

# LabVIEW & USRP Introduction

周柏均、黃騰輝

National Taiwan University  
Communication Systems Lab

Spring 2017

# 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

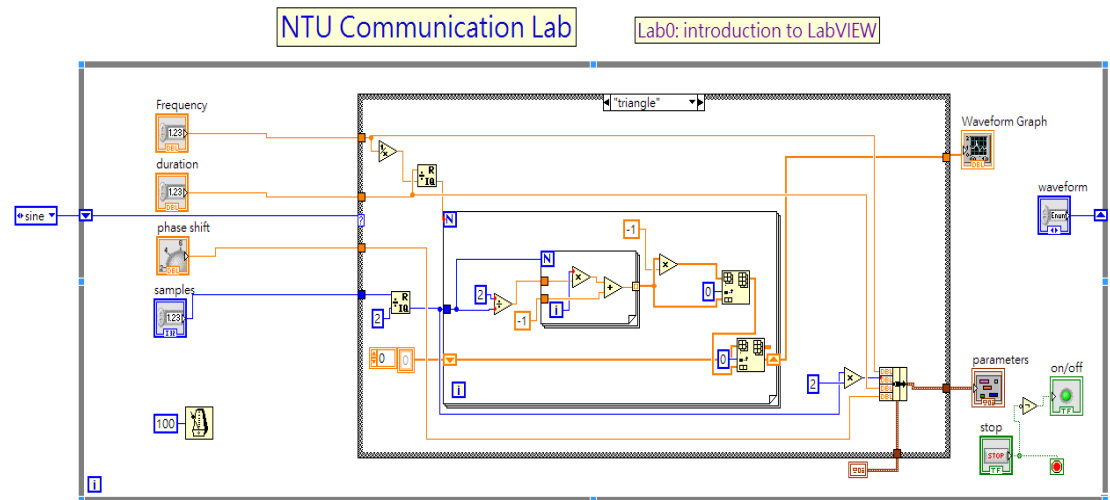
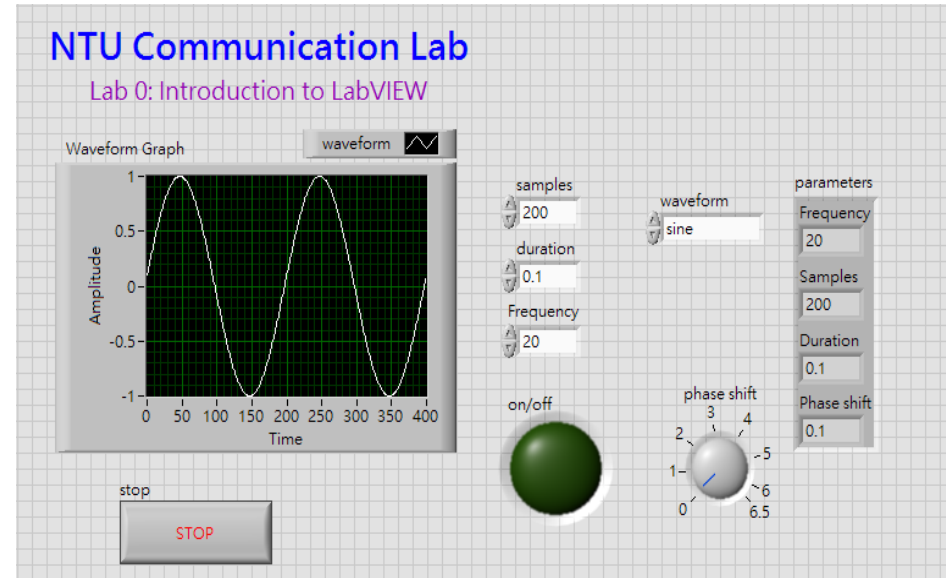
- Hardware: **USRP**

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

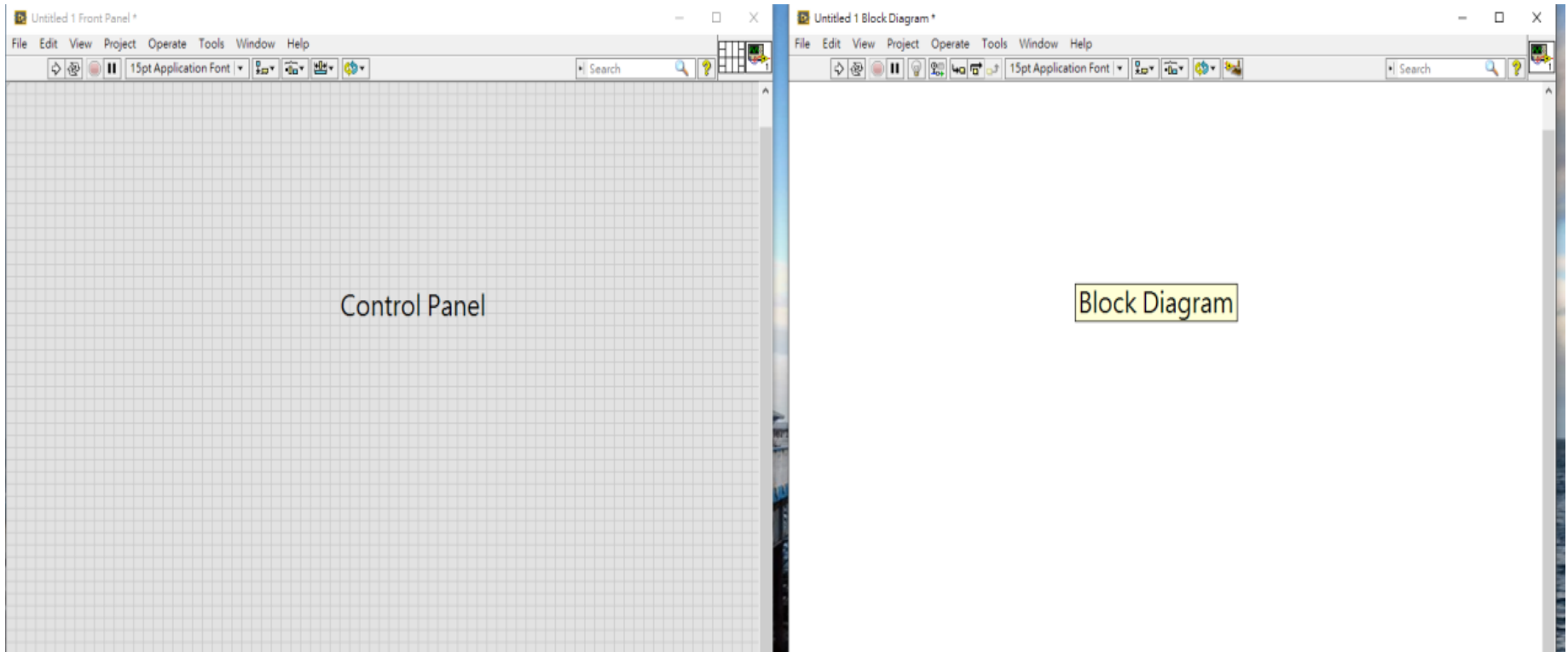


# LabVIEW

- Easy to operate
- Convenient application
- Good support for USRP



# 介面

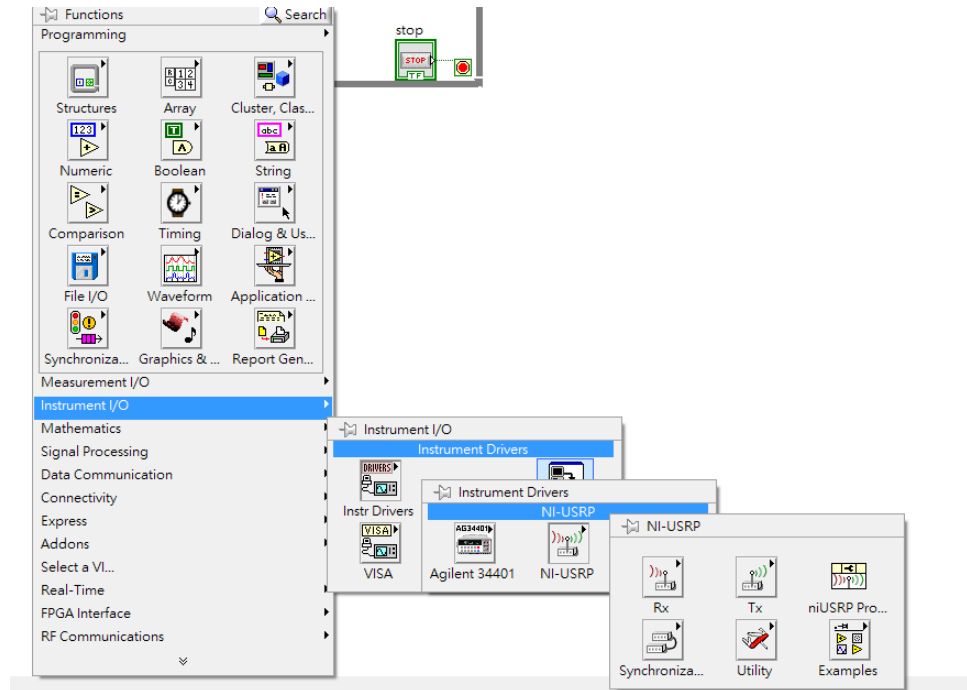


Front panel 主要是作為參數輸入輸出的介面，而block diagram則是主要程式設計的介面。

# 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

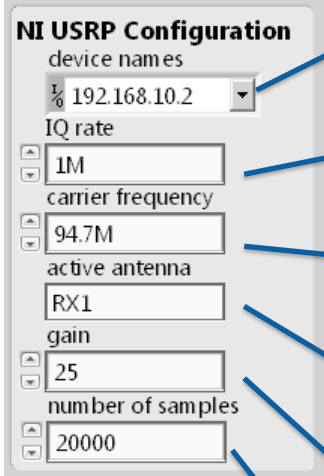
- RF 硬體參數:
  - 載波頻率範圍:
  - 取樣速率
  - 天線增益範圍
- 特色:
  - 雙天線(一傳一收)
  - 支援MIMO cable
  - 透過Ethernet 與PC交換資料



# NI USRP- 軟體定義無線電



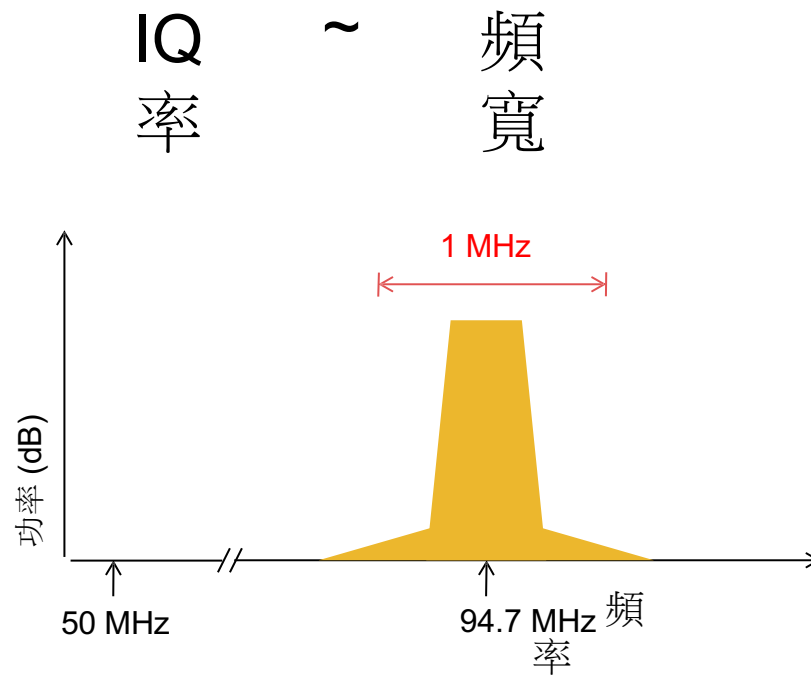
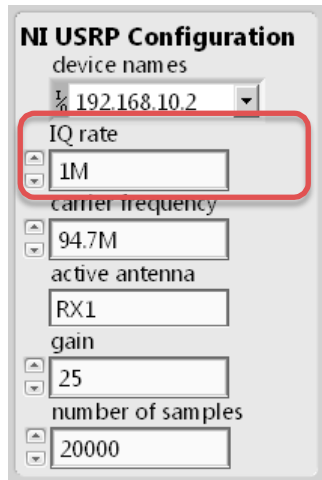
# 使用 USRP 設定 6 個參數



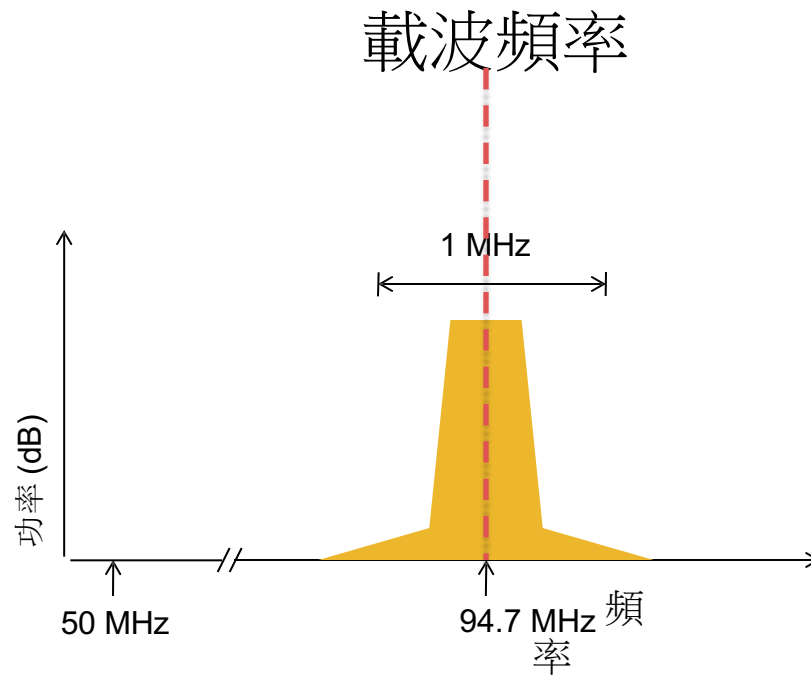
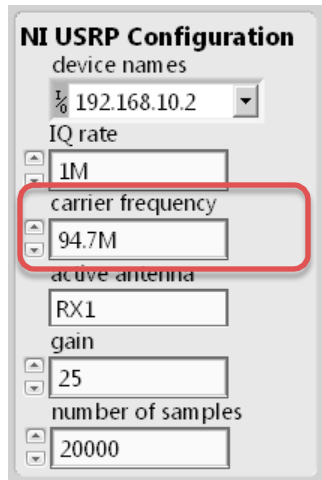
The image shows a screenshot of the 'NI USRP Configuration' dialog box. It contains several fields with blue arrows pointing to them from a list of six numbered items on the right. The fields and their values are: 'device names' (192.168.10.2), 'IQ rate' (1M), 'carrier frequency' (94.7M), 'active antenna' (RX1), 'gain' (25), and '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

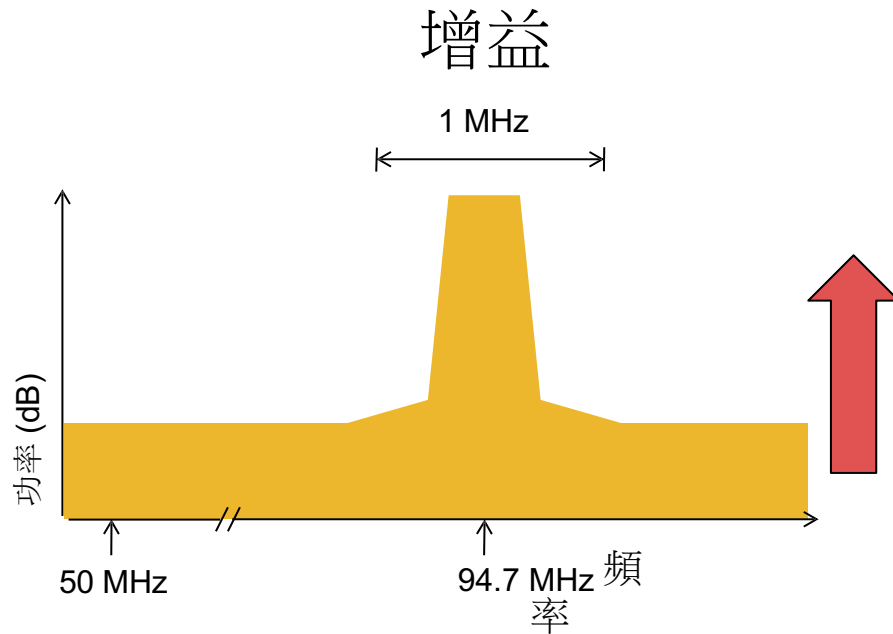
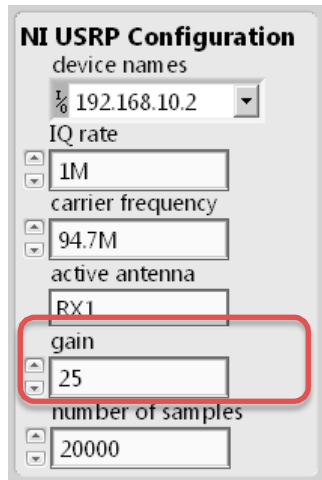
# NI USRP RF 接收參數



# NI USRP RF 接收參數



# 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

LabView (Fall 2014) 2014/10/13

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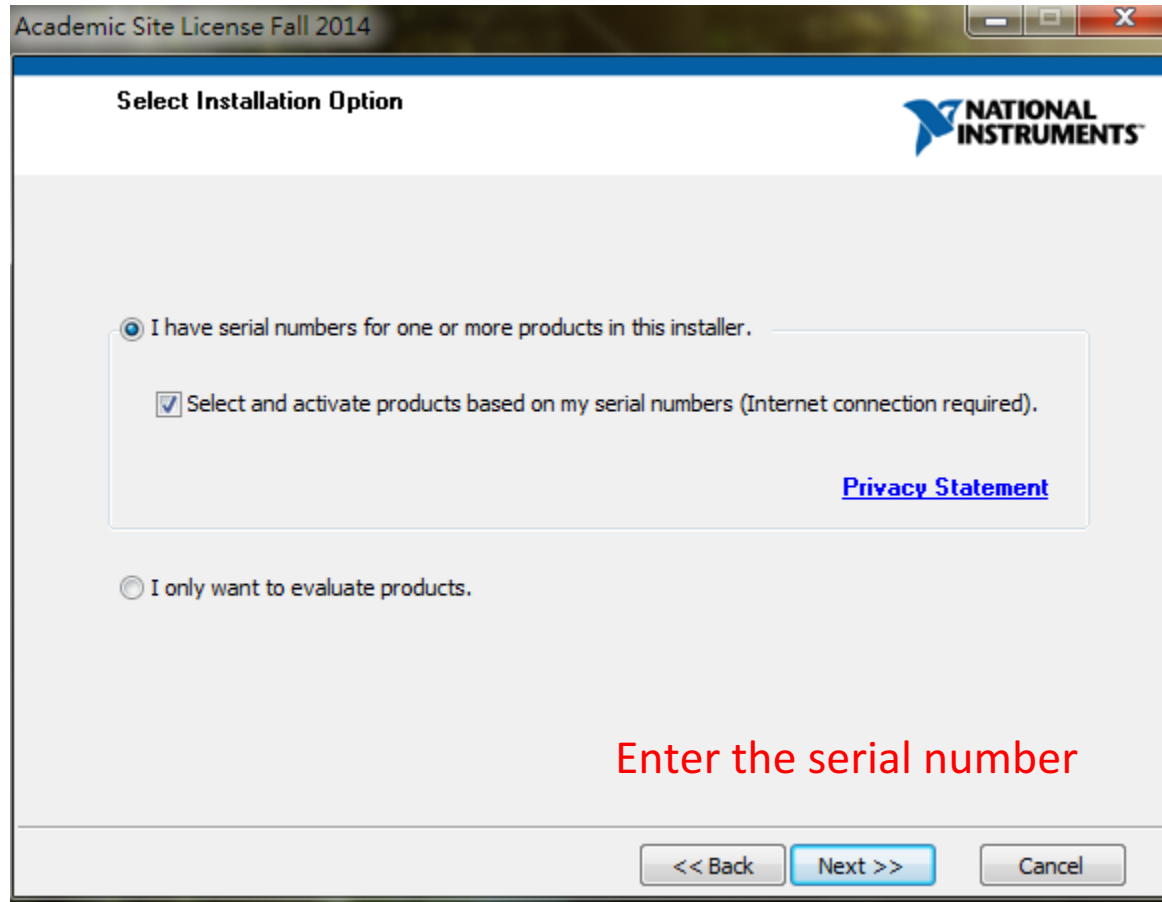
LabView (Fall 2014)  
1. Software from the LabVIEW Core DVDs.  
2. NI LabVIEW 2014 FPGA Module.  
3. NI Device Drivers.

serial: XXXXXXXXXX

download DVD 1  
(optional) DVD 2

DVD 1 of 3	Filesize: 7.1G	<a href="#">download 下载</a>
DVD 2 of 3	Filesize: 7.3G	<a href="#">download 下载</a>
DVD 3 of 3	Filesize: 7.1G	<a href="#">download 下载</a>
NI LabVIEW 2014 FPGA Module for Windows	Filesize: 7.3G	<a href="#">download 下载</a>
NI LabVIEW 2014 FPGA Module for Linux	Filesize: 7.2G	<a href="#">download 下载</a>
NI LabVIEW 2014 for Linux and Mac OS X 10.8.0 to 10.9.0	Filesize: 3.1G	<a href="#">download 下载</a>
NI Device Drivers	Filesize: 7.8G	<a href="#">download 下载</a>

# Step 2: Install LabVIEW



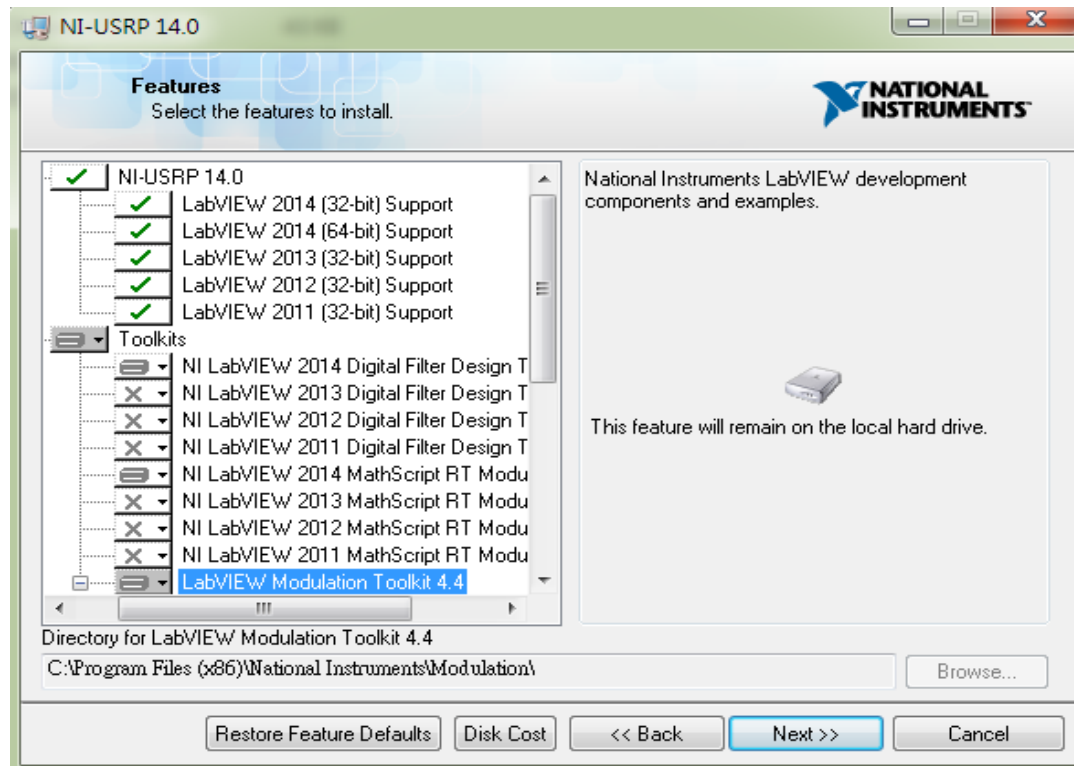
# Step 3: Install USRP modules

- 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

NATIONAL INSTRUMENTS™

解決方案 選購 **支援** 社群

台灣 (Taiwan) 我的帳號 Teng-Hui... 登出

首頁 > 支援 > 下載 > NI 產品下載 > 搜尋結果

搜尋完整網站

搜尋範圍

- Downloads
- Product Downloads
- Drivers
- Camera Network
- DataPlugins

縮小依據

- 產品
  - LabVIEW Add-ons (15)
  - RF (11)
- 版本
  - 4.4 (1)
  - 4.3.4 (1)
  - 4.3.3 (1)
  - 4.1.1 (1)
  - 4.1 (1)

產品下載結果

Product Downloads Modulation toolkit

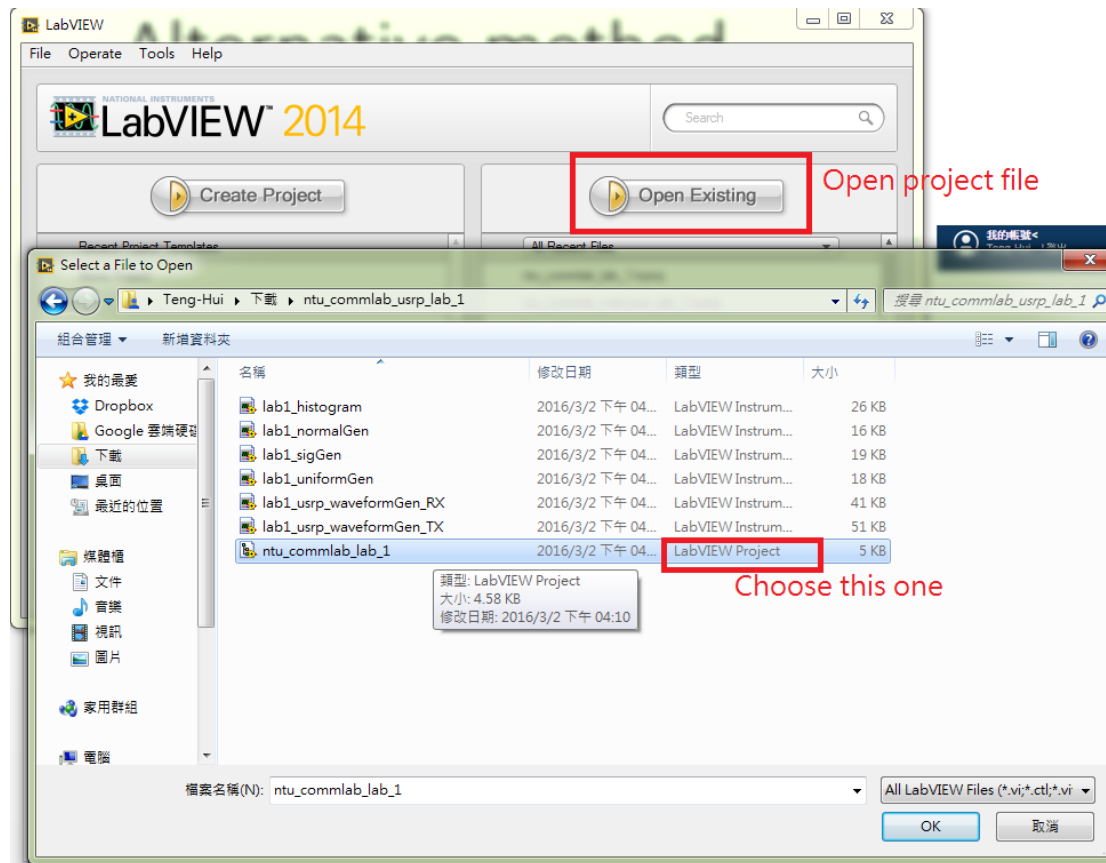
需要不只一個產品? 深入了解新的網路式安裝程式或立即選擇下載項目。

語言: 英文 / 中文 檢視: 10 顯示 1-10 項結果 (共 18 項)

Product/Version	Language	Operating System	Release Date	Download
LabVIEW Modulation Toolkit 4.3.3	English Japanese	Windows 7 Windows Vista Windows XP 32-bit Windows Server 2008 R2 64-bit Windows Server 2003 R2 32-bit	2012 February	下載
NI Modulation Toolkit 15.0	English Japanese	Windows 8.1 Windows 8 Windows 7 Windows Vista Windows XP (SP3) 32-bit Windows Server 2012 R2 64-bit Windows Server 2008 R2 64-bit Windows Server 2003 R2 32-bit	2015 June	下載

# Open project file

- All USRP lab will be given as a LabVIEW project



# USRP Guide

Step-by-step Tutorial



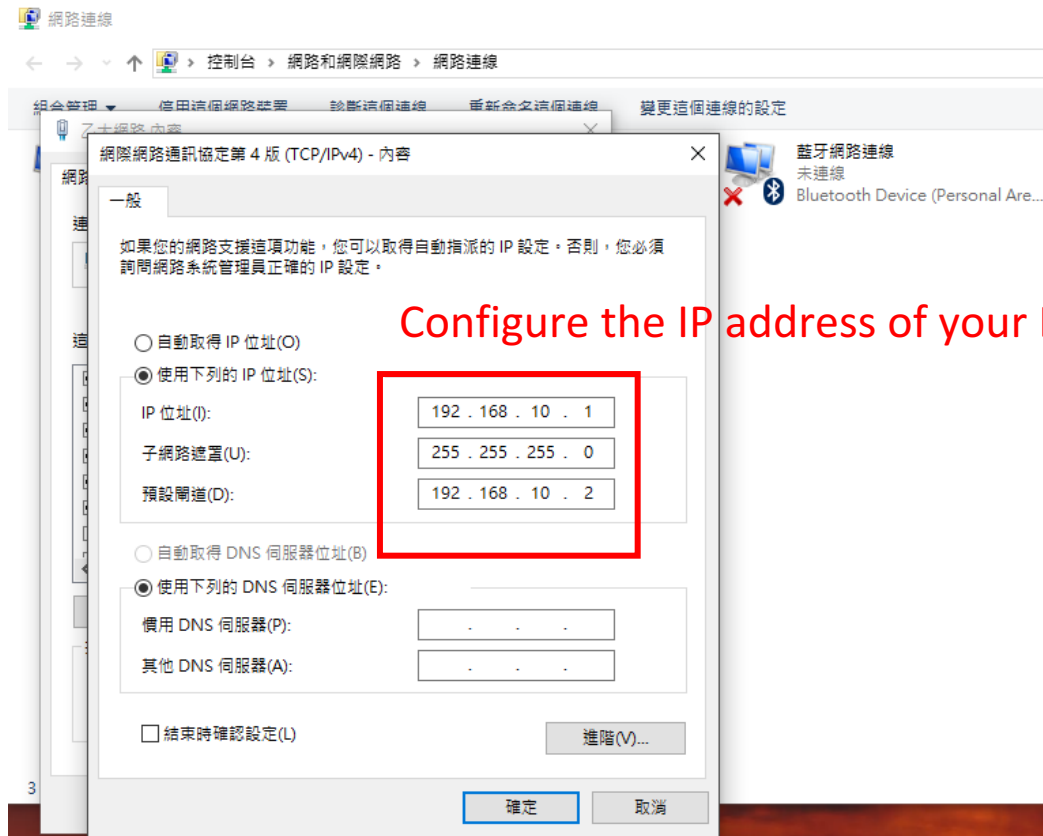
# How to use USRP?

- Connect the power line, Ethernet cable, antennas



# How to use USRP?

- Configure the IP address as follow



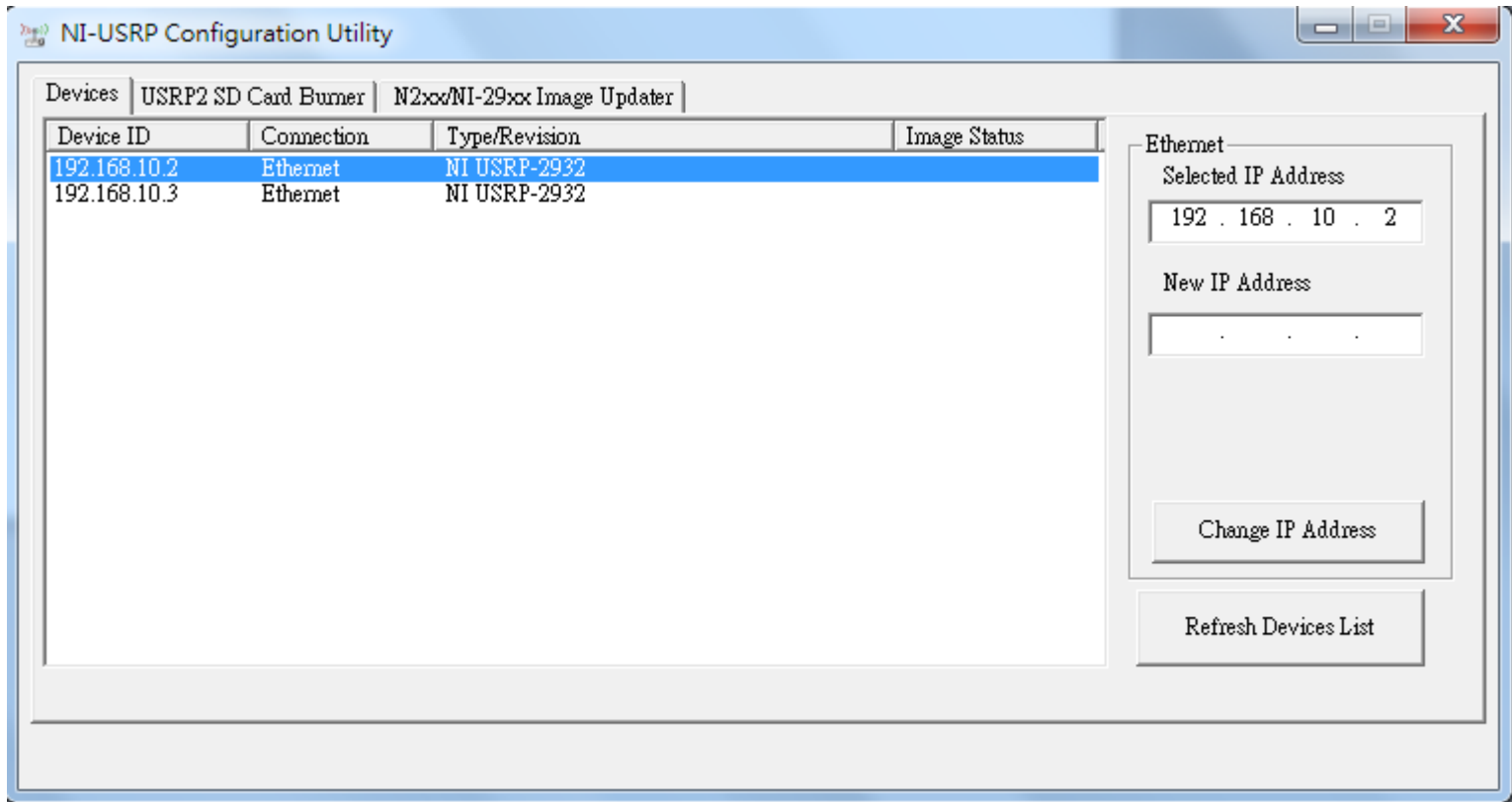
# How to use USRP?

- Open “NI-USRP Configuration Utility”



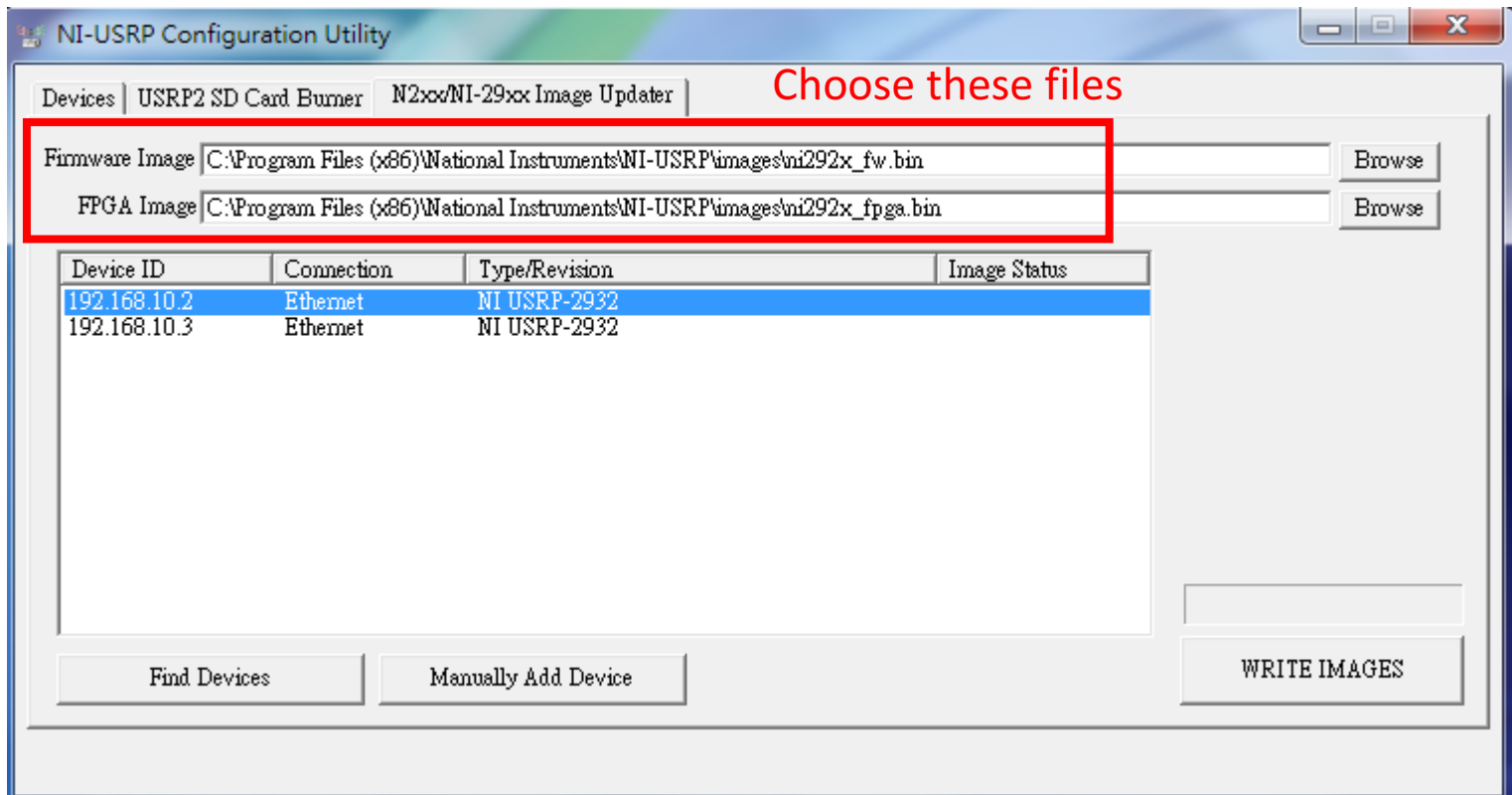
# How to use USRP?

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

黃騰輝

- [r04942057@ntu.edu.tw](mailto:r04942057@ntu.edu.tw)

周柏均

- [d02942012@ntu.edu.tw](mailto:d02942012@ntu.edu.tw)