DAQ, LabVIEW and Program Introduction

Joe Kao
Application engineer, eCloudValley

2022/03/25

Speaker Introduction

- Joe Kao, Application Engineer, eCloudvalley
- National Taiwan University, Institute of Applied Mechanics
- Expertise: Advanced Fluid Mechanics, Advanced Engineering Mathematics, LabVIEW

Outline

- DAQ Introduction
- LabVIEW introduction
- Program Introduction

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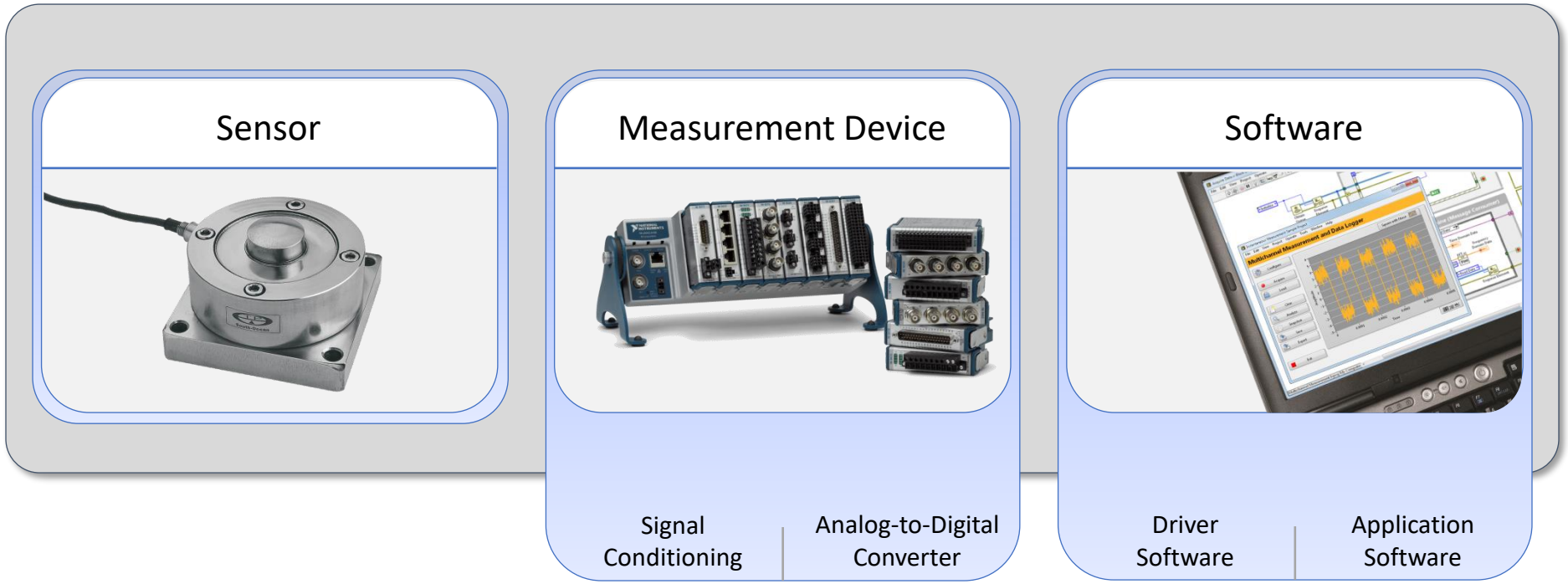
DAQ in NI


C
F
100°
90°
80°
70°
60°
50°
40°
30°
20°
10°
0°
-10°
-17.78°
212°
194°
176°
158°
140°
122°
104°
86°
68°
50°
32°
14°
0°

Architecture of an Integrated Measurement System

Today, we'll learn about three key differentiating components of a National Instruments data acquisition system:



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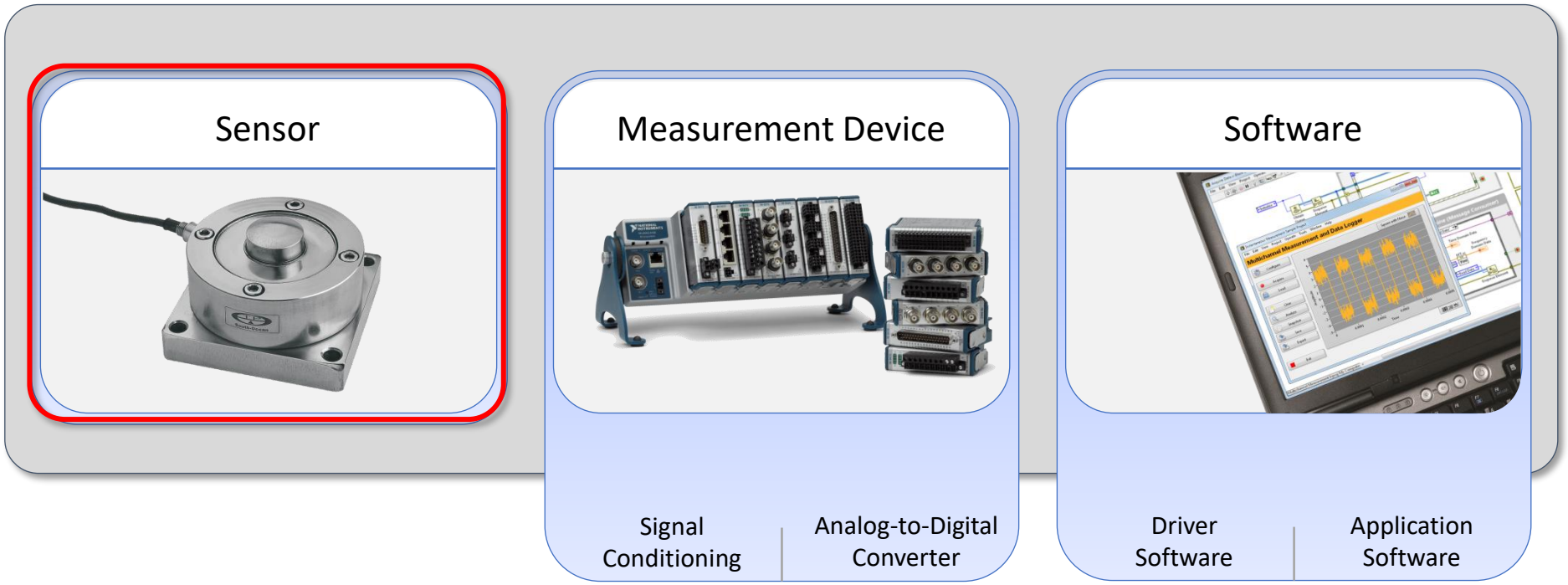

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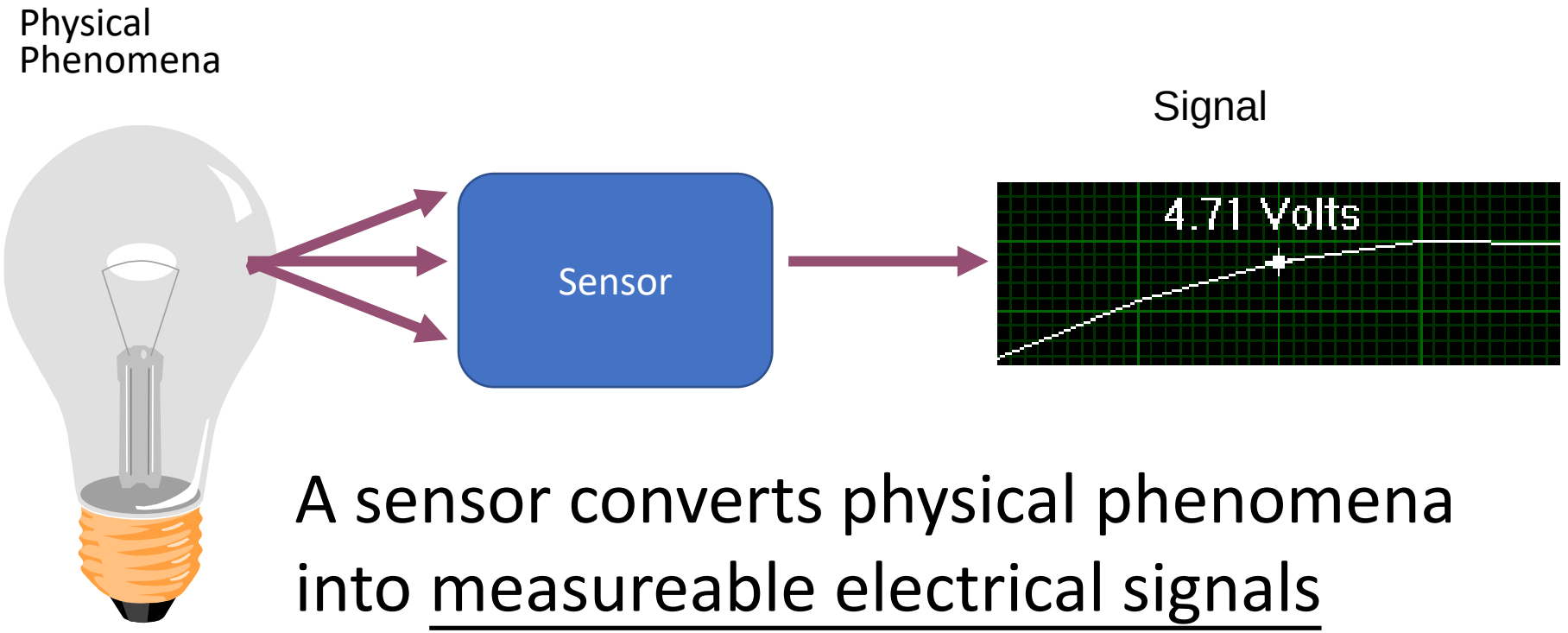
What is a Sensor?



A sensor converts physical phenomena into measureable electrical signals

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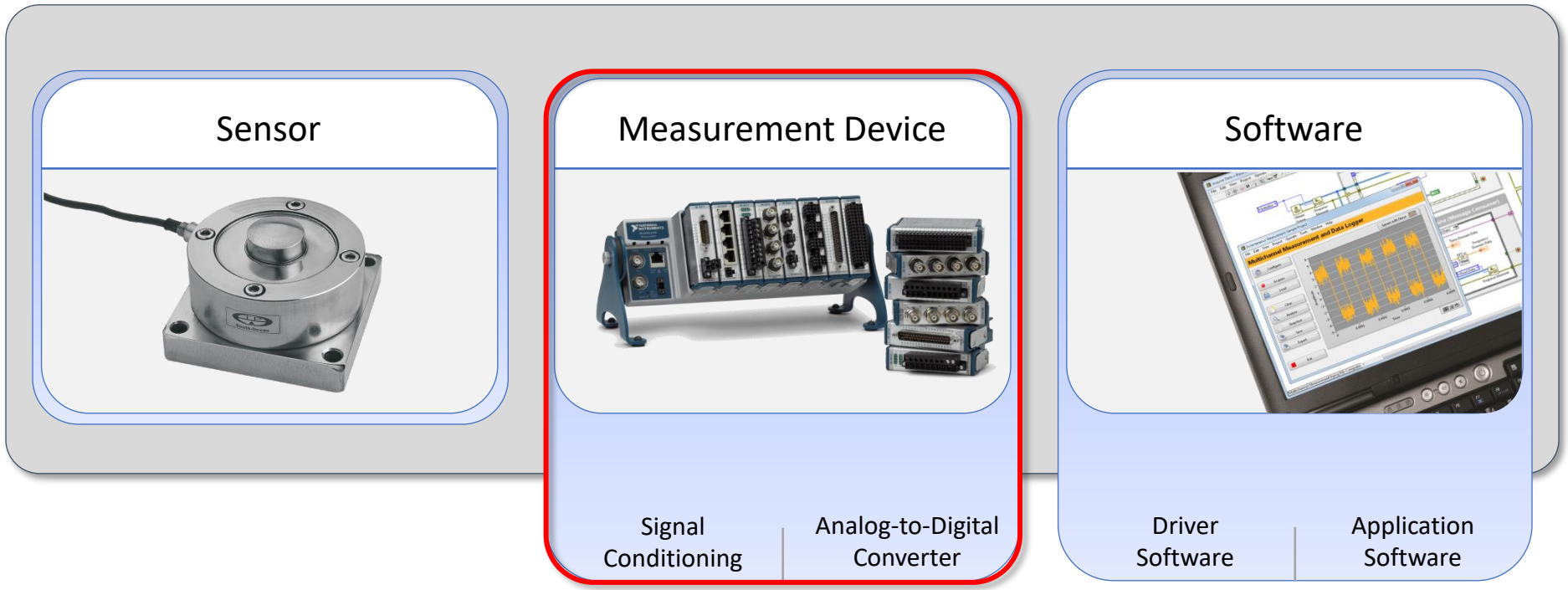

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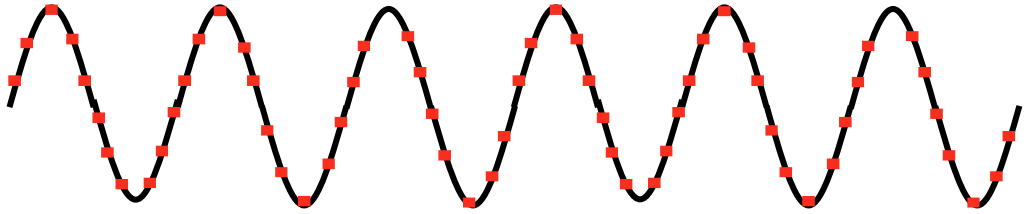
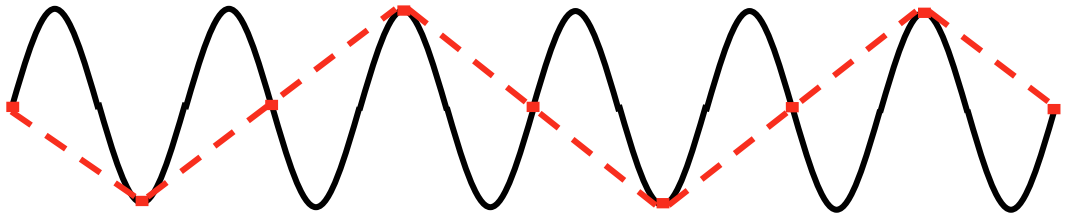
How to choose your DAQ?

- **Sample rate:**

Adequately Sampled



Aliased Due to Undersampling



Nyquist Theorem

$$f_s \geq 2fh$$

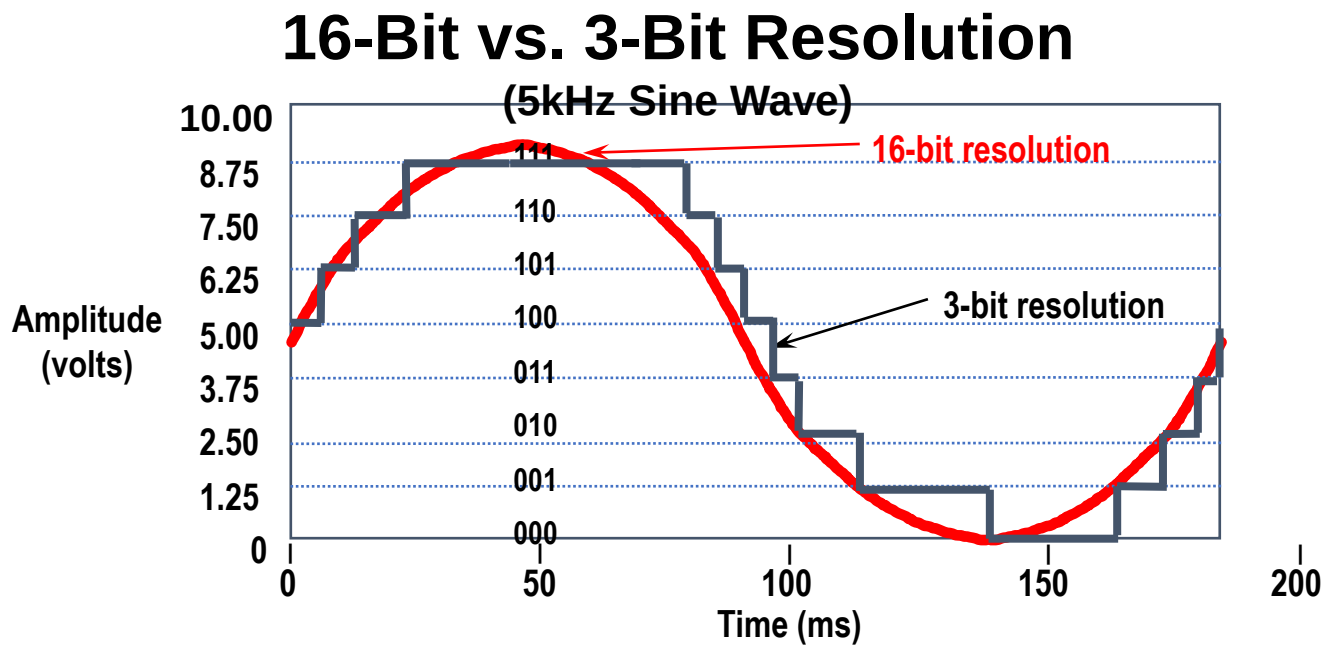
- You must sample at **greater** than **2 times** the **maximum** frequency component of your signal to accurately represent the FREQUENCY of your signal.

- **NOTE**: You must sample between 5–10 times greater than the maximum frequency component of your signal to accurately represent the SHAPE of your signal.

How to choose your DAQ?

- **Resolution:**

$$\text{code width} = \frac{\text{Device input range}}{2^{\text{resolution}}}$$



Let’s choose your DAQ

- **Request:**

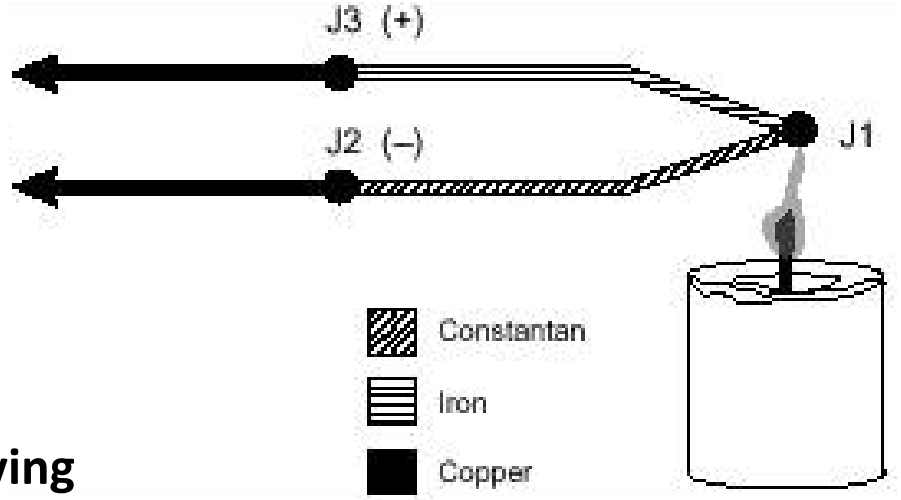
- A vibration signal with 100Hz frequency and 3.2V amplitude.

- Resolution at least 3 mV.

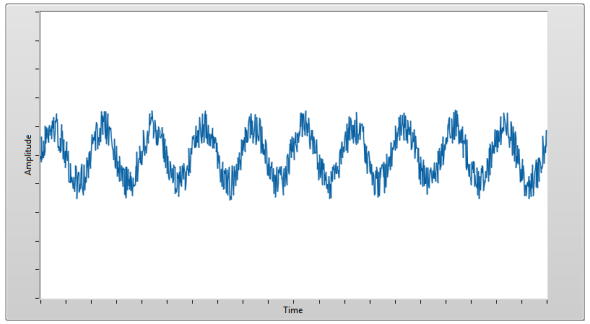
- **Solution:**
- NI 9234
  - 51.2 kS/s per channel maximum sampling rate; ±5 V input
  - 24-bit resolution

Signal Conditioning Example: Thermocouple

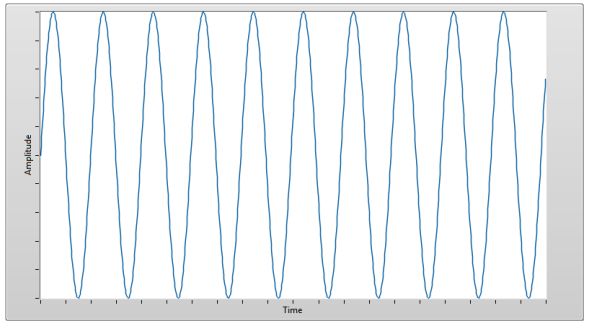
Cold Junction Compensation (CJC)



Filtering & Amplifying



Signal Conditioning



Noisy, Low-Level Signal

Filtered, Amplified Signal

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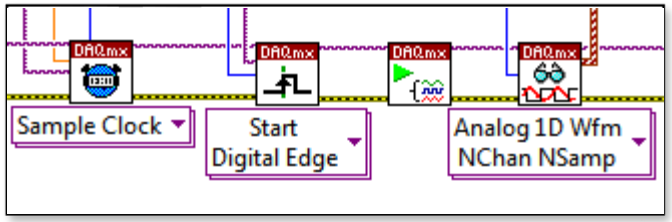
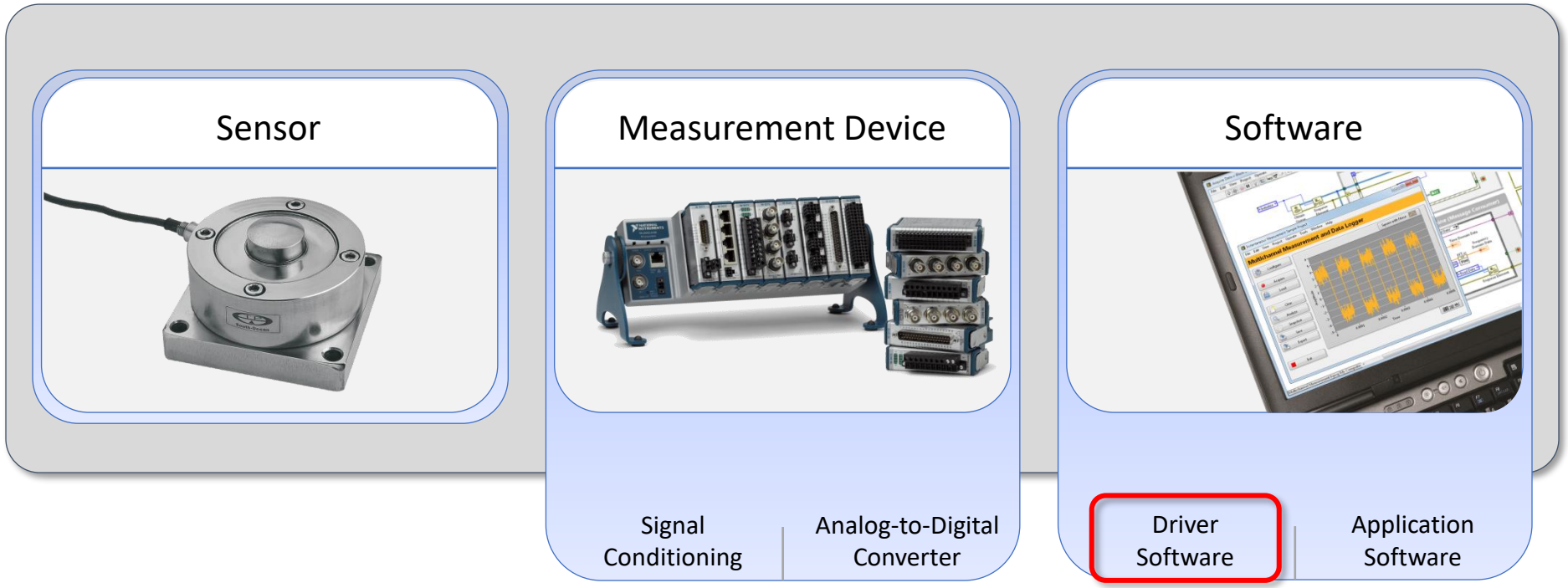
Architecture of an Integrated Measurement System



NI-DAQmx is free driver software that can be used in conjunction with several different programming languages to control thousands of different data acquisition devices with a consistent API.



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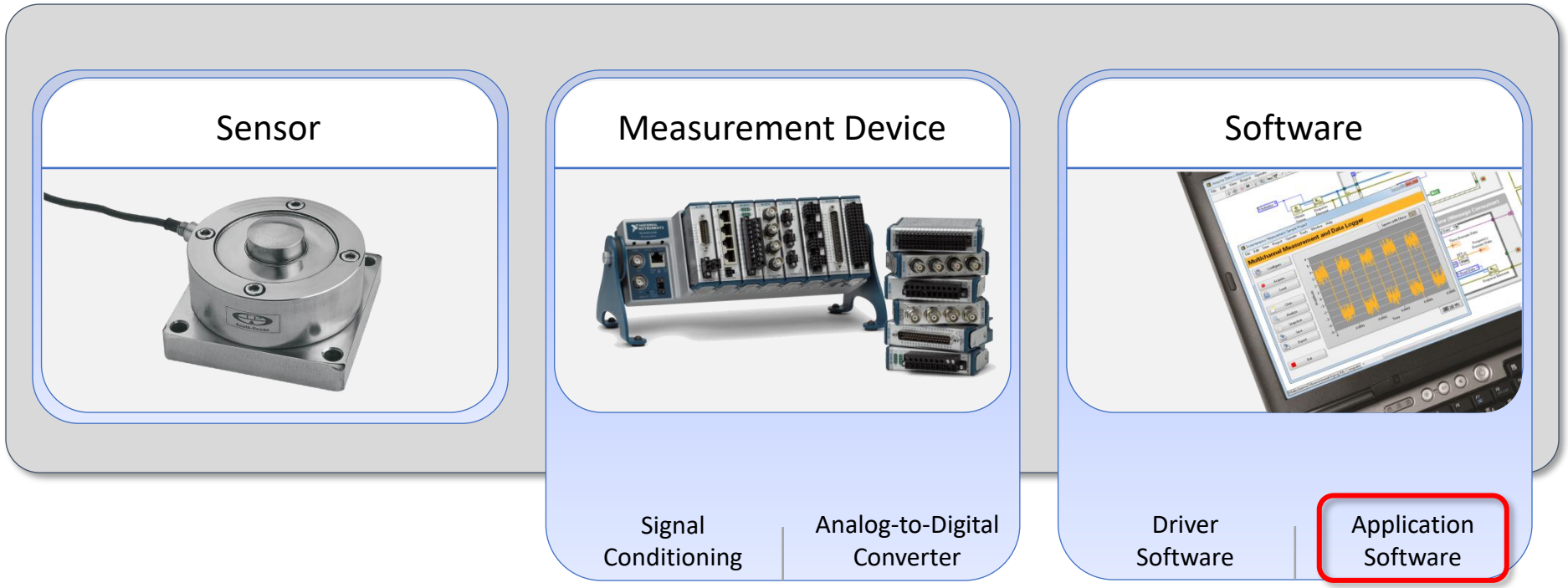
Architecture of an Integrated Measurement System

NATIONAL INSTRUMENTS LabVIEW™

LabVIEW is system design software that provides engineers and scientists with the tools needed to create and deploy measurement and control systems through unprecedented hardware integration.



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- 輕鬆建立客製化使用者介面
- 快速建立圖形化介面測試量測程式
- 無與倫比的硬體整合能力
- 重複利用現有程式碼與函式庫
- 資料可視化與完整分析函數功能

LabVIEW™

Integrate Hardware. Visualize Data. Accelerate Engineering.

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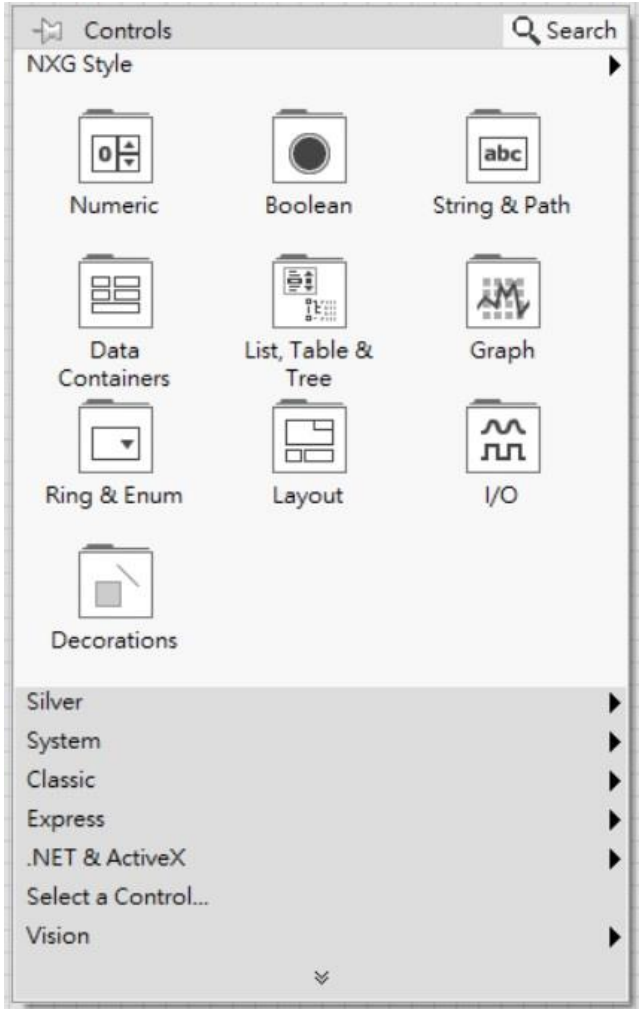
快速建立專業的使用者介面

拖放控制元件和顯示元件可幫助您創建客製化的專業人機界面以操作系統

Right Click



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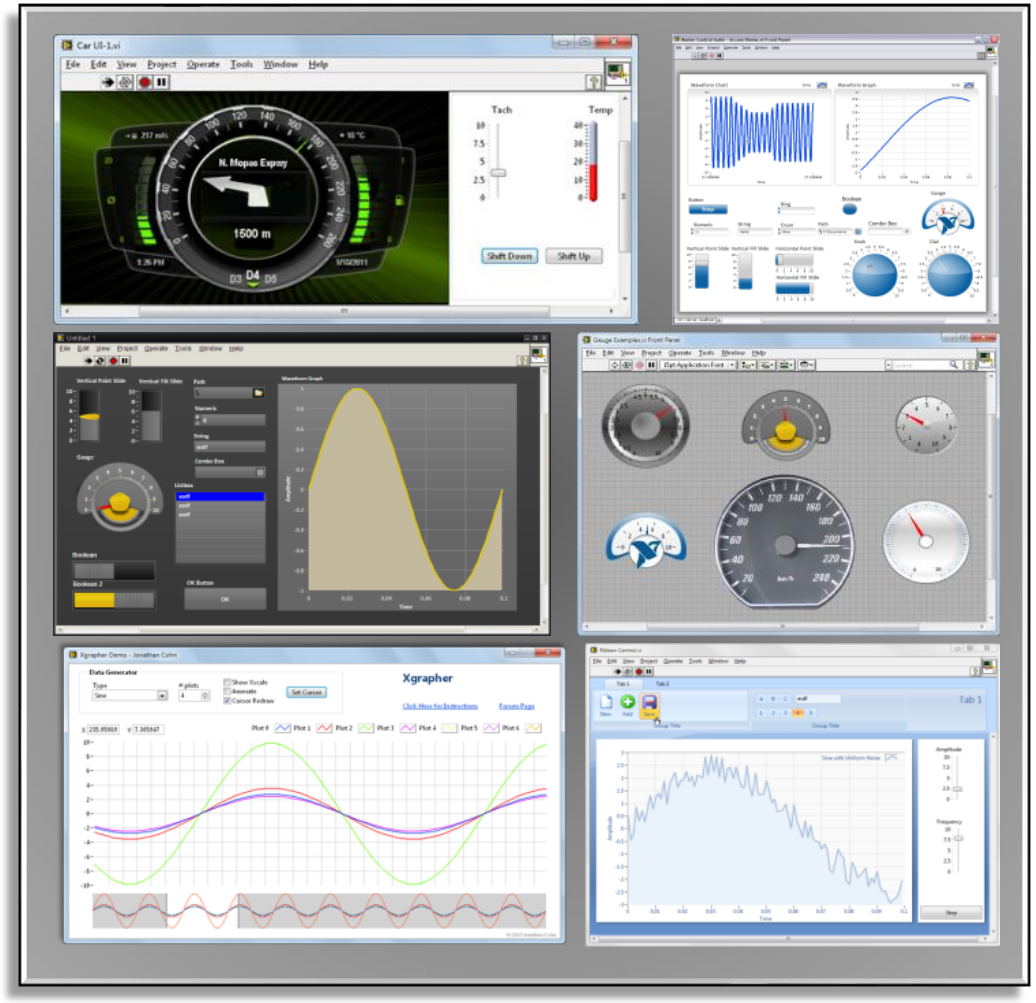
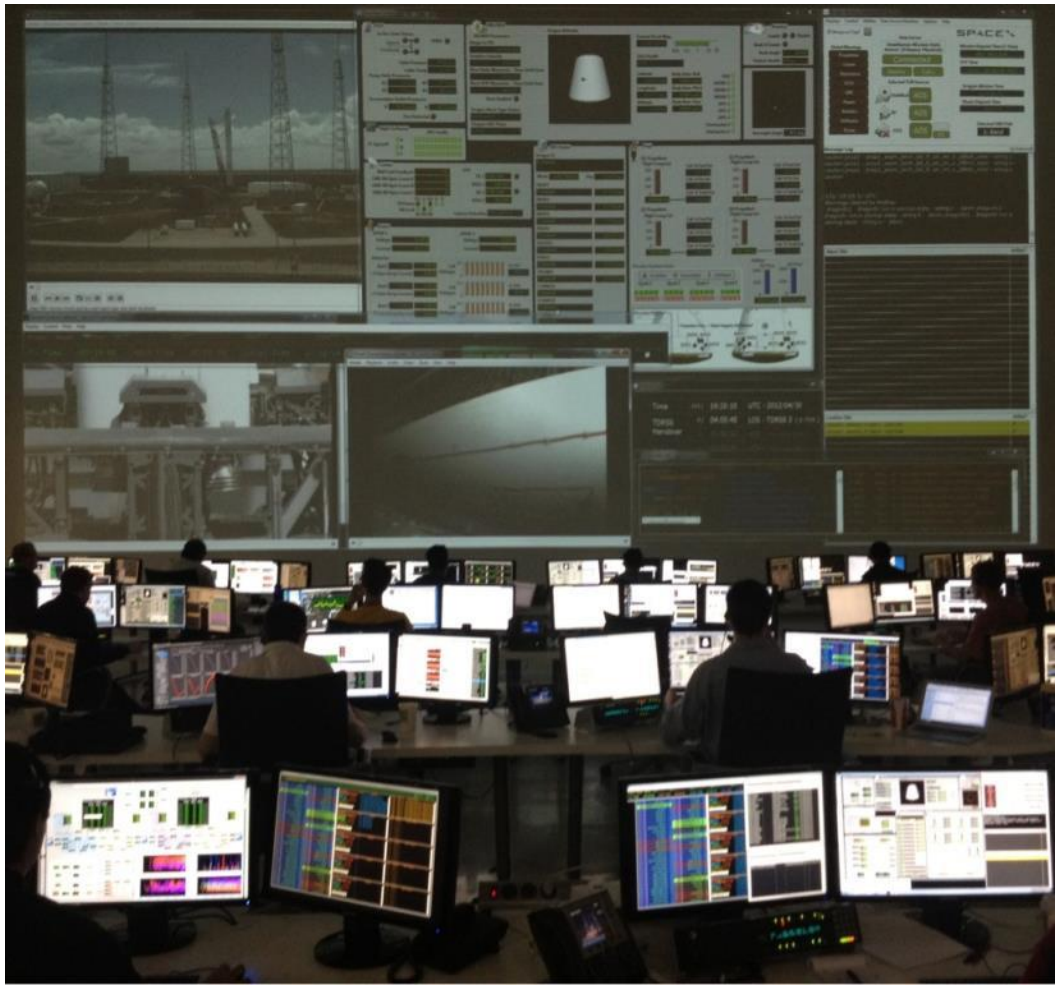
LabVIEW Front Panels in Action



All of the front panels above were contributed for sharing and reuse by members of the global LabVIEW community.

Dozens of LabVIEW front panels at SpaceX Mission Control during successful launch of Dragon
Photo Credit: Elon Musk



- 輕鬆建立客製化使用者介面
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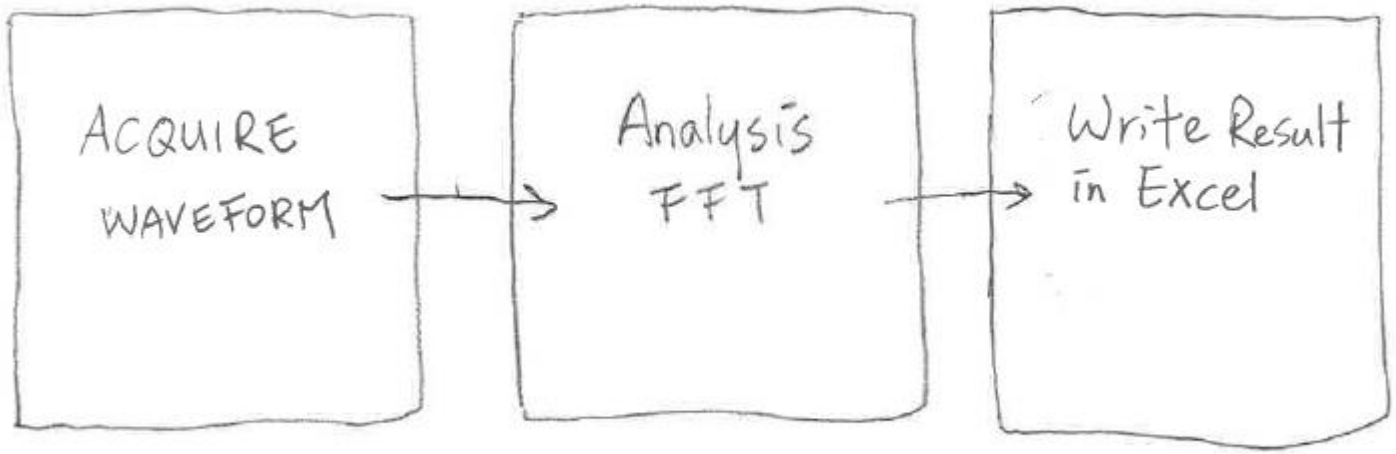
程式方塊圖

With LabVIEW, You Can Program the Way You Think



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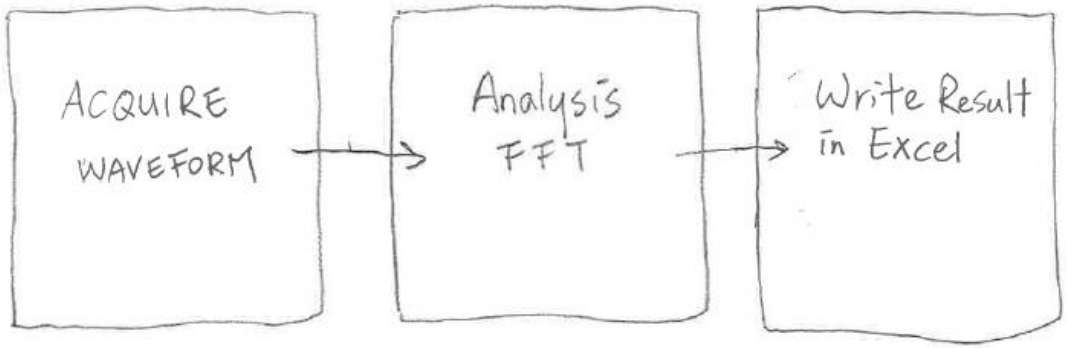

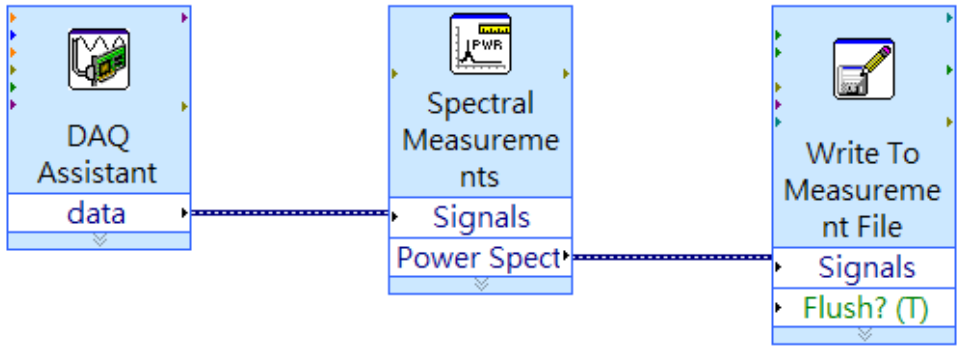

The graphical, dataflow-based G programming language is ideal for programming parallel test and measurement hardware.

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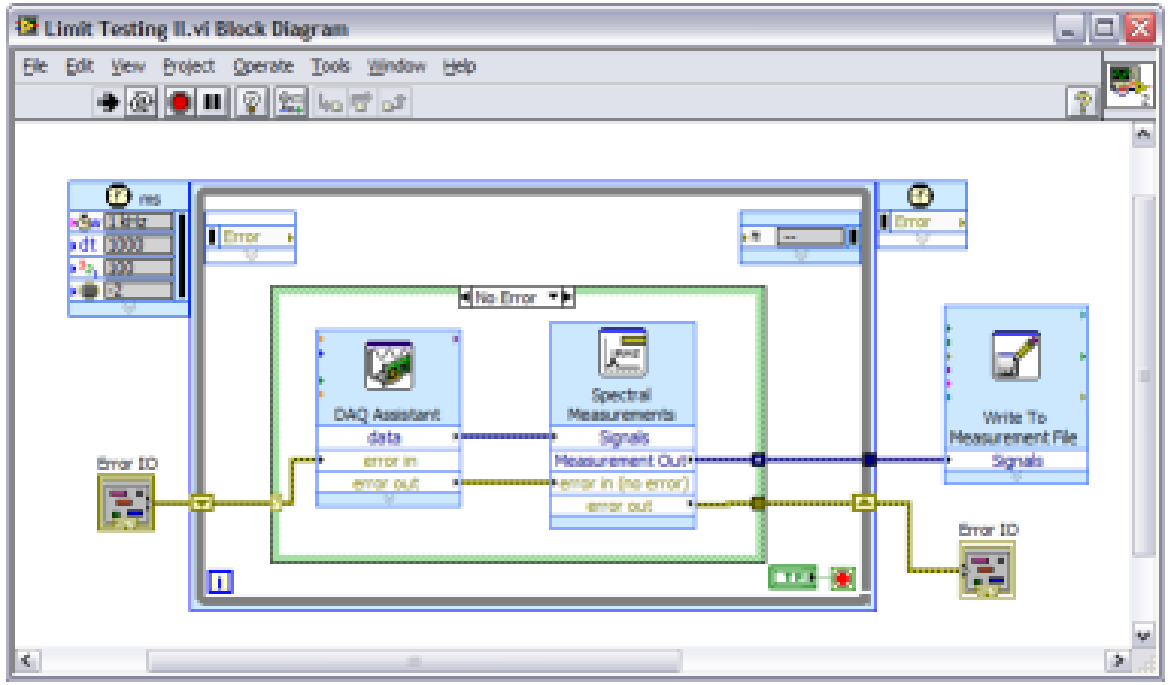
LabVIEW 是一個圖形化程式語言

- 圖形化程式語言包括
  - 不同資料型態與資料結構
  - 程式架構 (i.e. 迴圈, case, 事件處理)
  - 標準的功能(i.e. 存取檔案)



	DBL Numeric	Integer Numeric	String
Scalar			
1D Array			
2D Array			

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LabVIEW™

Integrate Hardware. Visualize Data. Accelerate Engineering.

無與倫比硬體整合能力

- NI hardware
  - 200+ data acquisition devices
  - 450+ modular instruments
  - Cameras
  - Software define radio
  - Embedded real-time controller
- Third-party hardware
  - Instrument Driver Network
    - 10,000+ instrument drivers
    - 350+ instrument vendors
    - 100+ instrument types
  - Communicate over any bus (serial, OPC UA, ethernet, CAN, LIN……)

ni.com/idnet

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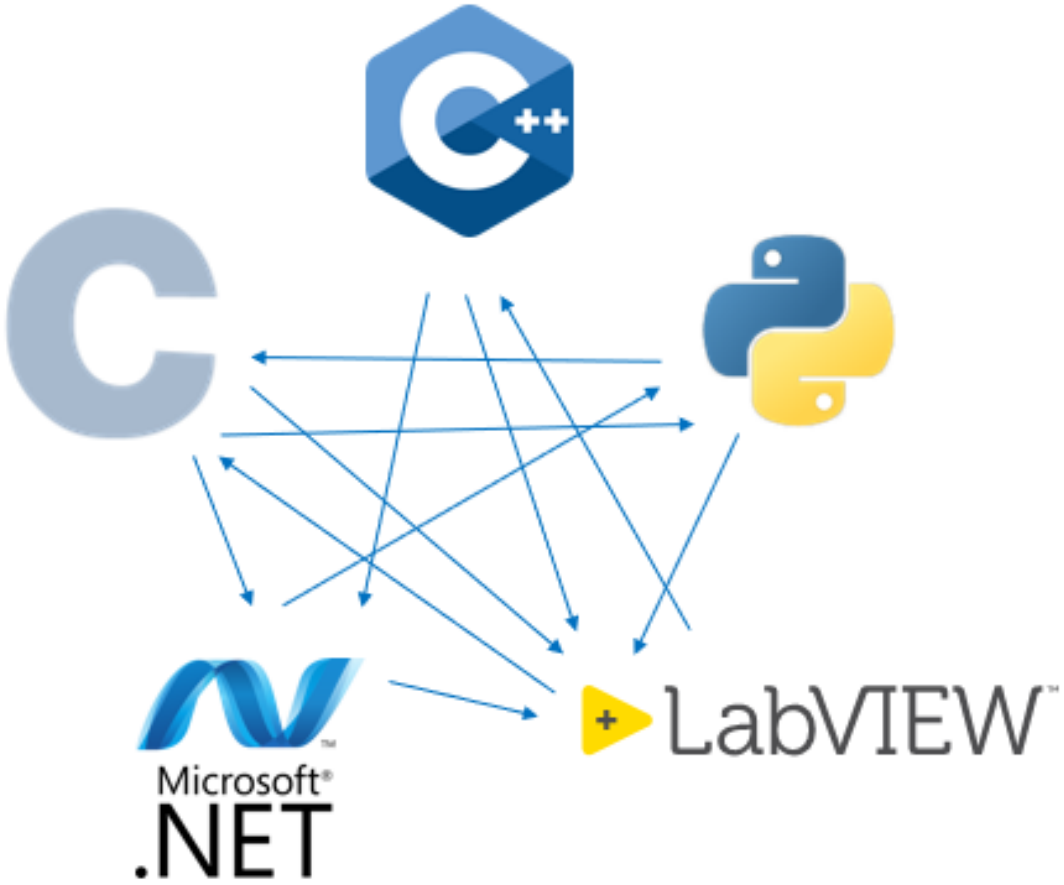
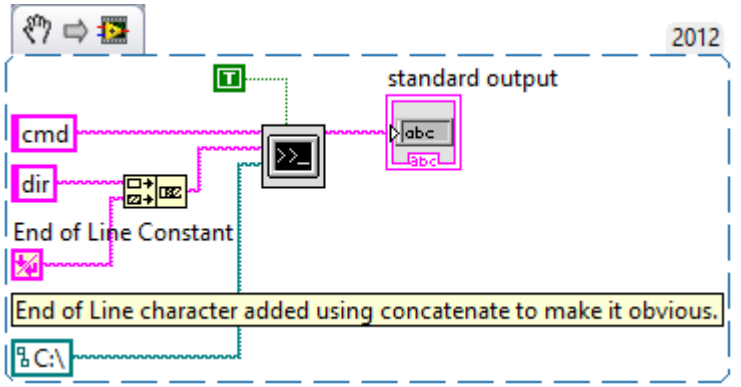
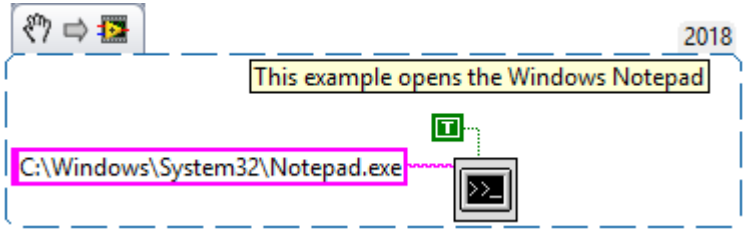
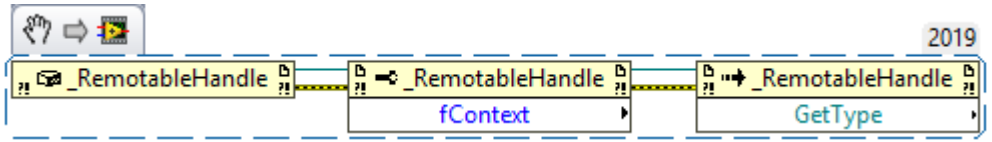
強大的連結性可重複利用現成程式碼

引入以不同程式語言編寫的IP或連接到軟體工程工具以改善工作流程









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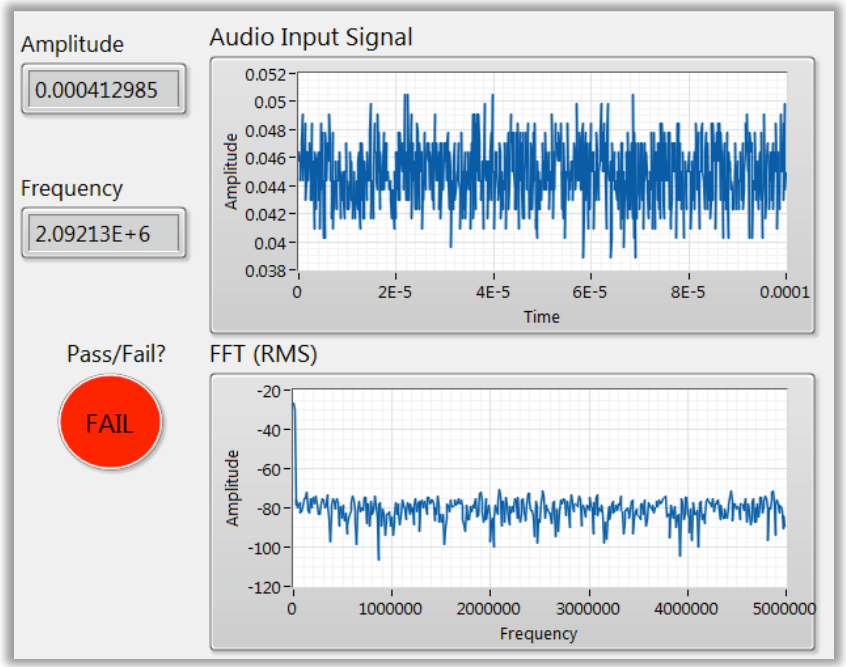
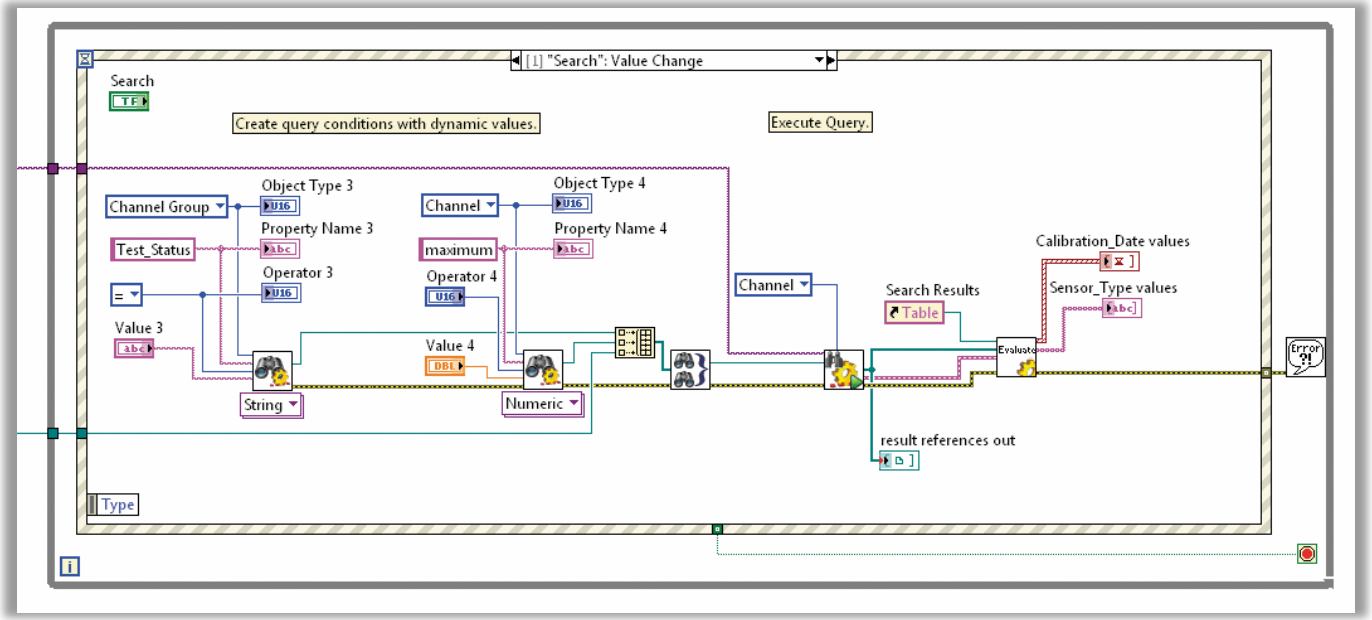
- 迅速讓資料可視化
- 利用內建完整分析功能剖析量測資料
- 超過850種資料分析、訊號處理和數學運算

分析函式





LabVIEW Math, Analysis, and Signal Processing Libraries

分析图式

Built-in

Signal Processing
- Signal Generation
- Windows
- Filters
- Transforms

Mathematics
- Numerics
- Linear Algebra
- Curve Fit
- Prob/Stats
- Optimization
- Diff EQ

Measurements
- Spectral
- Tone Extraction
- Pulse Params
- Timing/Transition
- Amp/Levels

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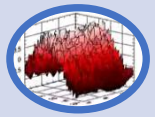
Toolkits

Advanced Control Design
- System ID
- Control Design
- Dynamic system simulation



Digital Filter Design
- FIR / IIR Filter Design
- Quantization
- Fixed-point Modeling/Simulation

Advanced Signal Processing
- Wavelets
- Time-Series Analysis
- Time-Frequency Analysis

Sound and Vibration
- Distortion
- Octave Analysis
- Swept Sine
- Freq Measurements, Transient
- S&V Level
- Weighting
- Waterfall Plot

Order Analysis
- Order Tracking
- Spectrum Selection
- Tachometer Processing
- Waterfall, Orbit / Polar Plots, Bode Plots

Modulation
- Bit Error Rate
- AWGN
- Phase Noise
- Constellation Plots
- Eye Diagrams

Spectral Measurements
- Zoom FFT
- Power-in-Band
- Adjacent Channel Power

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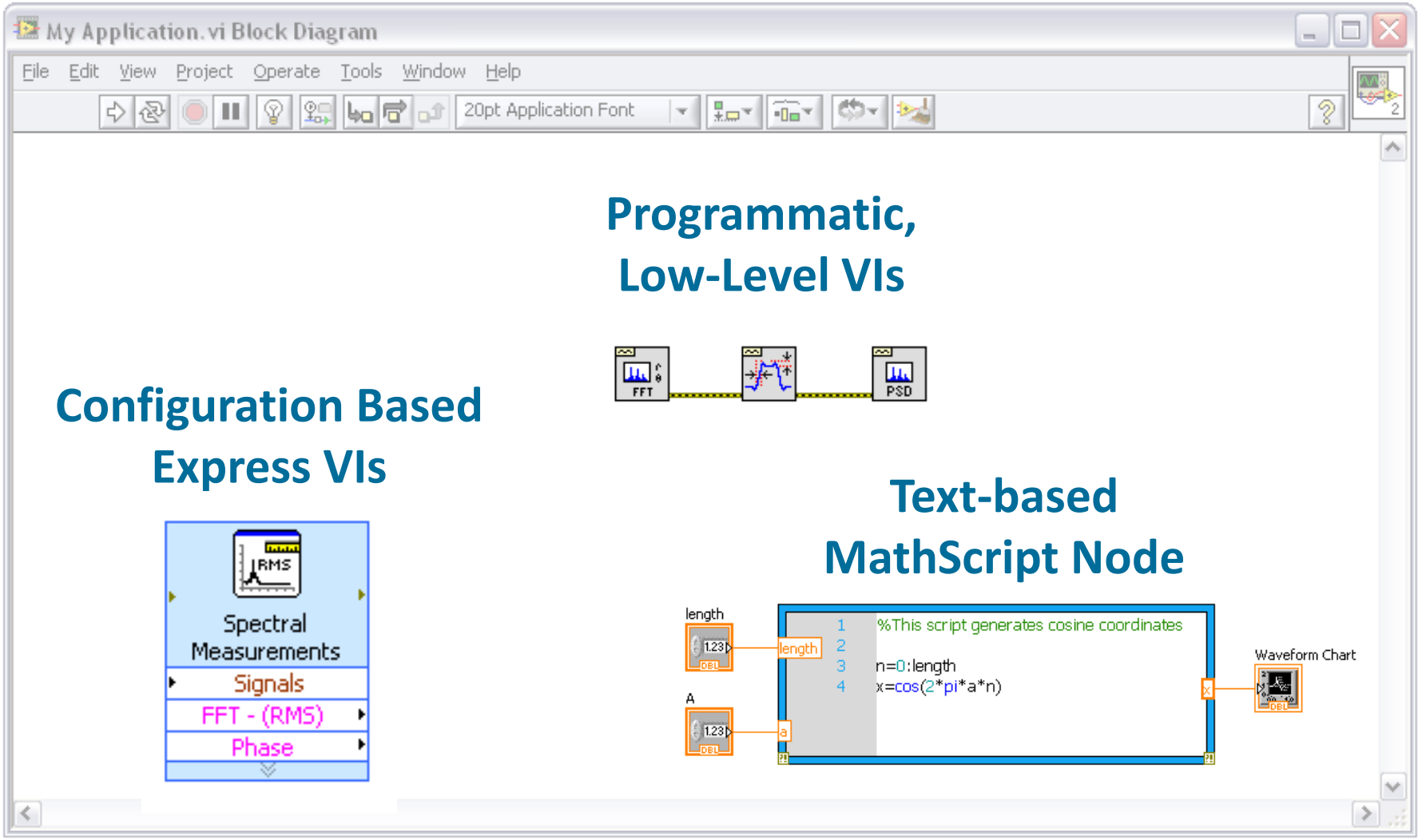
Using Analysis Functions



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No other development software boosts your productivity better than LabVIEW

Outline

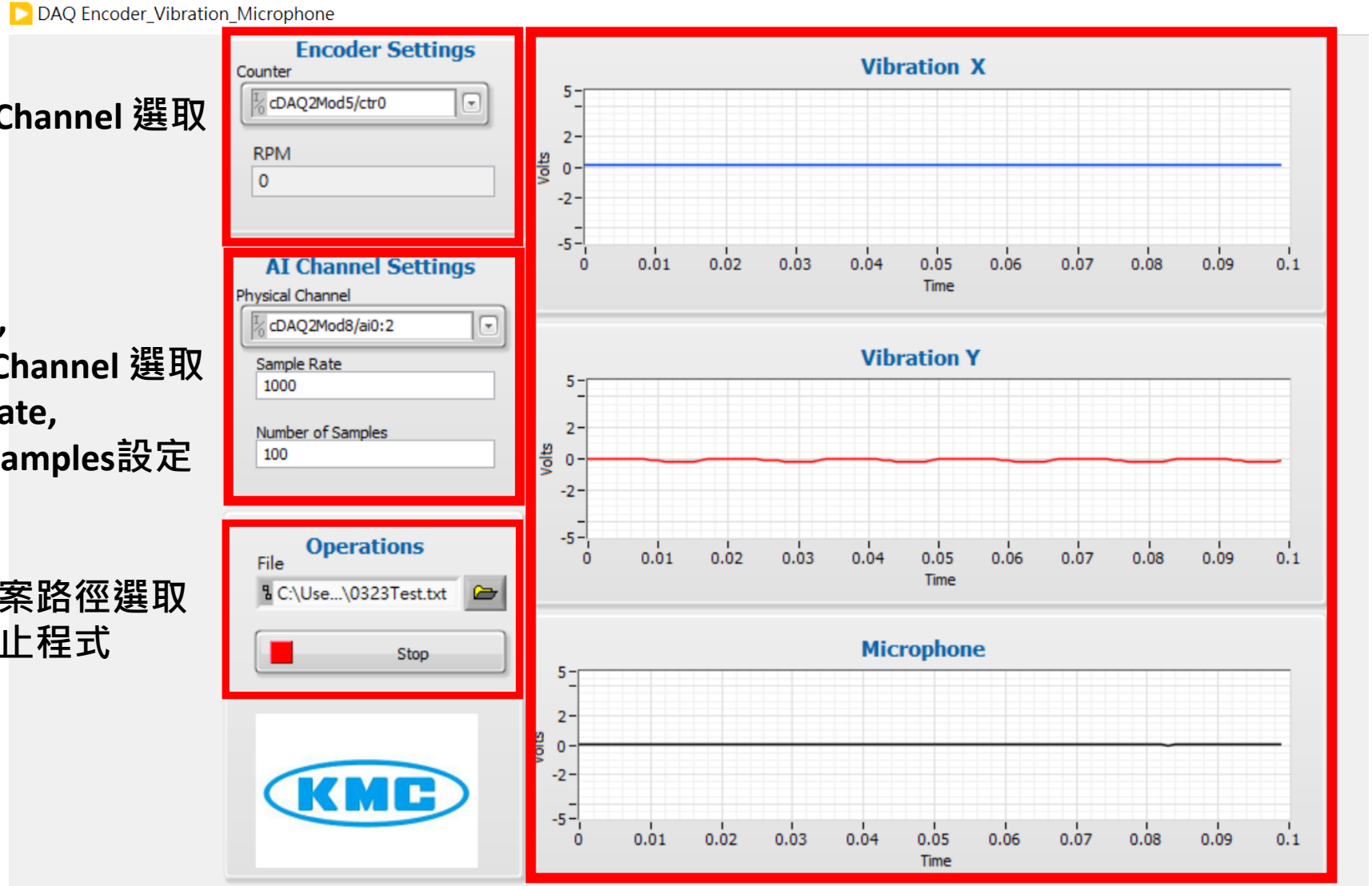
- DAQ Introduction
- LabVIEW introduction
- Program Introduction

DAQ for Encoder, Vibration and Microphone

1.Encoder Channel 選取

2.
(1). Vibration, Microphone Channel 選取
(2). Sample Rate, Numbers of Samples設定

3.
(1). 檔案路徑選取
(2). 停止程式



4.訊號呈現

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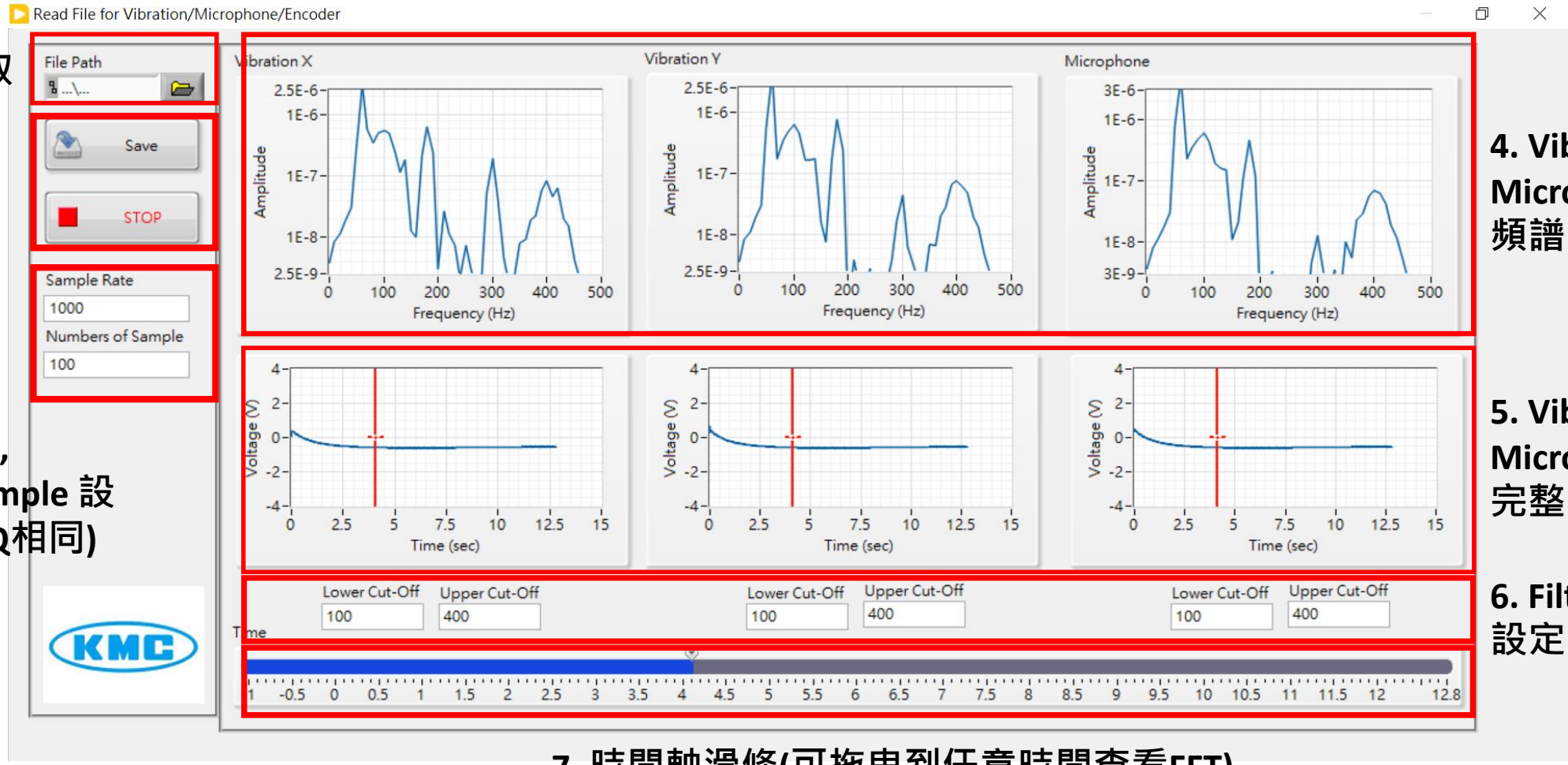
Read Back DAQ Data

1.DAQ Log 選取

2.
(1). 存取FFT
(2). 停止程式

3.Sample Rate, Number of Sample 設定(必須和DAQ相同)



4. Vibration, Microphone 頻譜分析(1 sec)

5. Vibration, Microphone 完整時域訊號

6. Filter 截止頻率設定

7. 時間軸滑條(可拖曳到任意時間查看FFT)

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Thank you for kind attention~

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E: joe.kao@ecloudvalley.com