LabVIEW & USRP Introduction

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Outline

- Overview of labs in this course
- Hardware & software used in this course
- Resources and installation guide
- Homework of the first week

Purposes of Labs

- Learn how to bring theory into practice
  - How to implement a communication system
  - What are the challenges?
  - How to overcome the challenges?
- From basic to advanced
  - Techniques in labs can be extended to WiFi, LTE, etc.
  - Understand the differences of these system

Lab Overview

- Basics of LabVIEW and USRP

- Digital modulation/demodulation

- Coded transmission (convolutional code)

- Wideband systems (OFDM transceiver)

- We will use **real-world, over-the-air, real-time** transmission to verify our implementation!

Software & Hardware

- Software: **LabVIEW**
  - Graphic programming software
  - Block-diagram based environment
 - Available licenses for NTU students

- Hardware: **USRP**
  - Software defined radio
  - No need to worry about RF front end!
  - Efficient communication system prototyping
 - Experiment through real-world transmission

LabVIEW

- Easy to operate
- Convenient application
- Good support for USRP
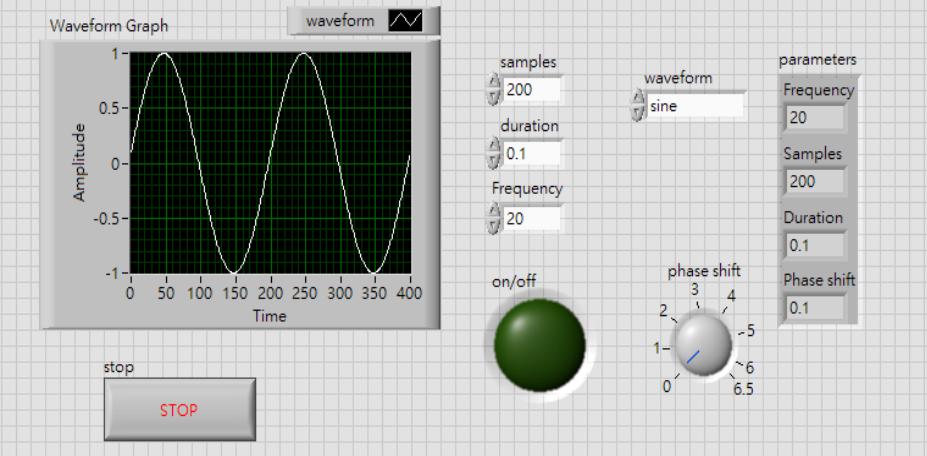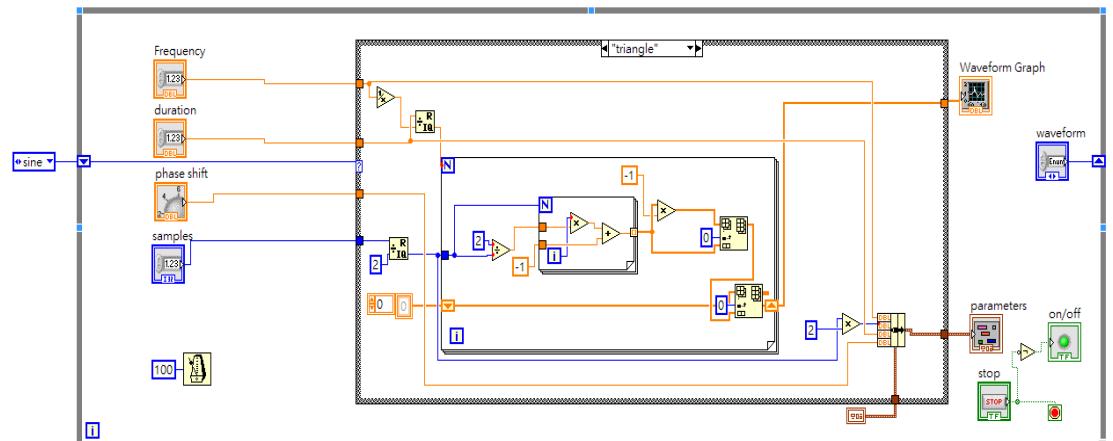
介面
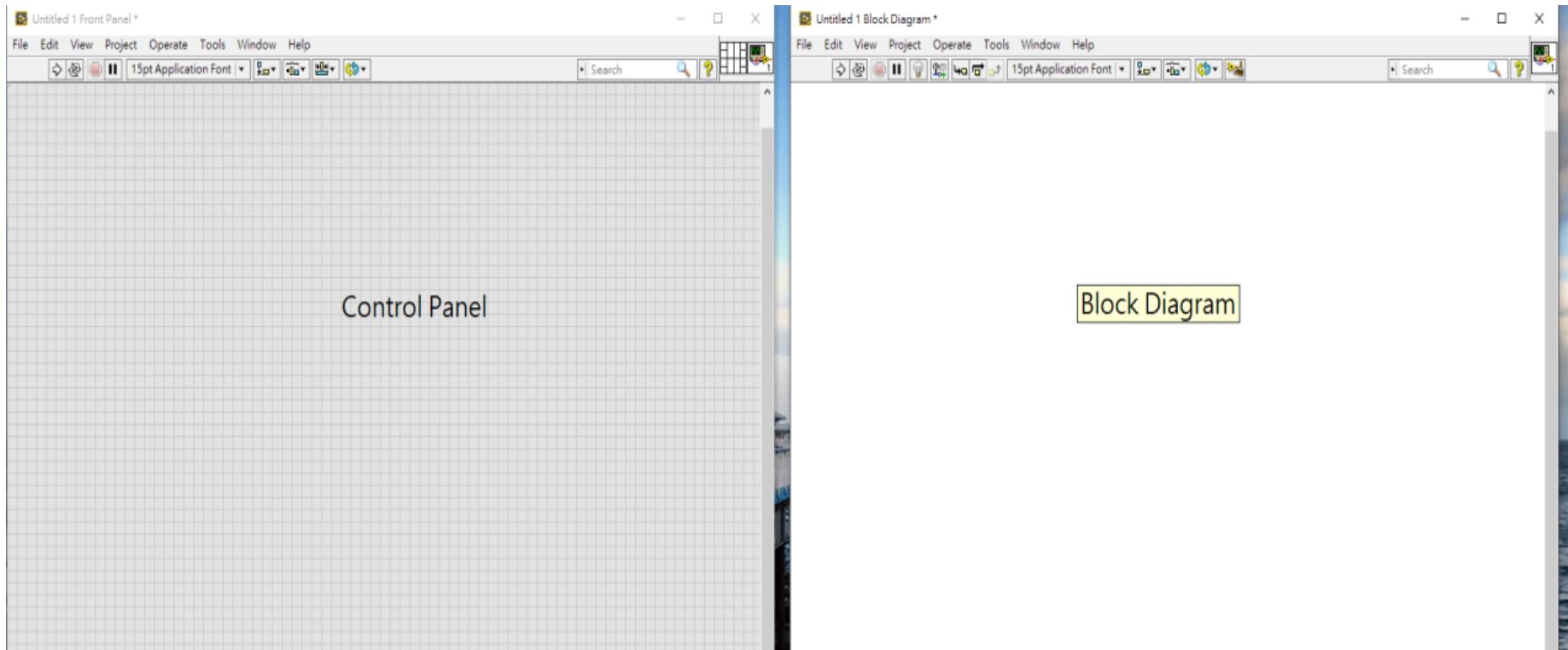
Front panel 主要是作為參數輸入輸出的介面，而block diagram則是主要程式設計的介面。

LabVIEW工具套件

- LabVIEW通信相關套件
  - Modulation
  - Real-time
  - NI USRP
  - NI MyRIO
  - NI FPGA
  - …
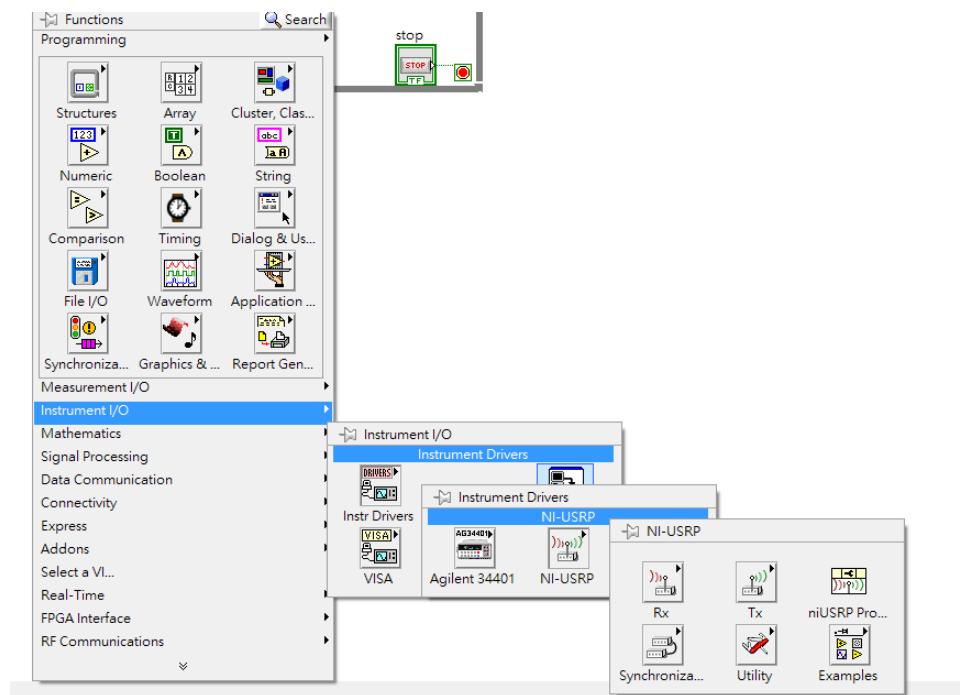
Resources

- 台大計中授權軟體下載
  - 搜尋"labVIEW"
  - 下載LabVIEW 2014 DVD1
- LabVIEW額外套件 (optional)
  - LabVIEW 2014 Modulation toolkits (DVD2)

- 國家儀器National Instrument(資源下載)
  - http://www.ni.com/downloads/zht/

- 國家儀器論壇 (範例程式及問題討論)
  - http://forums.ni.com/

NI USRP – 軟體定義無線電

- RF 硬體參數:
  - 載波頻率範圍:
  - 取樣速率
  - 天線增益範圍

- 特色:
  - 雙天線(一傳一收)
  - 支援MIMO cable
  - 透過Ethernet 與PC交換資料

NI-USRP 2920

# NI USRP- 軟體定義無線電

RF 收發器

基頻
IQ

軟體處理功能

使用 USRP 設定 6 個參數

NI USRP Configuration
device names
192.168.10.2 ▼
IQ rate
1M
carrier frequency
94.7M
active antenna
RX1
gain
25
number of samples
20000
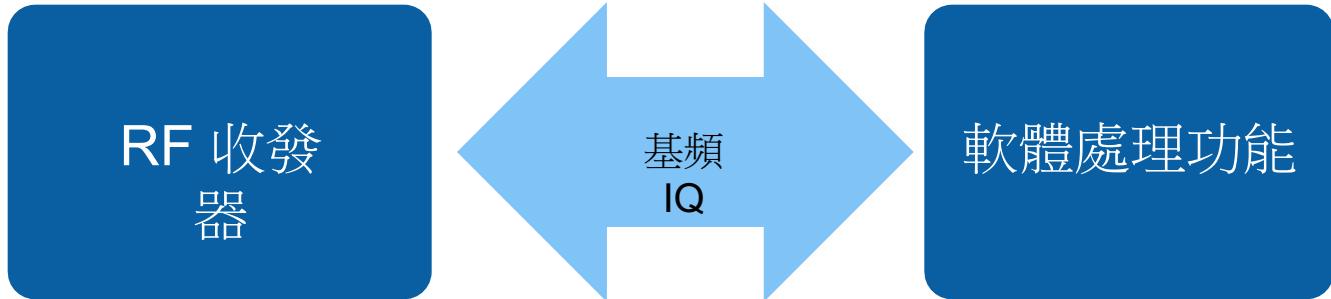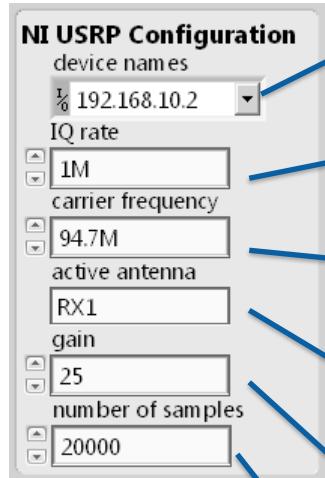
1. 裝置名稱：一或多個 USRP 的 IP 位址

2. IQ 率：正交取樣率，等同於頻寬

3. 載波頻率：目標頻率

4. 天線：選擇要接收的天線連接埠

5. 增益：數位化訊號之前的訊號放大功能

6. 取樣率：每次擷取的樣本數量

# NI USRP RF 接收參數

NI USRP Configuration
device names
192.168.10.2

IQ rate
1M

carrier frequency
94.7M

active antenna
RX1

gain
25

number of samples
20000

IQ 率 ~ 頻寬

1 MHz

功率 (dB)

50 MHz

94.7 MHz 頻率

NI USRP RF 接收參數

NI USRP Configuration

device names

I_{δ} 192.168.10.2

IQ rate

1M

carrier frequency

94.7M

active antenna

RX1

gain

25

number of samples

20000

載波頻率

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功率 (dB)

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94.7 MHz 頻率
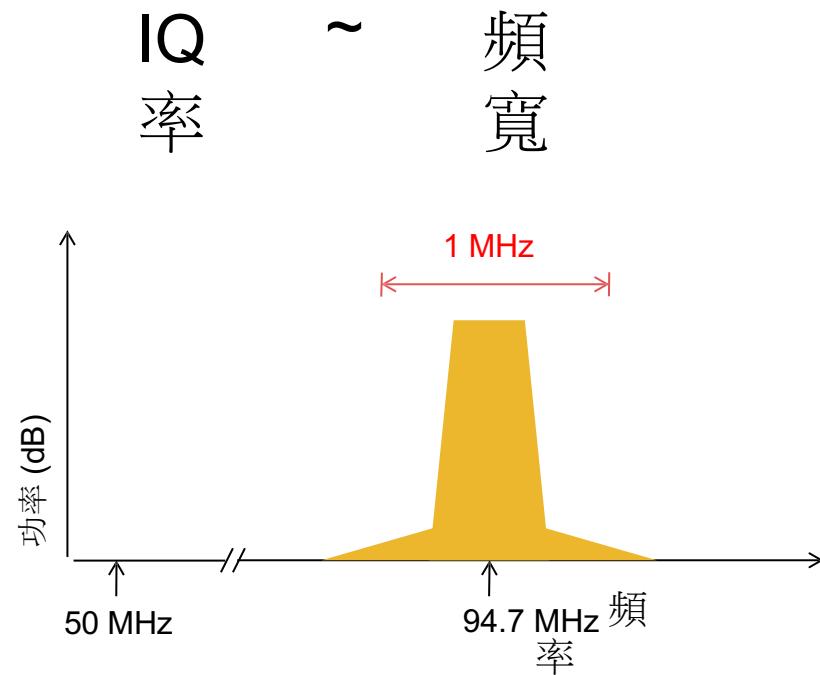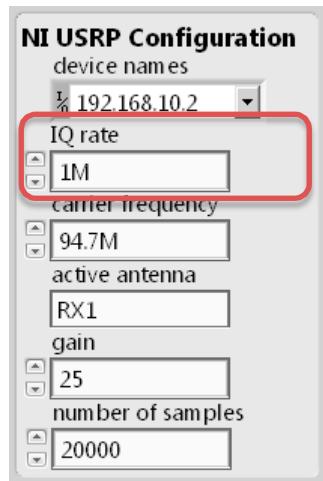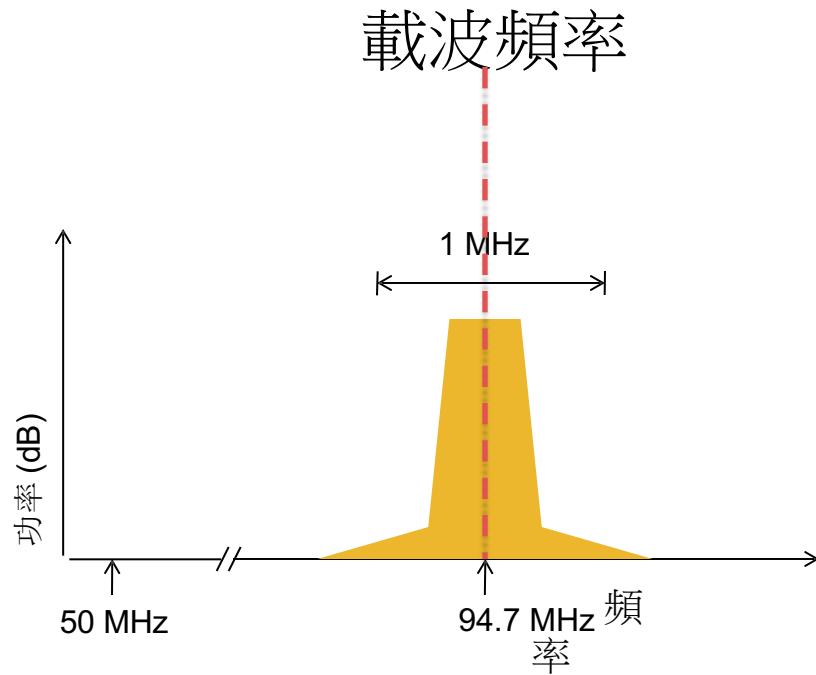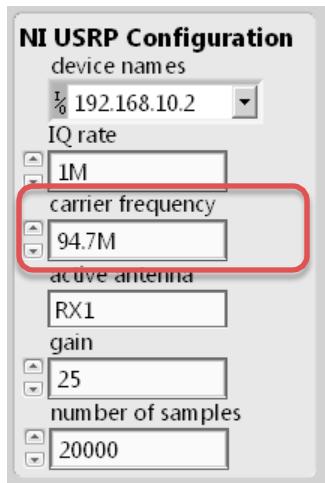
NI USRP RF 接收參數
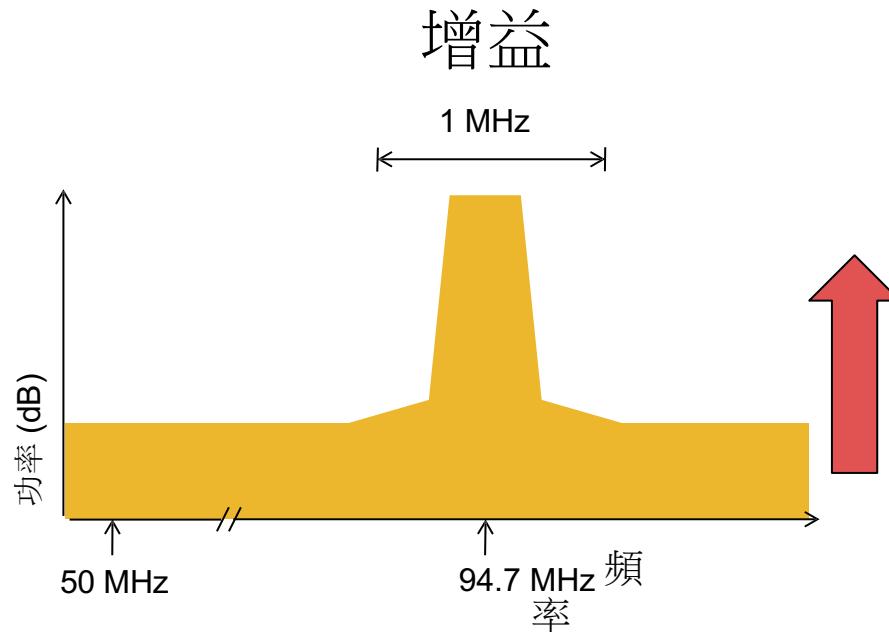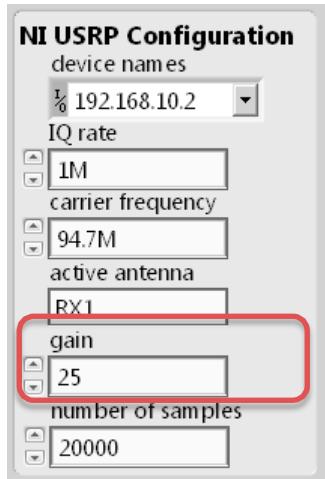
You will tune these parameters to see the effect in Lab1

Install LabVIEW & USRP

Step-by-step tutorial

Step 1: Download LabVIEW

- Brought to you by NTU
  - Only for NTU students

- ISO file
  - Free resources: Daemons tool...

- May need an NI account
  - You can apply one with NTU mail for free

# Step 2: Install LabVIEW

Step 3: Install USRP modules

- Each group has one NI-USRP DVD
  - Install on Lab PC or laptop with CD-ROM

- For those who do not have CD-ROM
  - Download from NI.com
  - Burn the DVD to ISO file
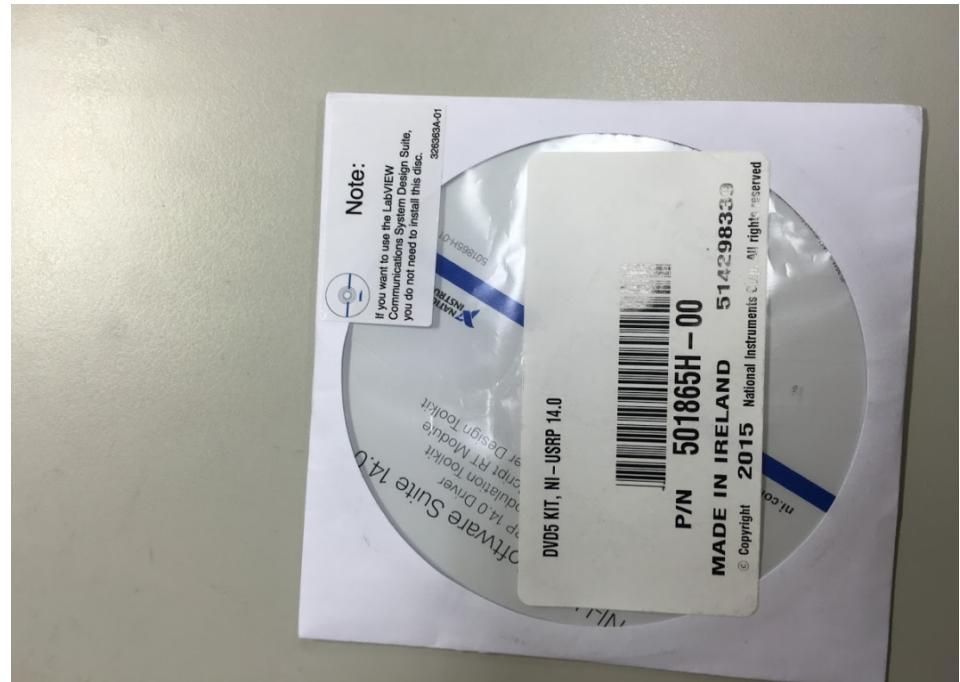
Step 4: Install Modulation toolkit

- The NI-USRP DVD contains Modulation toolkit
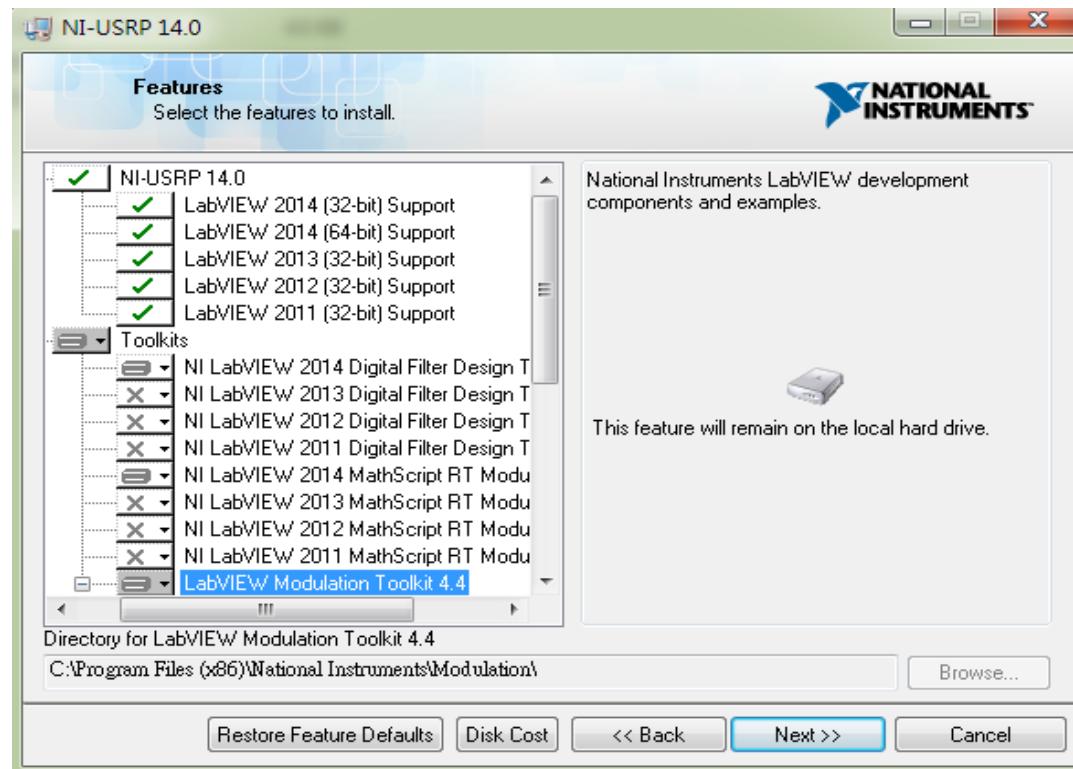
Alternative method

- Download from NI support
  - NI-USRP 14.0
  - http://www.ni.com/download/ni-usrp-14.0/4999/en/

  - Or search "NI USRP" at the support page of NI website

Alternative method

- NI Modulation Toolkit
    - NI Account required

Open project file

- All USRP lab will be given as a LabVIEW project
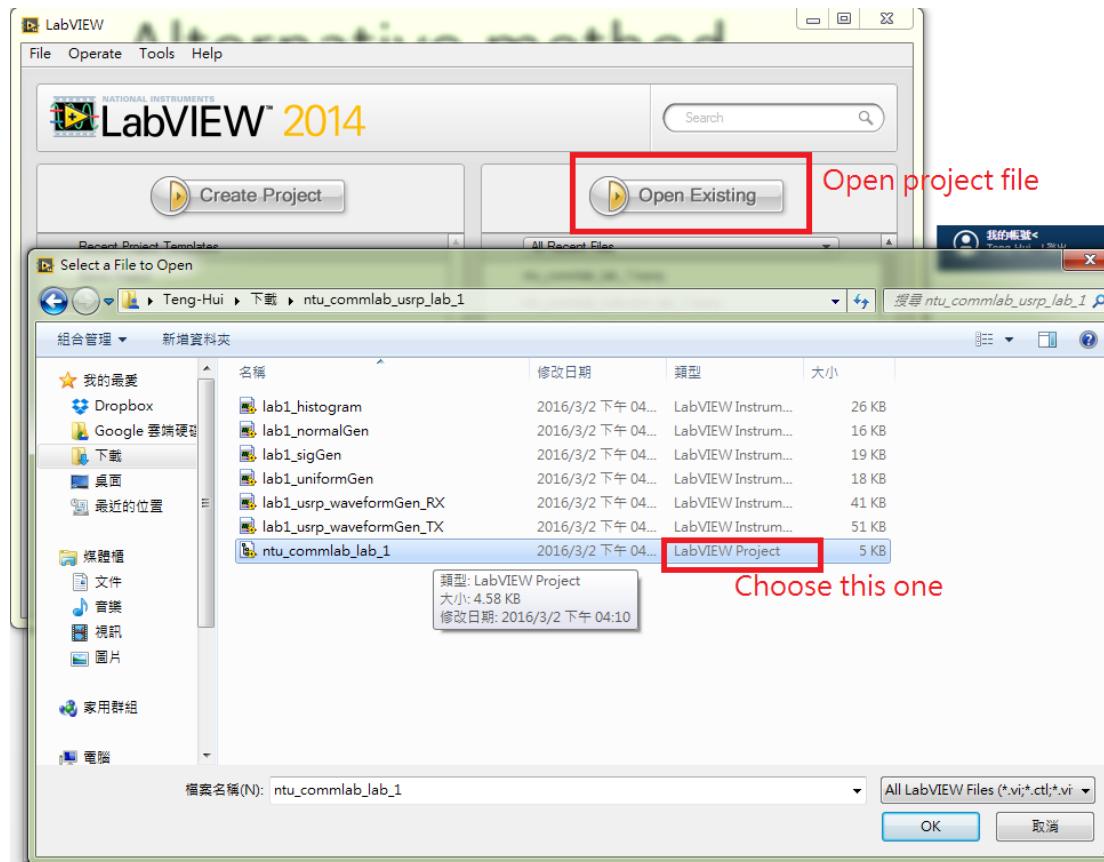
USRP Guide

Step-by-step Tutorial

How to use USRP?

- Connect the power line, Ethernet cable, antennas

How to use USRP?

- Configure the IP address as follow

Configure the IP address of your Ethernet card (IPv4)
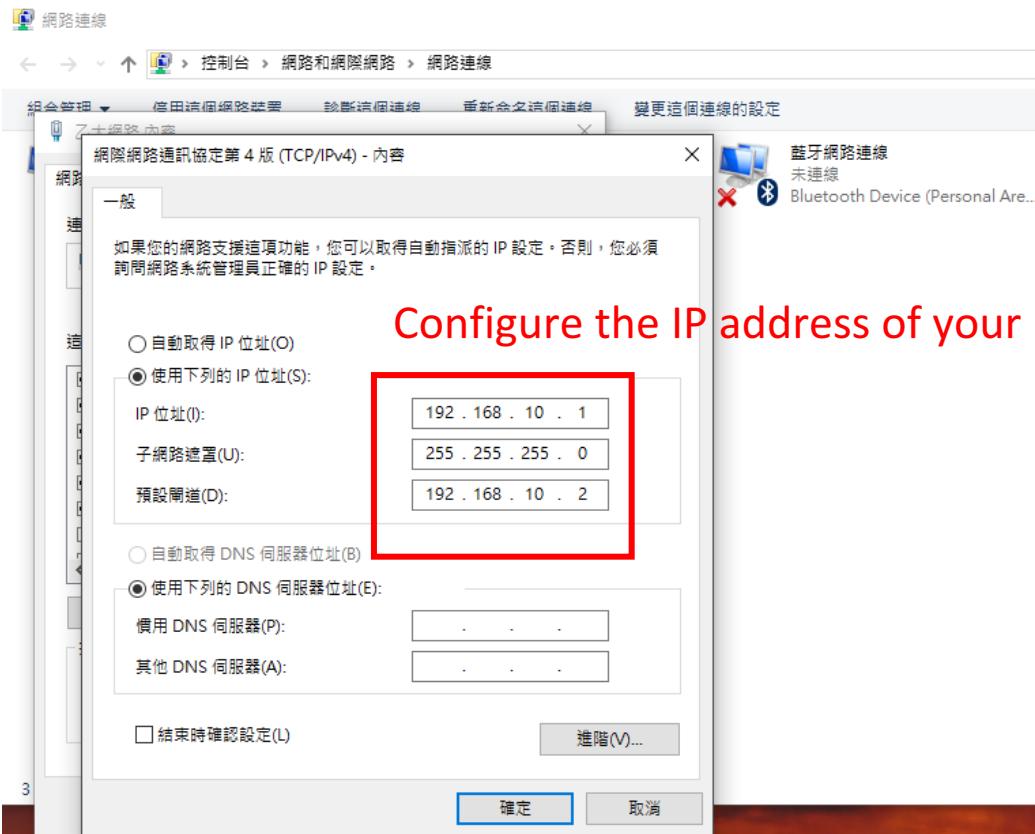
How to use USRP?

- Open "NI-USRP Configuration Utility"

How to use USRP?

See things similar to the following if you setup correctly
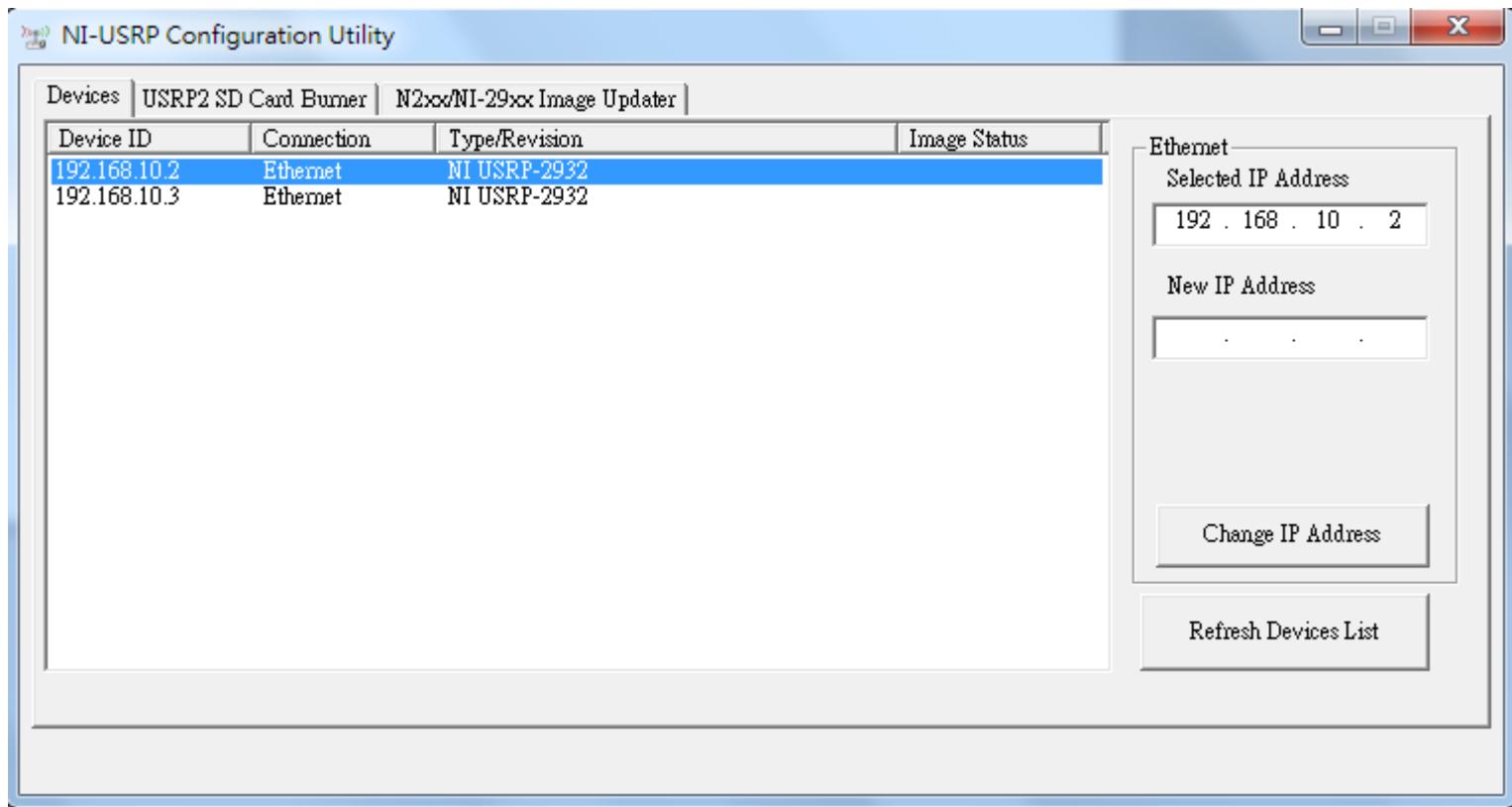
Update the FPGA firmware

If there's something wrong:
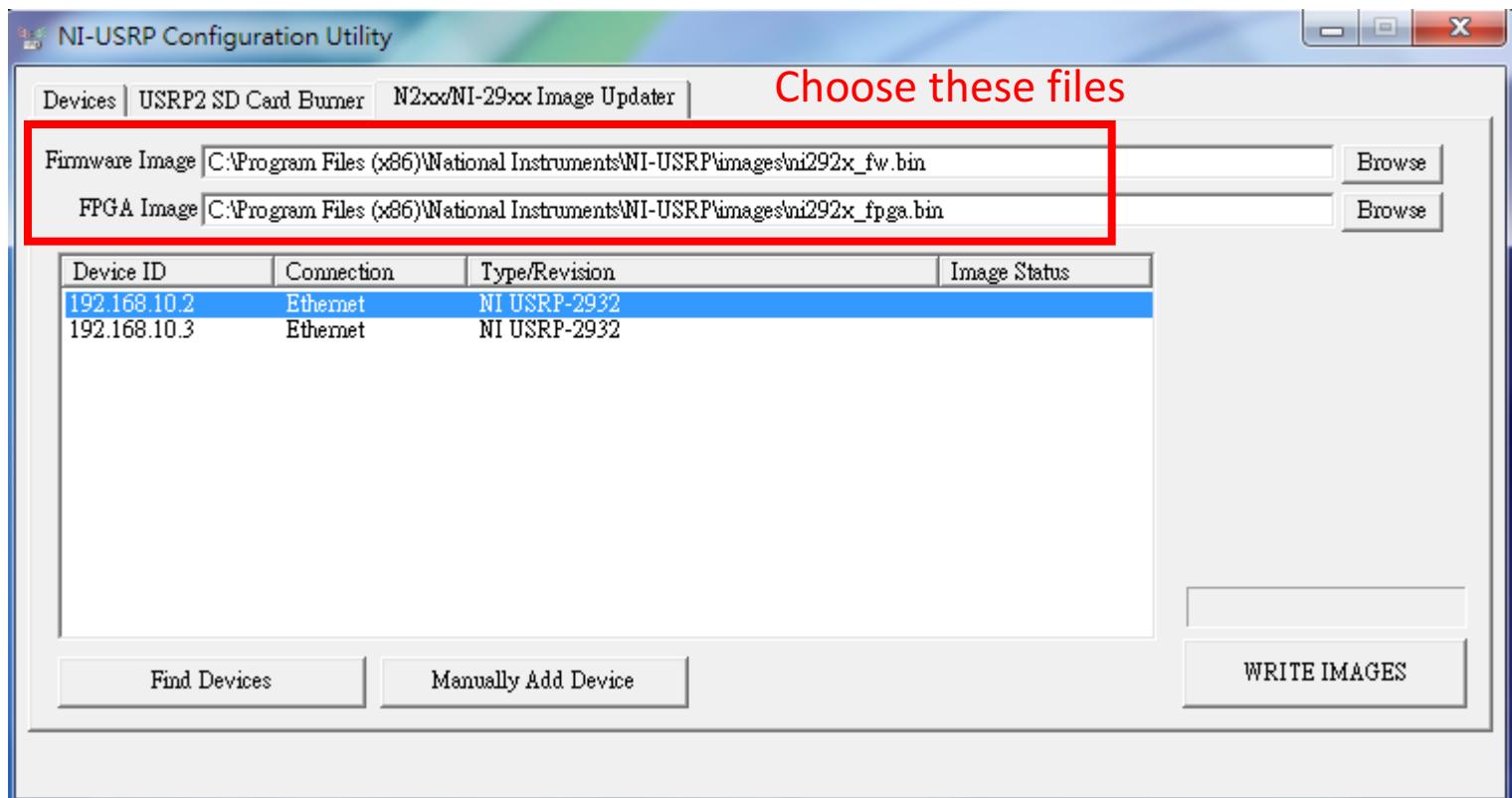
Treat USRP gently!

Have fun!

Warm up

- You can learn to use Labview and USRP on this website

  ## http://www.labviewpro.net/

Contact information

- Contact TAs for any problem you cannot solve
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  周柏均
  - d02942012@ntu.edu.tw