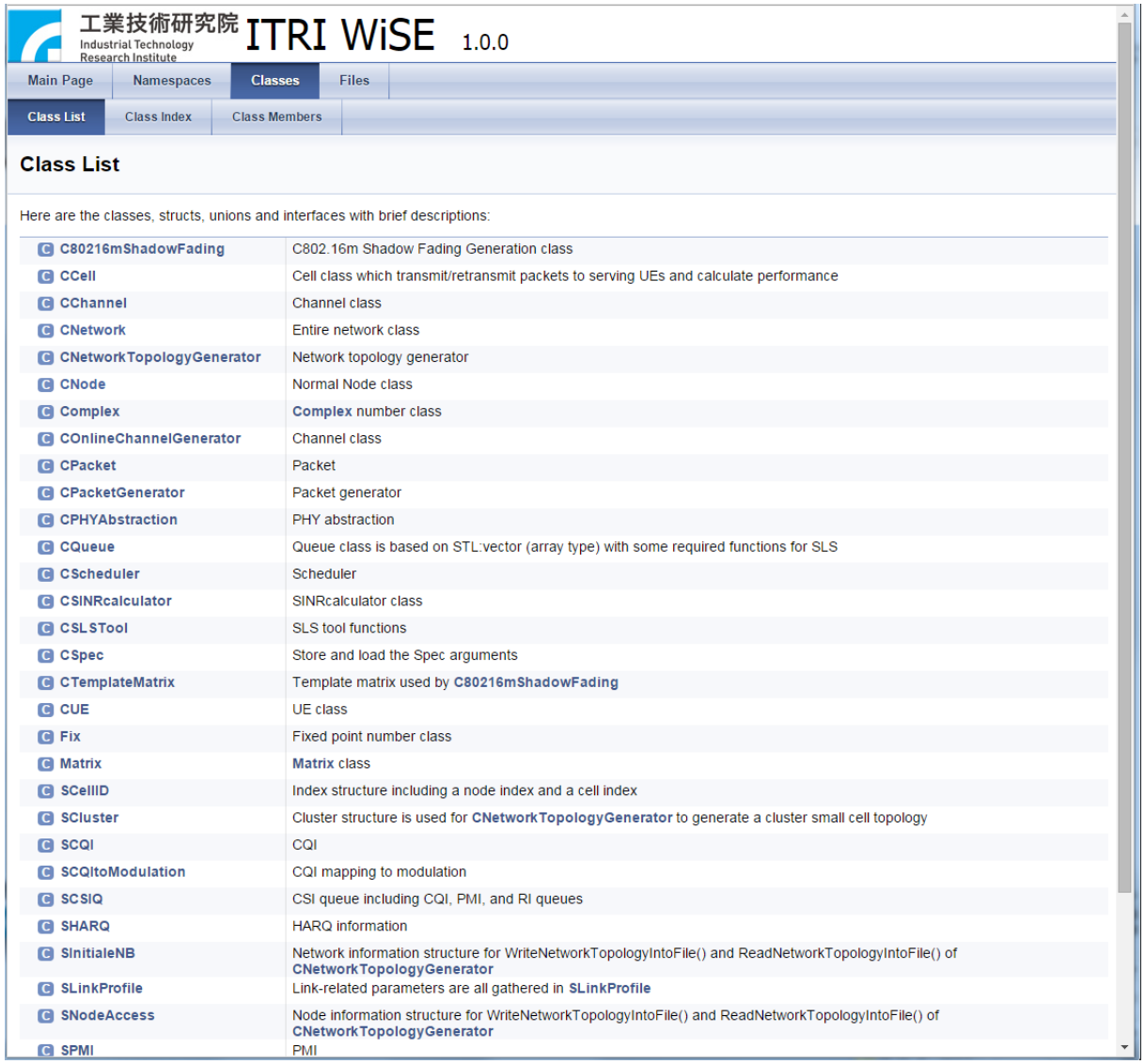
工業技術研究院
Industrial Technology
Research Institute

WiSE使用說明與示範

工研院資通所/
周冠宏

- WiSE Library Website
- WiSE Cloud Services
- WiSE GUI Analysis Tool
- Use Examples

WiSE Library Website



工業技術研究院 Industrial Technology Research Institute ITRI WiSE 1.0.0

Main Page | Namespaces | Classes | Files

Class List | Class Index | Class Members

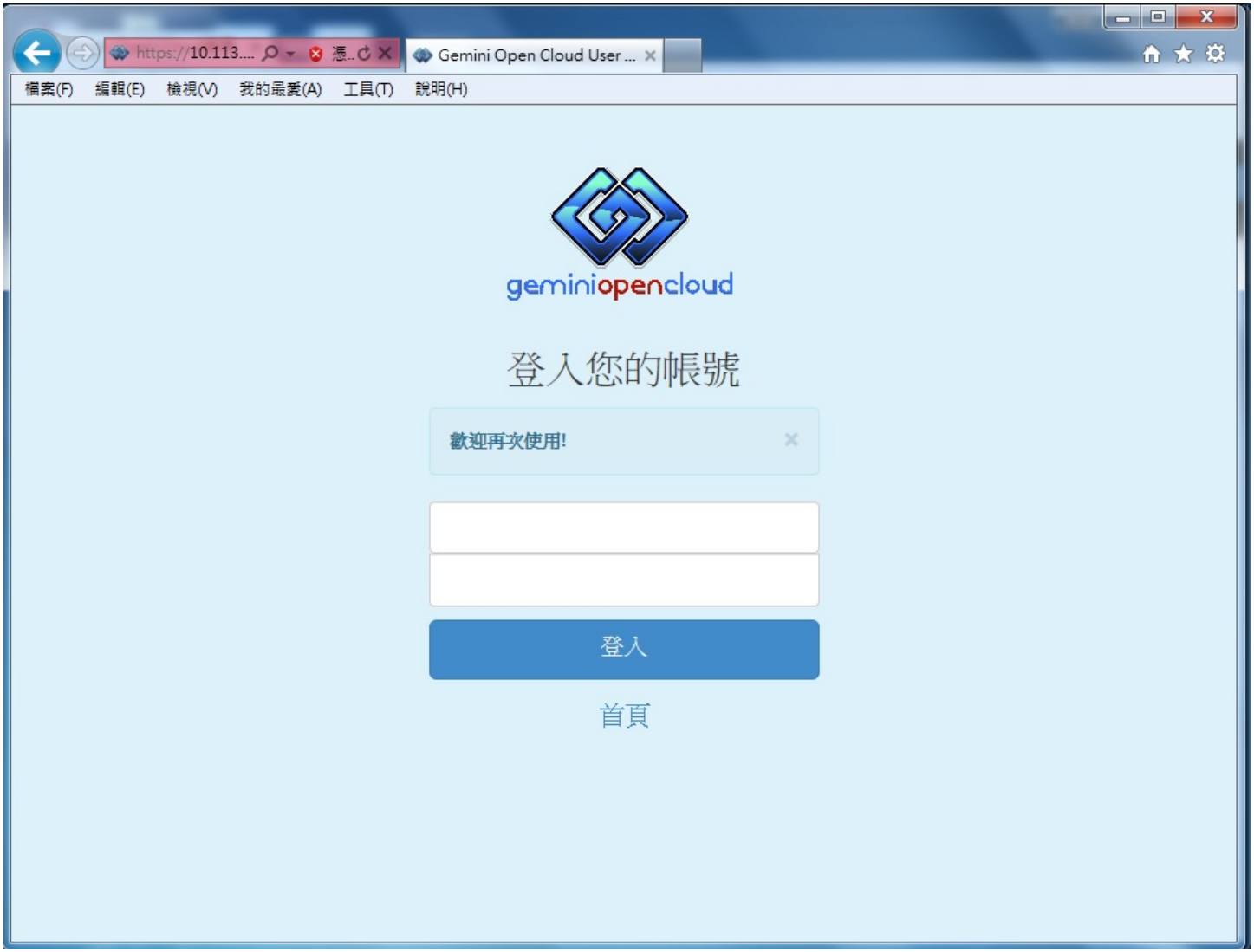
Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

C80216mShadowFading	C802.16m Shadow Fading Generation class
CCell	Cell class which transmit/retransmit packets to serving UEs and calculate performance
CChannel	Channel class
CNetwork	Entire network class
CNetworkTopologyGenerator	Network topology generator
CNode	Normal Node class
Complex	Complex number class
COnlineChannelGenerator	Channel class
CPacket	Packet
CPacketGenerator	Packet generator
CPHYAbstraction	PHY abstraction
CQueue	Queue class is based on STL:vector (array type) with some required functions for SLS
CScheduler	Scheduler
CSINRcalculator	SINRcalculator class
CSLSTool	SLS tool functions
CSpec	Store and load the Spec arguments
CTemplateMatrix	Template matrix used by C80216mShadowFading
CUE	UE class
Fix	Fixed point number class
Matrix	Matrix class
SCellID	Index structure including a node index and a cell index
SCluster	Cluster structure is used for CNetworkTopologyGenerator to generate a cluster small cell topology
SCQI	CQI
SCQItoModulation	CQI mapping to modulation
SCSIQ	CSI queue including CQI, PMI, and RI queues
SHARQ	HARQ information
SInitialeNB	Network information structure for WriteNetworkTopologyIntoFile() and ReadNetworkTopologyIntoFile() of CNetworkTopologyGenerator
SLinkProfile	Link-related parameters are all gathered in SLinkProfile
SNodeAccess	Node information structure for WriteNetworkTopologyIntoFile() and ReadNetworkTopologyIntoFile() of CNetworkTopologyGenerator
SPMI	PMI

http://wireless.itri.org.tw/waux/WiSE/WiSE_Library_Doc_html/index.html

WiSE Cloud Services

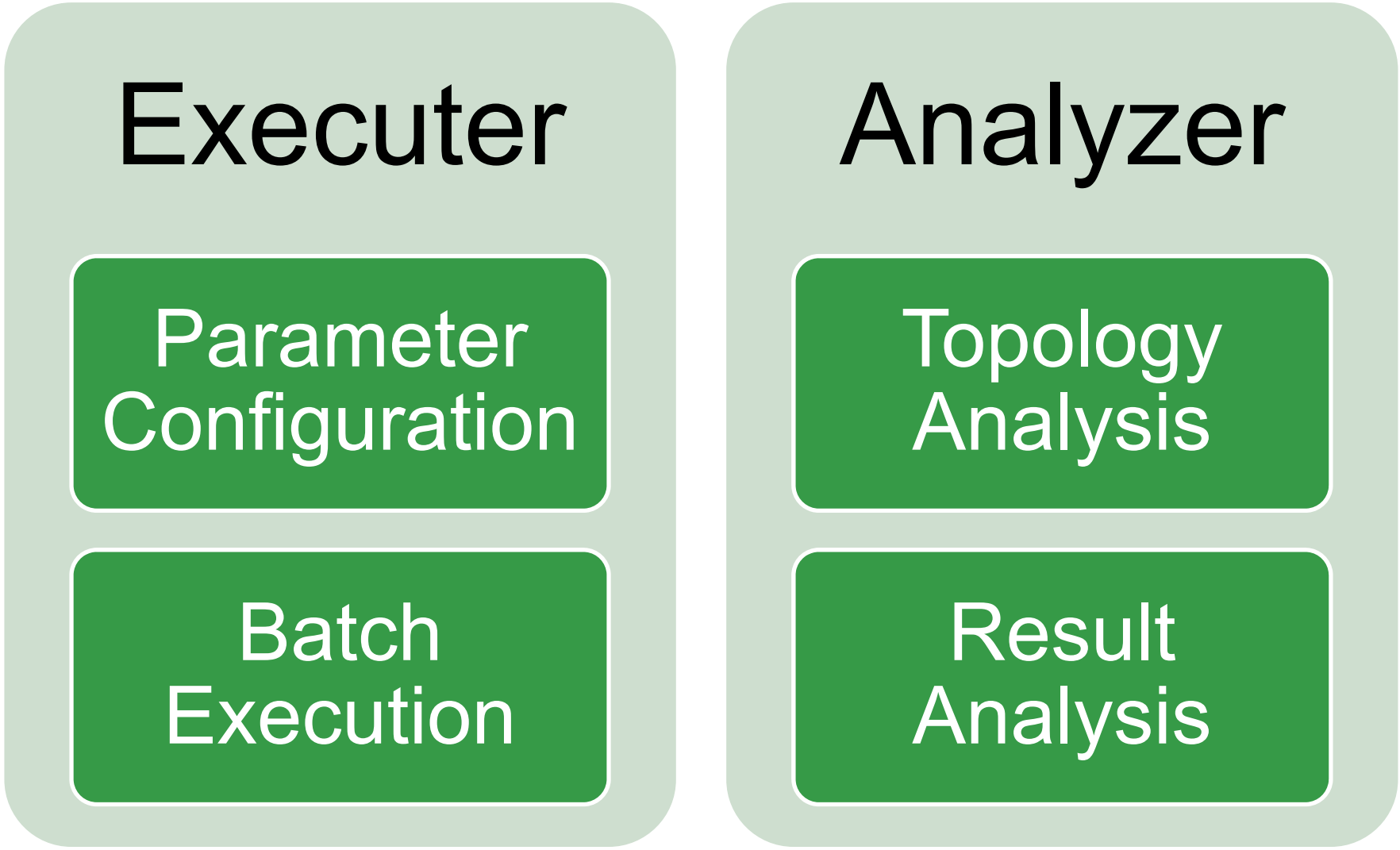


WiSE GUI Analysis Tool

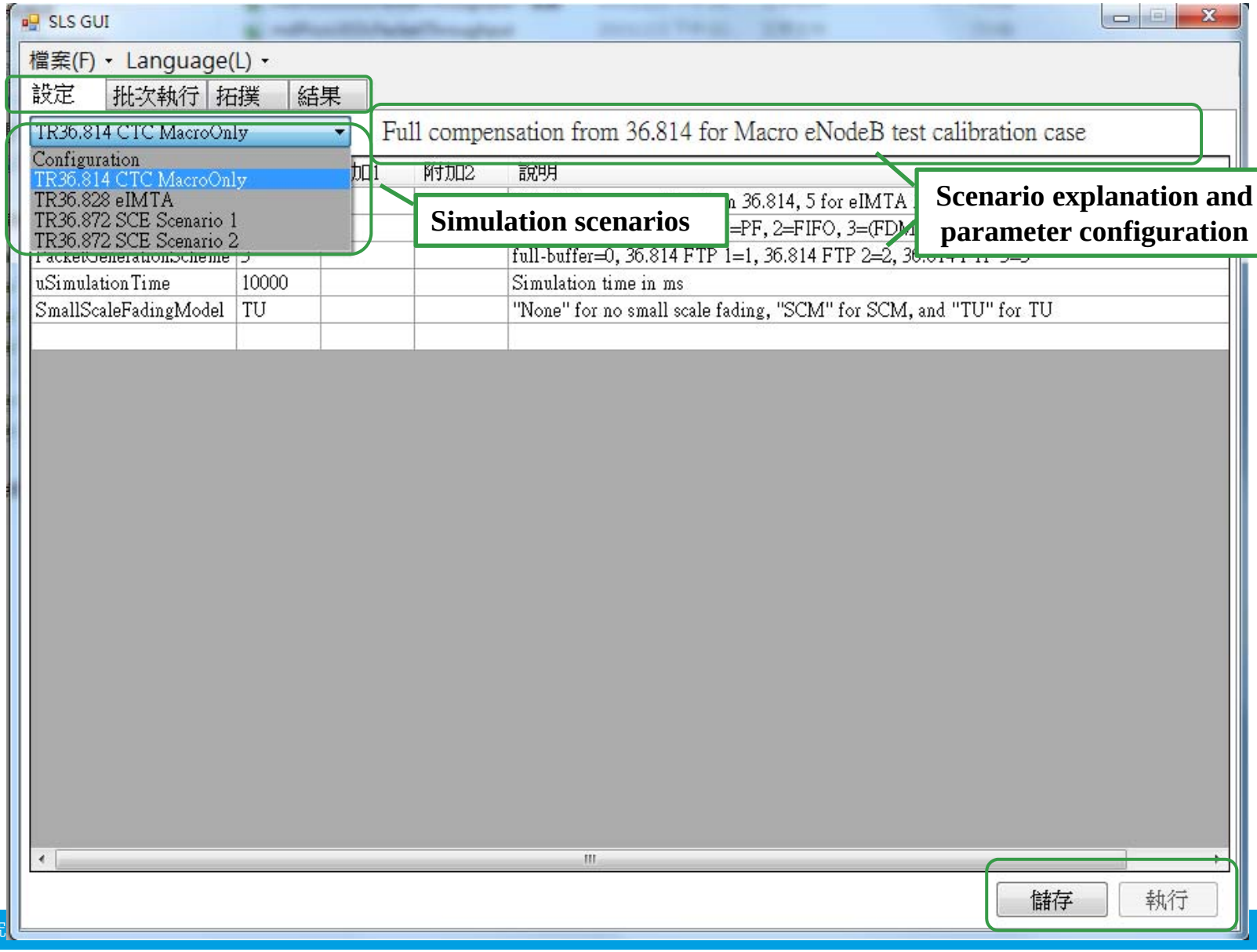
Executer

Analyzer

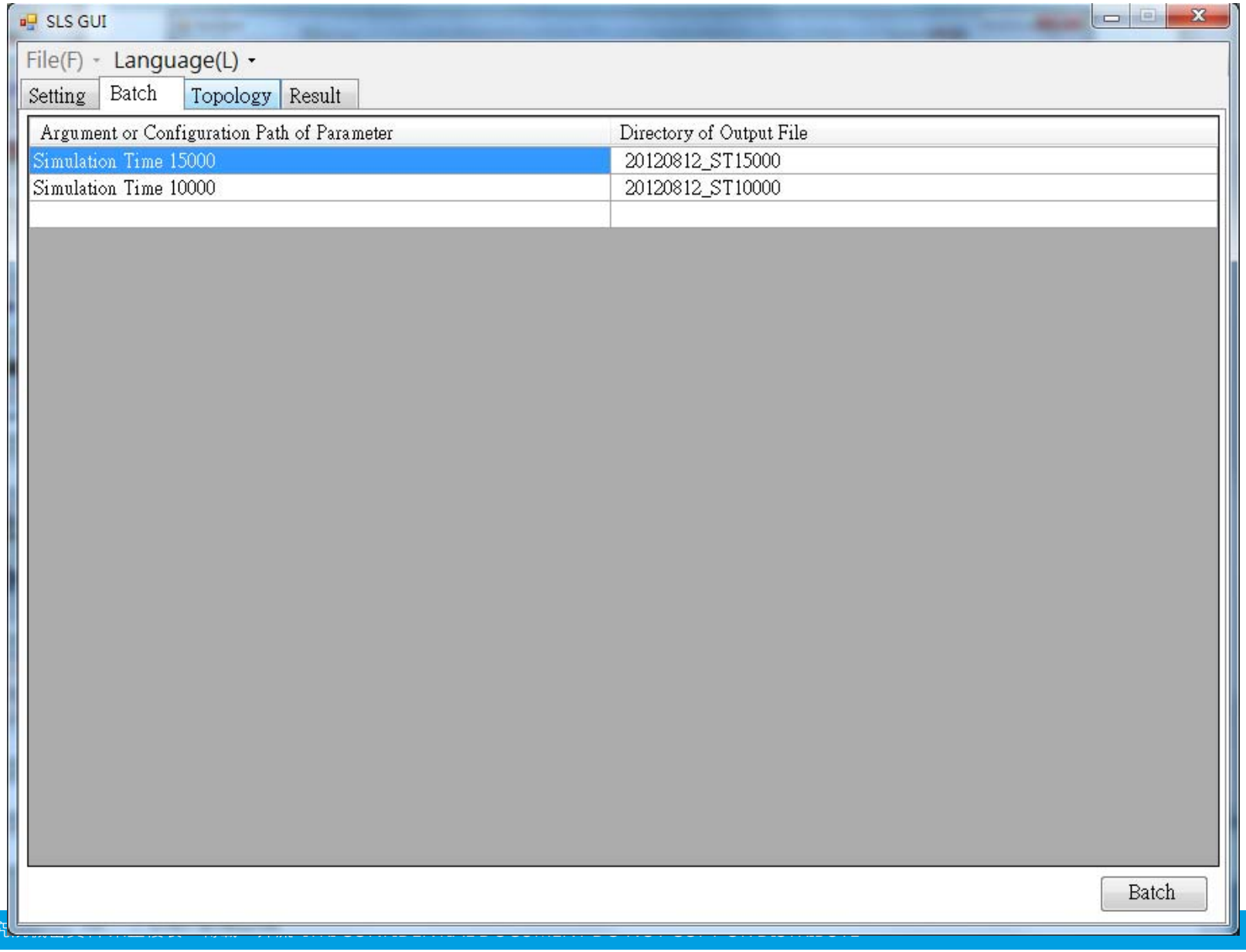
WiSE GUI Analysis Tool



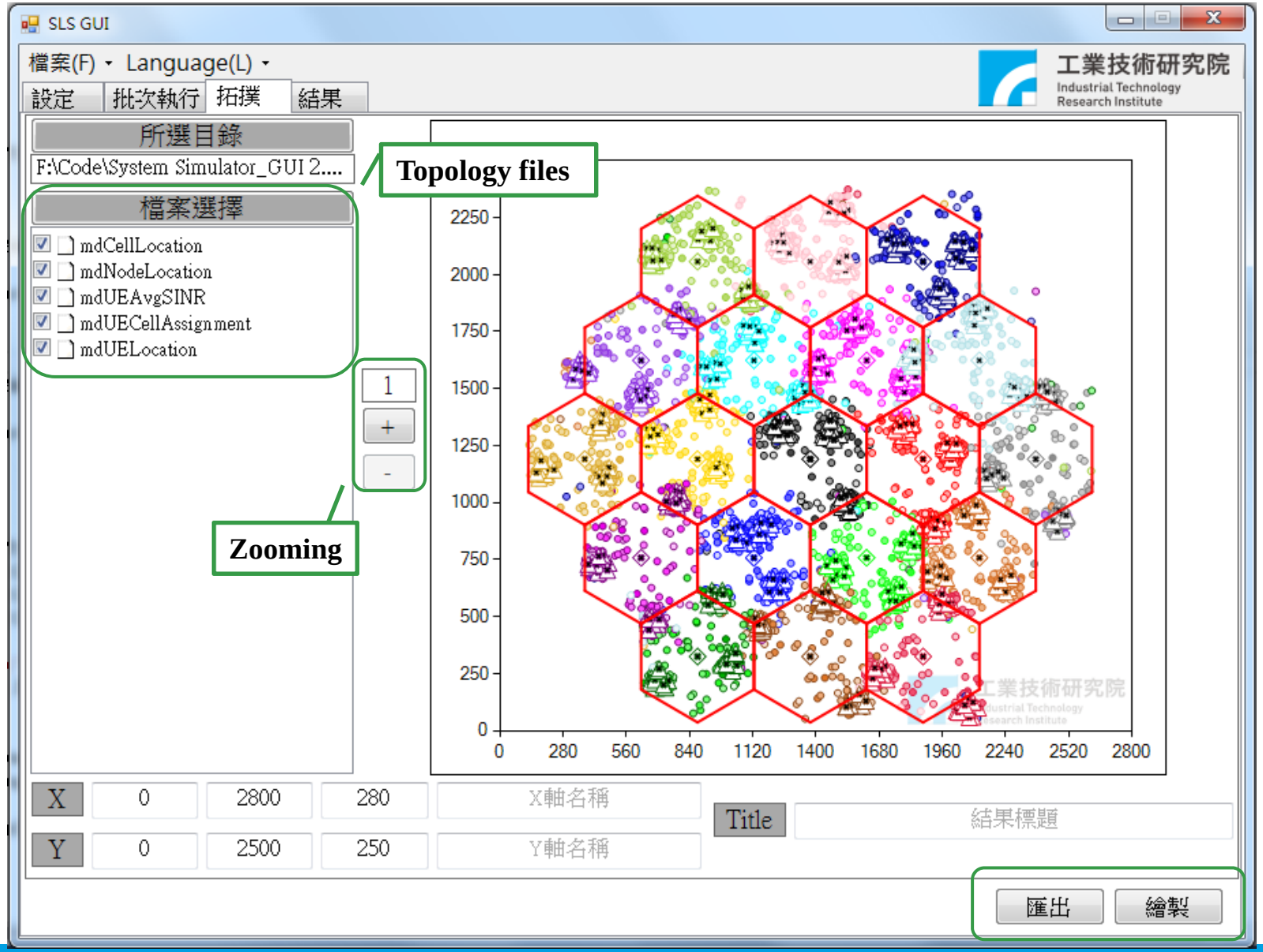
GUI Parameter Configuration



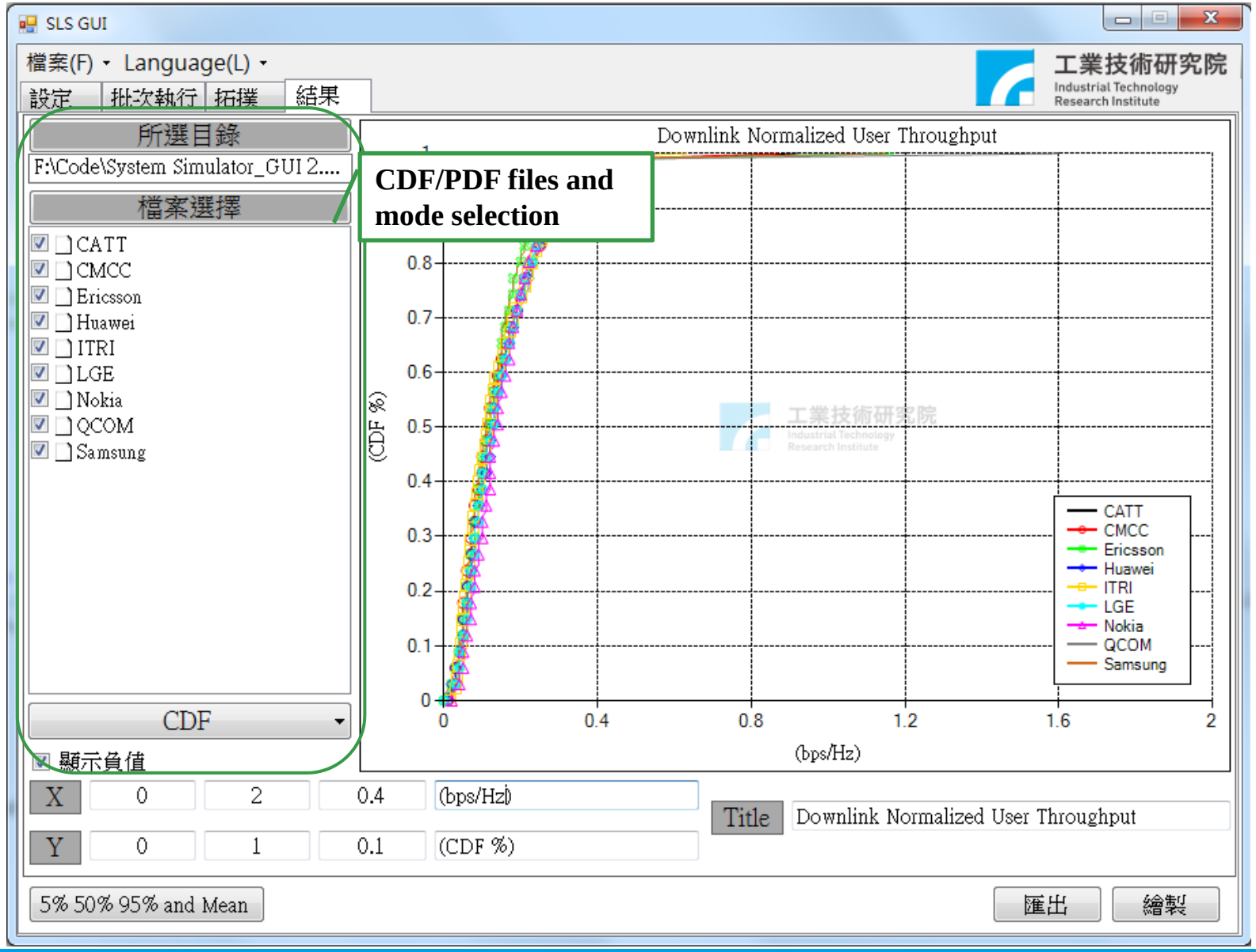
GUI Batch Execution



GUI Topology



Result Analysis — CDF/PDF



Use Examples

Basic Calibration Example

- 3GPP 36.814 Calibration

Quick Verification Example

- Higher UL Power

Use Example

- Interference Avoidance Method Development: Method 1, 2, and 3

3GPP 36.814 Calibration

- 基本設定圖
- 結果圖

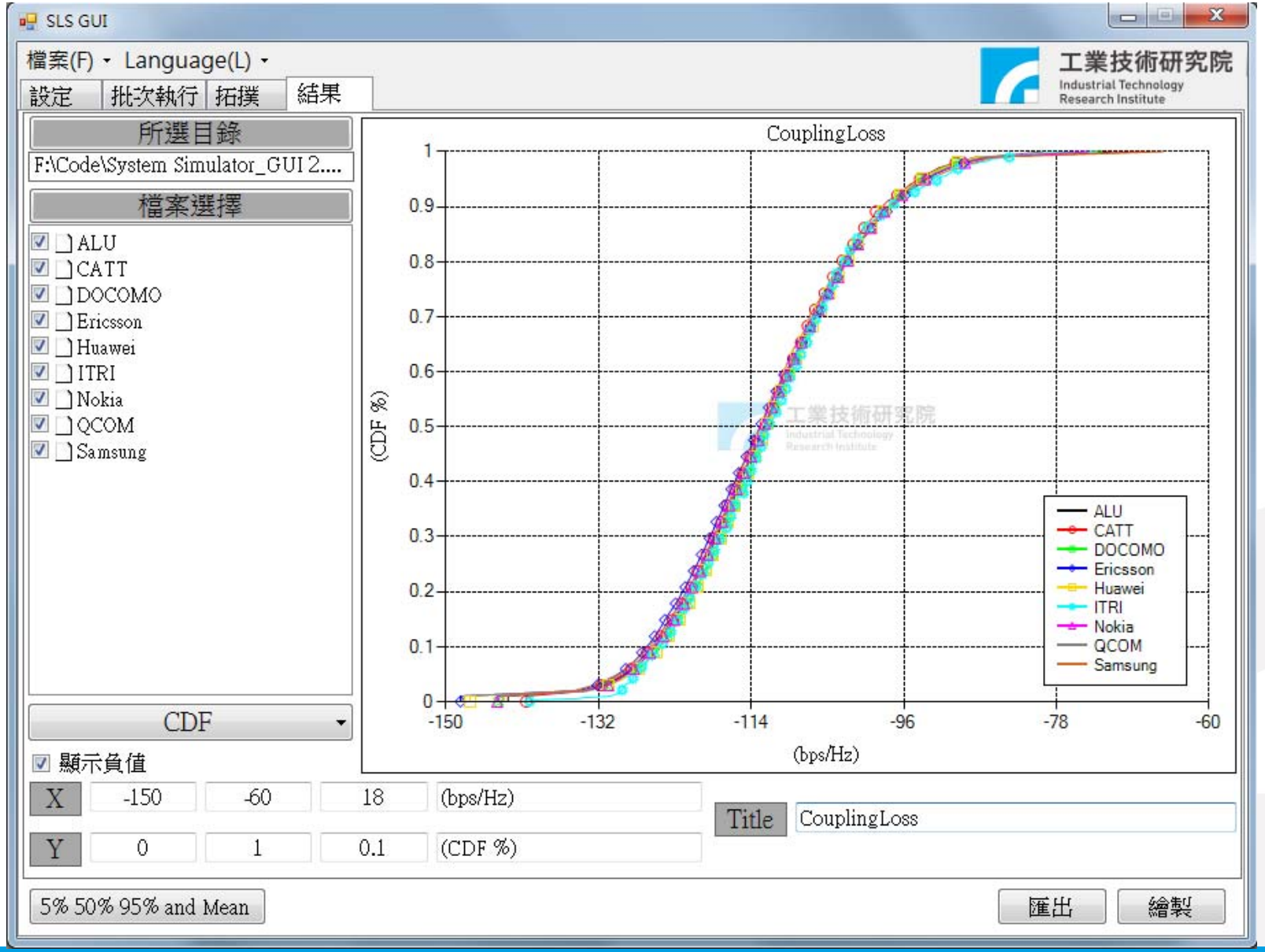
Parameter (variable in WiSE)	Value (value in WiSE)
General	Parameters and assumptions not explicitly stated here according to ITU guidelines M.2135 and 3GPP specifications (eScenario=TR36814_3GPPCase)
Duplex method (uDuplexingMode)	FDD (uDuplexingMode=0)
Network synchronization	Synchronized
Handover margin	1dB
Downlink transmission scheme (uNumMacroTxAntenna and uNumUERxAntenna)	1x2 SIMO (uNumMacroTxAntenna=1 and uNumUERxAntenna=2)
Downlink scheduler (uSchedulingScheme)	Round robin with full bandwidth allocation (uSchedulingScheme=0)
Downlink link adaptation (uCQIPMIperiodicity and uCSIFeedbackDelay)	Wideband CQI, no PMI on PUCCH (mode 1-0) 5ms periodicity, 6ms delay total (measurement in subframe n is used in subframe n+6) CQI measurement error: None MCSs based on LTE transport formats [5] (uCQIPMIperiodicity= 5 and uCSIFeedbackDelay=5)
Downlink HARQ	Maximum four transmissions (Note: set uHARQCount>=4 will success transmission in Network.h)
Downlink receiver type (eUEReceiverType)	MRC (eUEReceiverType = MRC or MMSE) Note:MMSE equals to MRC as single TX antenna
Uplink transmission scheme (uNumUETxAntenna and uNumMacroRxAntenna)	1x2 SIMO (uNumUETxAntenna=1 and uNumMacroRxAntenna=2)
Uplink scheduler (uSchedulingScheme)	Frequency Domain Multiplexing (FDM) – non-channel dependent, share available bandwidth between users connected to the cell, all users get resources in every uplink subframe. With M users and Nrb PRBs available, Mh=mod(Nrb,M) users get floor(Nrb/M)+1 PRBs whereas Ml=M-Mh users get floor(Nrb/M) PRBs (uSchedulingScheme=3 and uUENumPerMacroCell=10)
Uplink Power control (dMacroULReferenceReceivedPower and dULPathLossCompensationAlpha)	P_0 = -106dBm, alpha = 1.0 (dMacroULReferenceReceivedPower = -106 and dULPathLossCompensationAlpha = 1)
Uplink Link adaptation (uCSIFeedbackDelay)	Based on delayed measurements. Ideal channel estimate from UL transmission in subframe n can be used for rate adaptation in subframe n+7 MCSs based on LTE transport formats (uCSIFeedbackDelay = 6)
Uplink HARQ	Maximum four transmissions Proponent to specify IR or CC
Uplink receiver type (eMacroReceiverType)	MMSE in frequency domain, MRC over antennas (no intercell interference rejection) (eMacroReceiverType = MMSE)
Antenna configuration	Vertically polarized antennas 0.5 wavelength separation at UE, 10 wavelength separation at basestation
Channel estimation	Ideal, both demodulation and sounding
Control Channel overhead, Acknowledgements etc.	LTE: L=3 symbols for DL CCHs, M=4 resource blocks for UL CCH, overhead for demodulation reference signals,
Channel model (eScenario=TR36814_3GPPCase and uMacroAntennaGainPattern)	According to ITU for ITU scenarios SCM urban macro high spread for 3GPP case 1 (eScenario=TR36814_3GPPCase For 3GPP Case1 3D: uMacroAntennaGainPattern=3 and For 3GPP Case1 2D: uMacroAntennaGainPattern=2)

3GPP 36.814 Calibration—結果

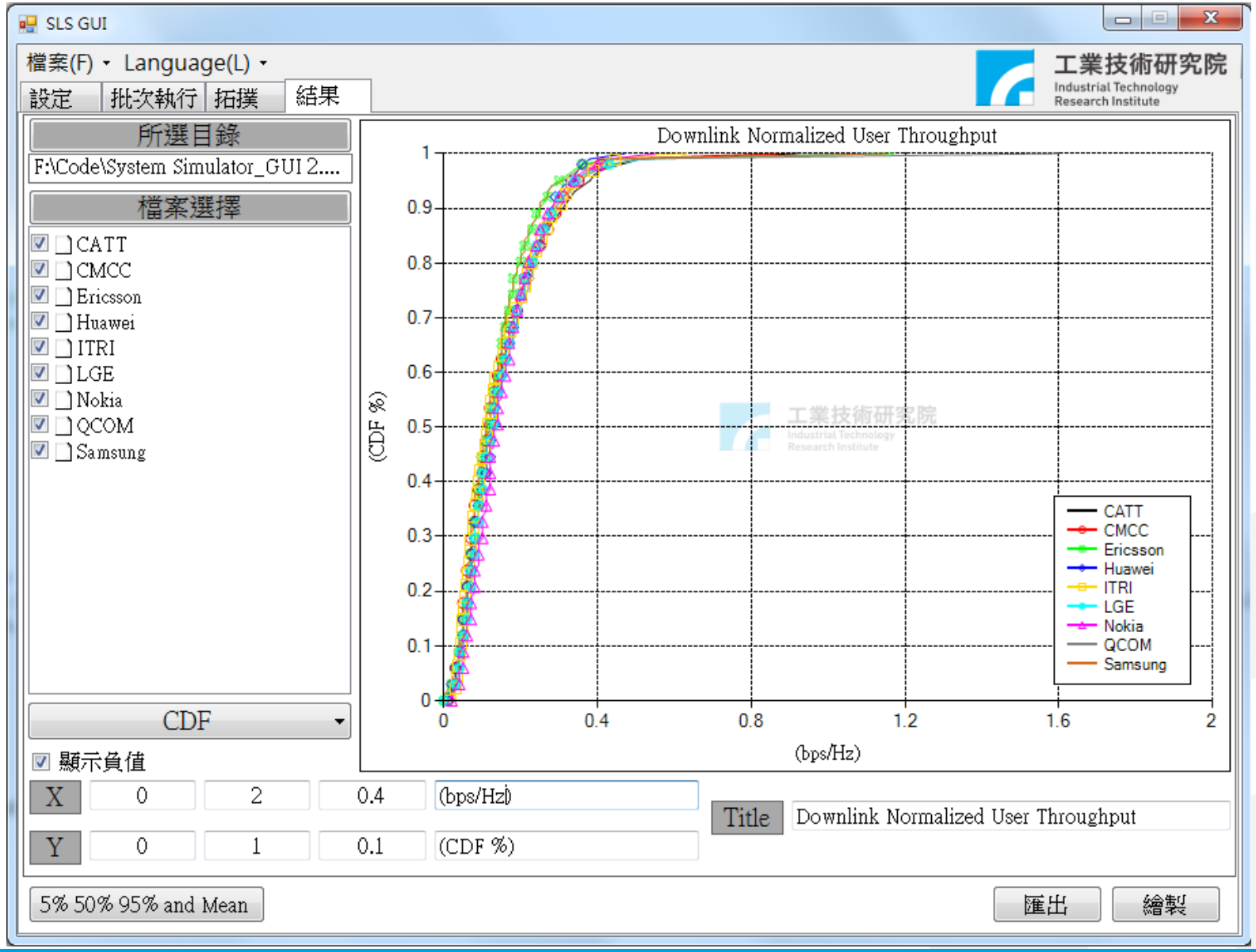
Table A.2.2-2. Spectral efficiencies for calibration in the different environments

Direction	Metric	InH	UMi	UMa	RMa	Case 1 3D	Case 1 2D
Downlink	Cell spectral efficiency	2.3	1.2	1.0	1.2	**1.5**	1.1
	Cell-edge user spectral efficiency	0.082	0.028	0.022	0.027	**0.035**	0.026
Uplink	Cell spectral efficiency	1.77	0.91	0.68	0.86	**0.99**	0.74
	Cell-edge user spectral efficiency	0.084	0.033	0.026	0.034	**0.036**	0.031

3GPP 36.814 Calibration—結果圖 (1/2)



3GPP 36.814 Calibration—結果圖 (2/2)



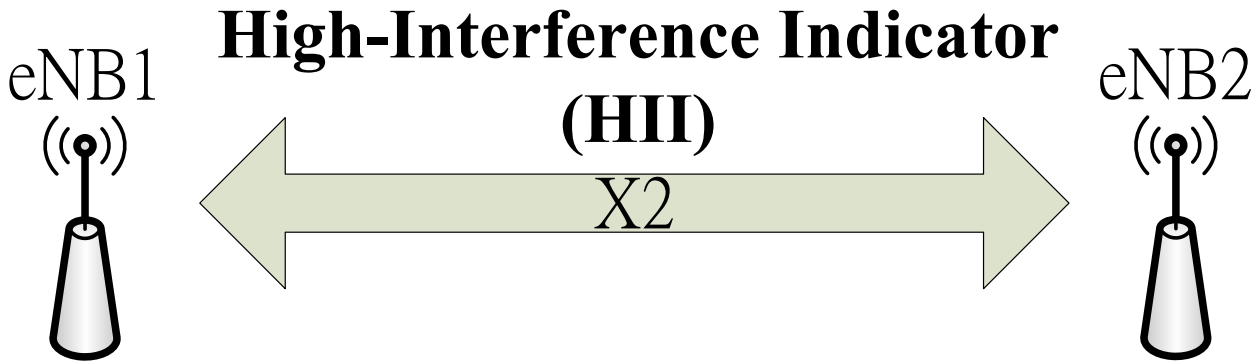
Quick Verification Example

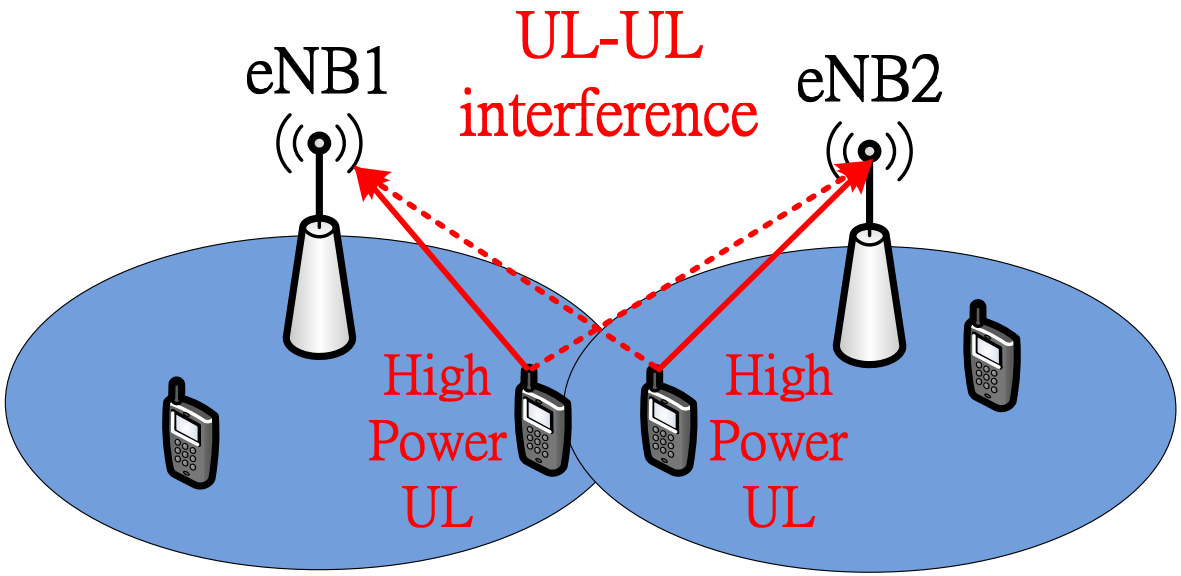
- Higher UL Power 實機修改
  - Shorter distance and higher UL power

Interference Avoidance Method Development

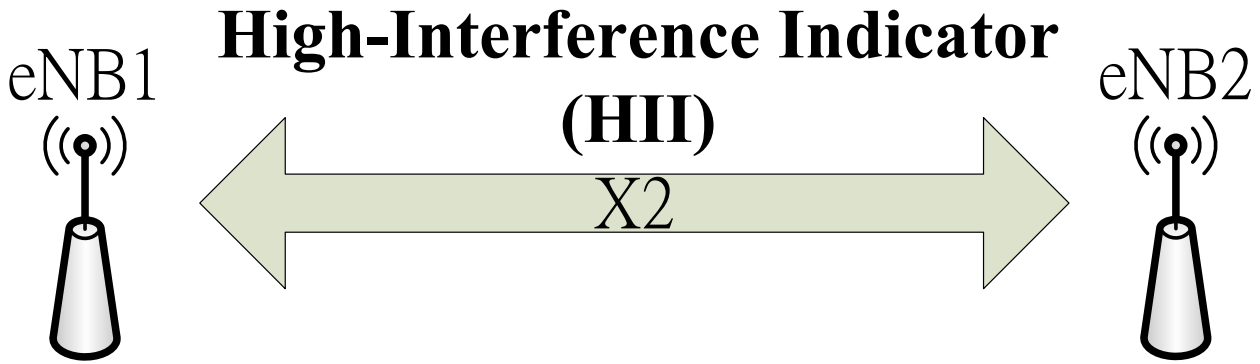
- 基本概念
- 程式碼修改對照
- 結果

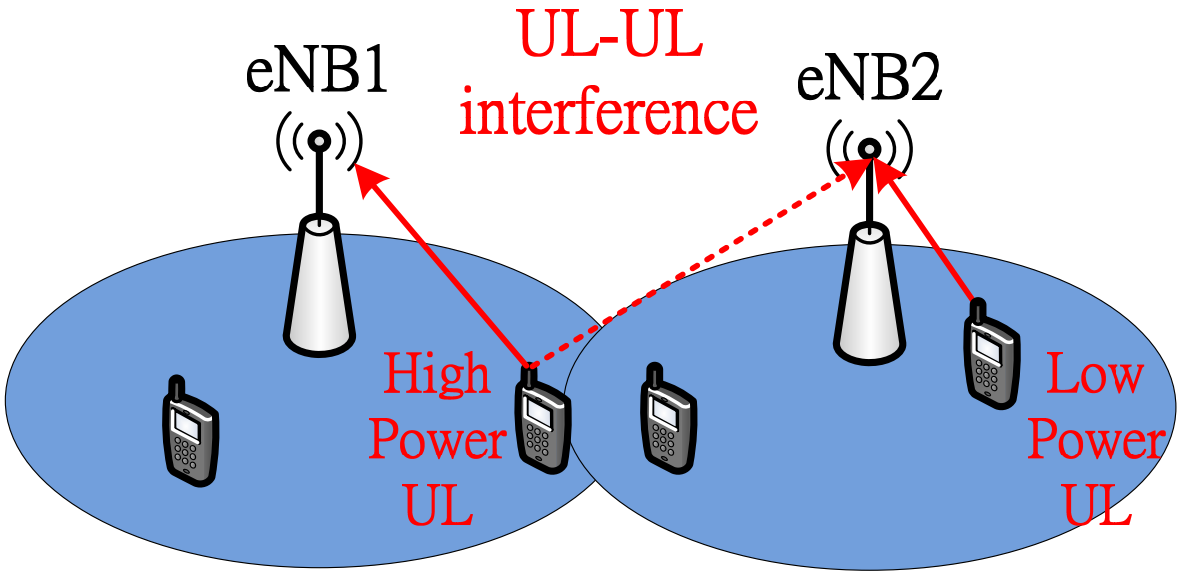
Interference Avoidance Method Development — Method 1基本概念



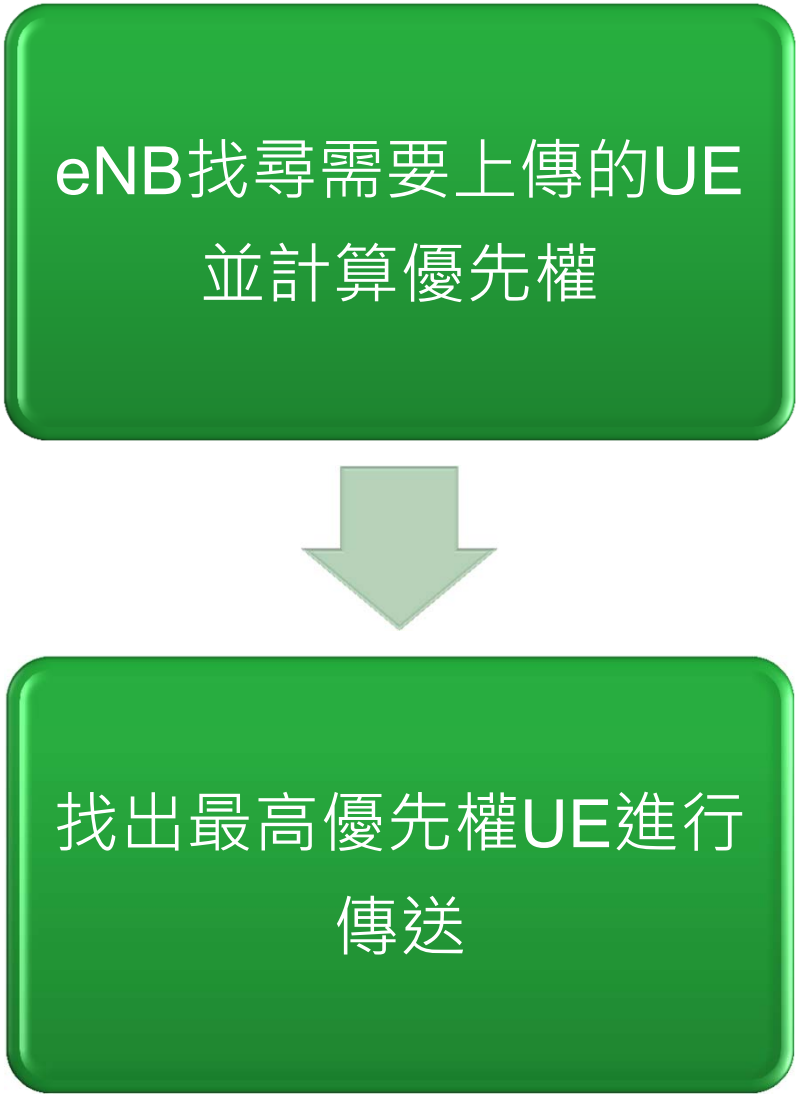


Interference Avoidance Method Development — Method 1基本概念

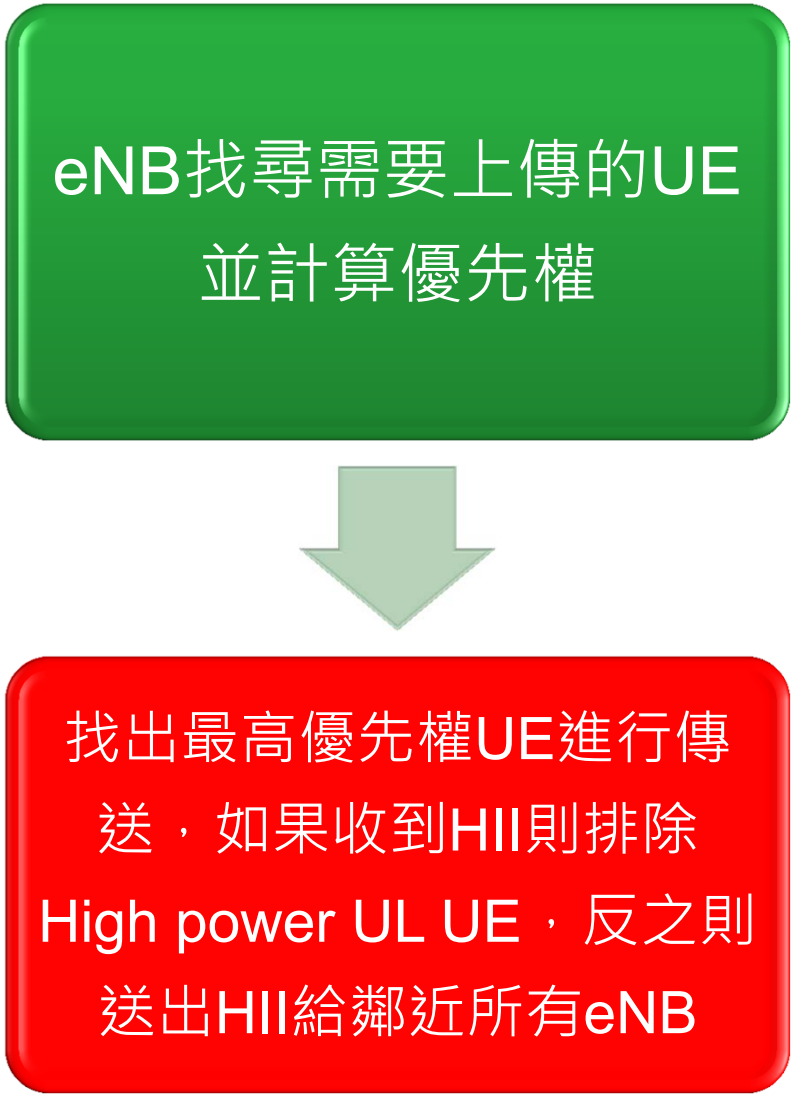




Interference Avoidance Method Development — 整體排程法概念



Interference Avoidance Method Development — Method 1修改流程



Interference Avoidance Method Development — Method 1程式碼修改

```
uServingUENum=cNode[n].cCell[c].GetServingUENum();
//Re-initialize vdTBBitNumMap and mvnRBAllocationMap
if(uServingUENum>0)
if(uServingUENum>0) // Skip the cells without UEs && Consider the time of turning on the cell
{
    //HARQ Packet First
    if(ScheduleRetransmission(cNode, cNode[n].cCell[c].eCurrentULDLState, n, c, dTempTime))
    {//Other Packets
        dMaxPriority=0;nUEIndex=-1;
        if(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]==U)// UL
        {
            for(size_t u=0;u<uServingUENum;u++)
            {
                if((cNode[n].cCell[c].vcUE[u]->cULQueue.Size()>0)||uPacketGenerationScheme==0)// Skip empty-queue and hand-overin
                {
                    nTempCQI=cNode[n].cCell[c].vcUE[u]->GetCurrentCQI(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]);
                    dTempPriority=pow(((double)(uRBNumber*12*7*(double)sSCQItoModulation[nTempCQI].uModulationOrder*sSCQItoModula
                    if(dMaxPriority<dTempPriority)  //Find the UE with a max priority
                    {
                        dMaxPriority=dTempPriority;
                        nUEIndex=u;
                    }
                }
            }
        }else{                                                          //DL
        if(nUEIndex>=0&&nUEIndex<(int)uServingUENum)
        {
            //Set
            nTempCQI=cNode[n].cCell[c].vcUE[nUEIndex]->GetCurrentCQI(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]);
            dTempBitNumber=((12.0*7.0*(double)sSCQItoModulation[nTempCQI].uModulationOrder)*sSCQItoModulation[nTempCQI].dCodingRa
            SetAllRB(cNode, cNode[n].cCell[c].eCurrentULDLState, n, c, nUEIndex, dTempBitNumber);
        }
    }
```

找尋需要上傳的UE並計算優先權

找出最高優先權UE進行傳送

Interference Avoidance Method Development — Method 1程式碼修改

```
uServingUENum=cNode[n].cCell[c].GetServingUENum();
//Re-initialize vdTBBitNumMap and mvnRBAllocationMap
if(uServingUENum>0)
if(uServingUENum>0) // Skip the cells without UEs && Consider the time of turning on the cell
{
    //HARQ Packet First
    if(ScheduleRetransmission(cNode, cNode[n].cCell[c].eCurrentULDLState, n, c, dTempTime))
    {//Other Packets
        dMaxPriority=0;nUEIndex=-1;
        if(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]==U)// UL
        {
            for(size_t u=0;u<uServingUENum;u++)
            {
                if((cNode[n].cCell[c].vcUE[u]->cULQueue.Size()>0)||uPacketGenerationScheme==0)// Skip empty-queue and hand-overing
                {
                    nTempCQI=cNode[n].cCell[c].vcUE[u]->GetCurrentCQI(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]);
                    dTempPriority=pow(((double)(uRBNumber*12*7*(double)sSCQItoModulation[nTempCQI].uModulationOrder*sSCQItoModulat
                    if(dMaxPriority<dTempPriority)  //Find the UE with a max priority
                    {
                        if(fHII==false||cNode[n].cCell[c].vcUE[u]->dTransmissionPowerdBm<cSpec.GetMaxUETransmissionPowerdBm())
                        {
                            dMaxPriority=dTempPriority;
                            nUEIndex=u;
                        }
                    }
                }
            }
        }else{                                                          //DL
        if(nUEIndex>=0&&nUEIndex<(int)uServingUENum)
        {
            //Set
            nTempCQI=cNode[n].cCell[c].vcUE[nUEIndex]->GetCurrentCQI(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]);
            dTempBitNumber=((12.0*7.0*(double)sSCQItoModulation[nTempCQI].uModulationOrder)*sSCQItoModulation[nTempCQI].dCodingRat
            SetAllRB(cNode, cNode[n].cCell[c].eCurrentULDLState, n, c, nUEIndex, dTempBitNumber);
            if(cNode[n].cCell[c].vcUE[nUEIndex]->dTransmissionPowerdBm>=cSpec.GetMaxUETransmissionPowerdBm())
                fHII=true;
        }
    }
}
```

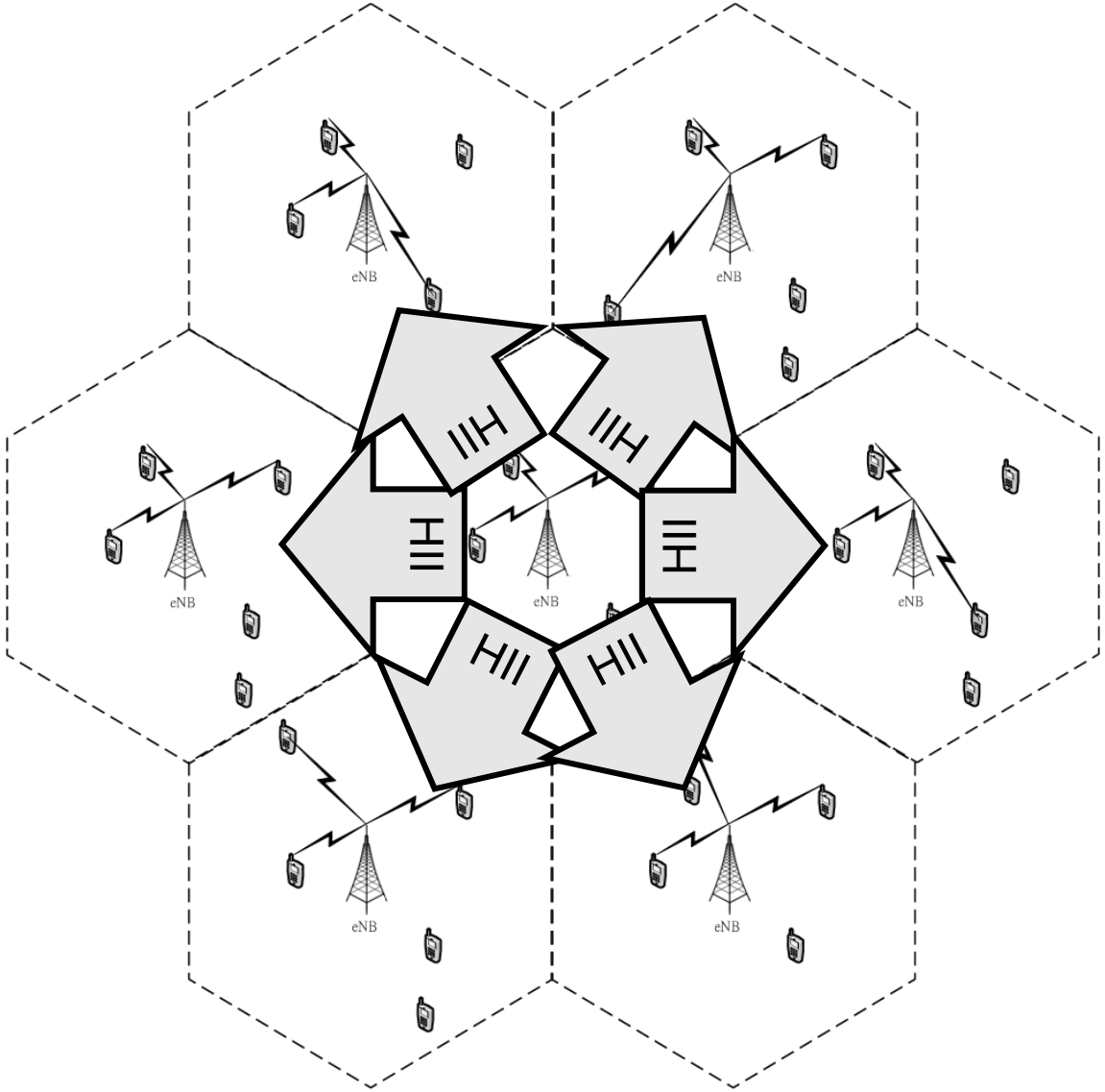
如果收到HII則排除High power UL UE

反之則送出HII

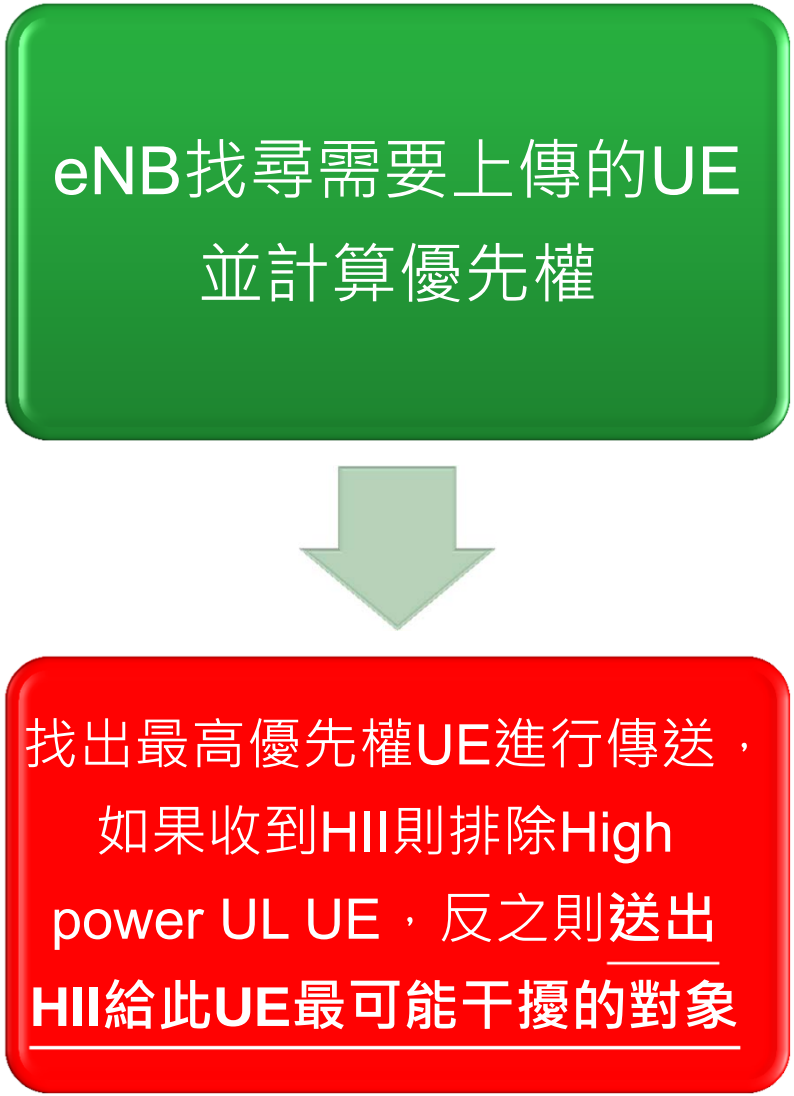
Interference Avoidance Method Development — Method 1結果

UL	Normal	Method1
HARQ (n/s)	214	158
5% UE SE(bps/Hz)	**0.0243**	**0.0004**
Avg UE SE(bps/Hz)	**0.986441**	**1.30456**
Cell Capacity(Mbps)	9.03986	12.4691

Interference Avoidance Method Development — Method 1問題



Interference Avoidance Method Development — Method 2修改流程



Interference Avoidance Method Development — Method 2程式碼修改

```
uServingUENum=cNode[n].cCell[c].GetServingUENum();
//Re-initialize vdTBBitNumMap and mvnRBAllocationMap
if(uServingUENum>0)
if(uServingUENum>0) // Skip the cells without UEs && Consider the time of turning on the cell
{
    //HARQ Packet First
    if(ScheduleRetransmission(cNode, cNode[n].cCell[c].eCurrentULDLState, n, c, dTempTime))
    {//Other Packets
        dMaxPriority=0;nUEIndex=-1;
        if(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]==U)// UL
        {
            for(size_t u=0;u<uServingUENum;u++)
            {
                if((cNode[n].cCell[c].vcUE[u]->cULQueue.Size()>0)||uPacketGenerationScheme==0)// Skip empty-queue and hand-overing UEs
                {
                    nTempCQI=cNode[n].cCell[c].vcUE[u]->GetCurrentCQI(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]);
                    dTempPriority=pow(((double)(uRBNumber*12*7*(double)sSCQItoModulation[nTempCQI].uModulationOrder*sSCQItoModulation[nT
                    if(dMaxPriority<dTempPriority)  //Find the UE with a max priority
                    {
                        if(fHIIList[n][c]==false||cNode[n].cCell[c].vcUE[u]->dTransmissionPowerdBm<cSpec.GetMaxUETransmissionPowerdBm())
                        {
                            dMaxPriority=dTempPriority;
                            nUEIndex=u;
                        }
                    }
                }
            }
        }else{                                                          //DL
        if(nUEIndex>=0&&nUEIndex<(int)uServingUENum)
        {
            //Set
            nTempCQI=cNode[n].cCell[c].vcUE[nUEIndex]->GetCurrentCQI(eULDLConfiguration[uTDDULDLConfiguration][uSubframeIndex]);
            dTempBitNumber=((12.0*7.0*(double)sSCQItoModulation[nTempCQI].uModulationOrder)*sSCQItoModulation[nTempCQI].dCodingRate);
            SetAllRB(cNode, cNode[n].cCell[c].eCurrentULDLState, n, c, nUEIndex, dTempBitNumber);
            if(cNode[n].cCell[c].vcUE[nUEIndex]->dTransmissionPowerdBm>=cSpec.GetMaxUETransmissionPowerdBm())
            {
                SCellID sInterferedCell1= cNode[n].cCell[c].vcUE[nUEIndex]->vsInterferedCell[0];
                fHIIList[sInterferedCell1.nNode][sInterferedCell1.nCell]=true;
            }
        }
    }
}
```

如果收到HII則排除High power UL UE

反之則送出HII給此UE最可能干擾的對象

Interference Avoidance Method Development — Method 2結果

UL	Normal	Method2
HARQ (n/s)	214	208
5% UE SE(bps/Hz)	**0.0256**	**0.0264 (3% ↑)**
Avg UE SE(bps/Hz)	**0.9770**	**0.9763 (0.07% ↓)**
Cell Capacity(Mbps)	9.3180	9.3107

Interference Avoidance Method Development — Method 3結果

- Method3—Method2 改進
  - 考慮使用95%~100%最大UL power的UE
  - 傳送HII給可能干擾的數個對象，並考量重傳。

UL	Normal	Method3
HARQ (n/s)	214	192
5% UE SE(bps/Hz)	**0.0256**	**0.0274 (7% ↑)**
Avg UE SE(bps/Hz)	**0.9770**	**0.9756 (0.14% ↓)**
Cell Capacity(Mbps)	9.3180	9.3049