S_X_MPL
Signal Acquisition Modeling and Processing Lab

Electrical Engineering Department
- Electronics
- Computers
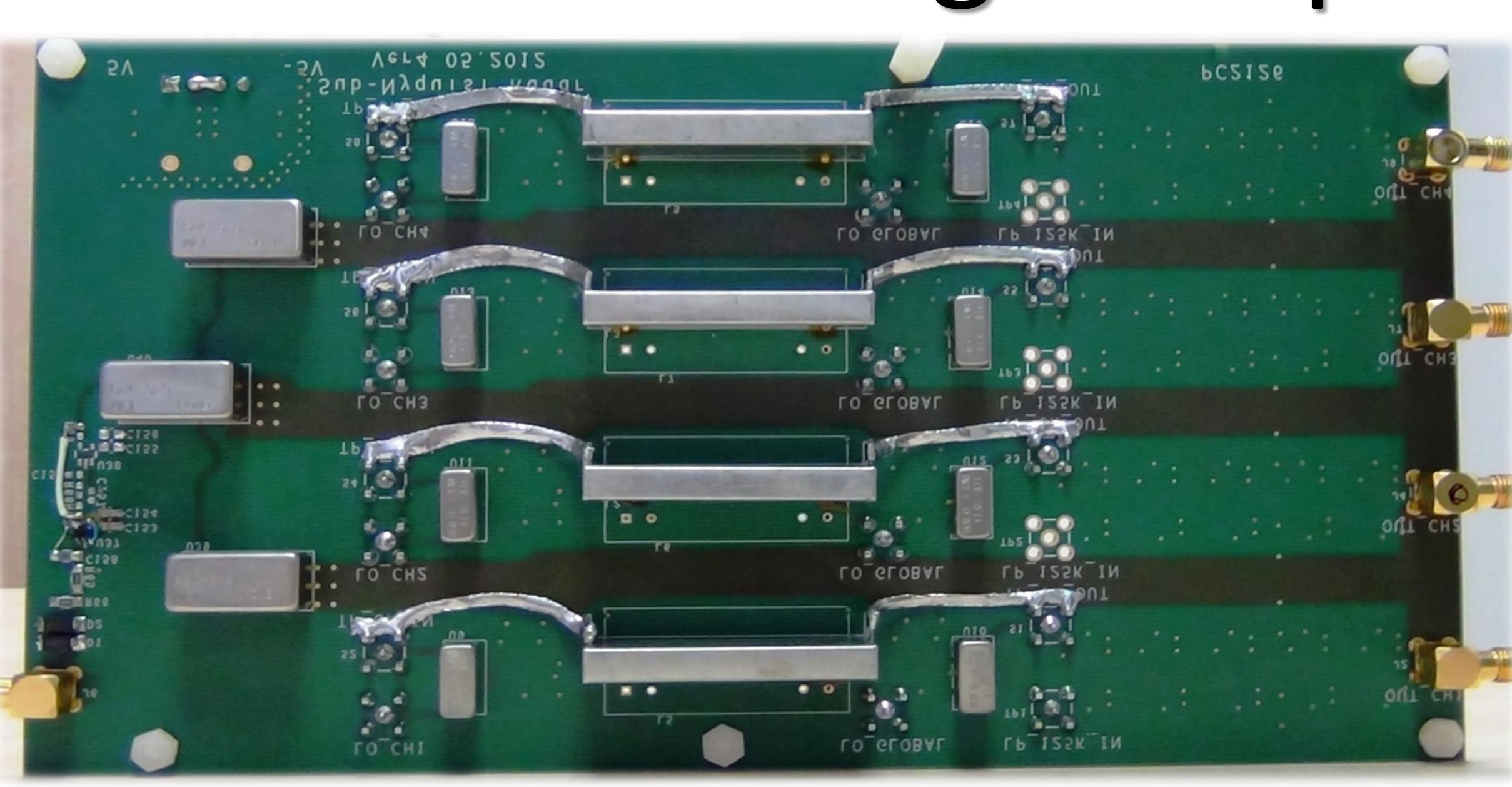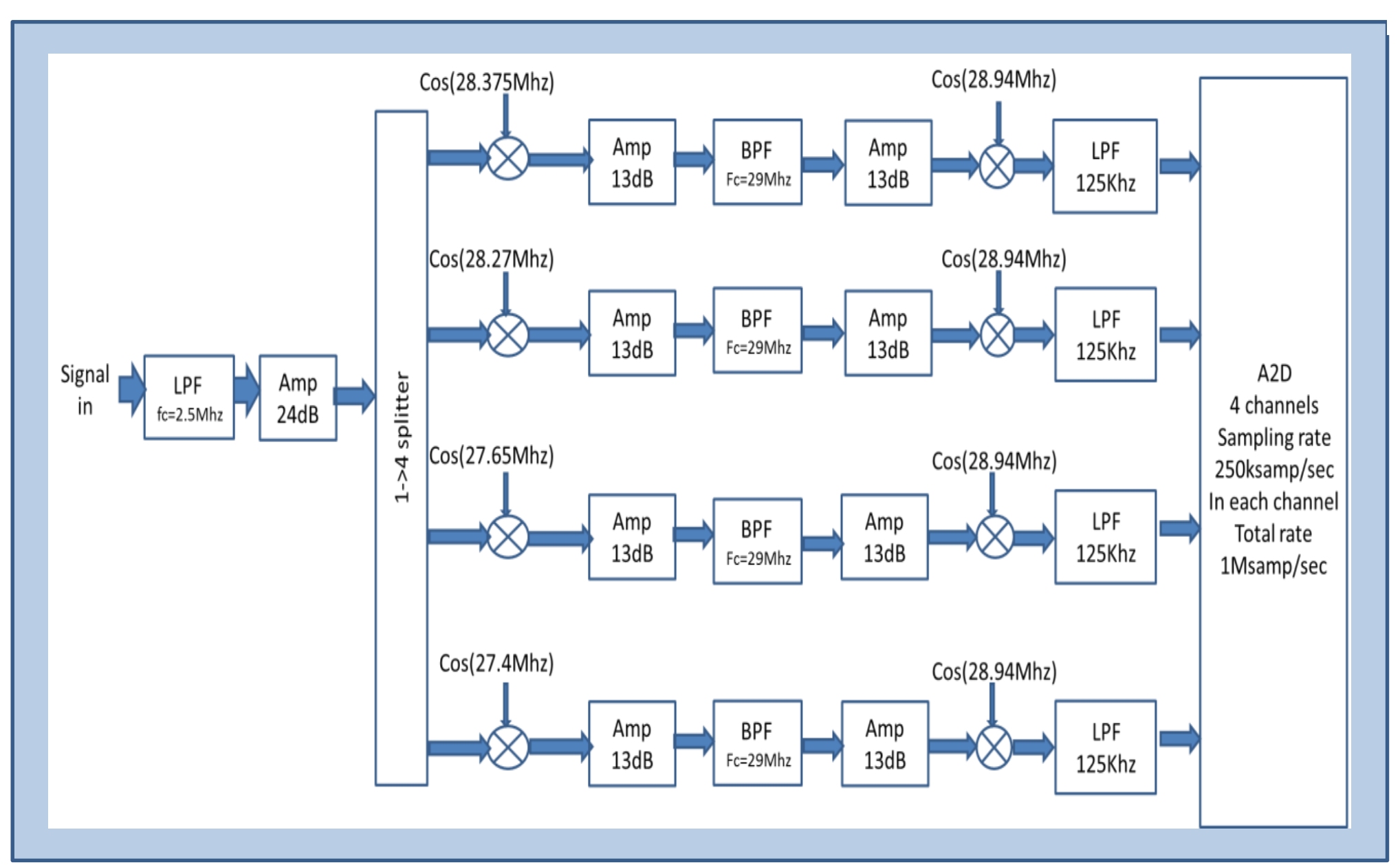- Communications

TECHNION
Israel Institute of Technology

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646804-BNYQ

Sub-Nyquist Radar Prototype

Omer Bar-Ilan, Idan Shmuel, Rolf Hilgendorf, Eli Shoshan and Yonina C. Eldar

Pulse Analog Xampler

Cos(28.375Mhz)   Cos(28.94Mhz)
Cos(28.27Mhz)   Cos(28.94Mhz)
Cos(27.65Mhz)   Cos(28.94Mhz)
Cos(27.4Mhz)   Cos(28.94Mhz)

Signal in — LPF fc=2.5Mhz — Amp 24dB — 1-4 splitter — Amp 13dB — BPF Fc=29Mhz — Amp 13dB — LPF 125Khz

A2D
4 channels
Sampling rate
250ksamp/sec
In each channel
Total rate
1Msamp/sec

- Input signal BW< 150MHz
- Crystal filter BW 70KHz
- Modular and flexible design
- Dynamic range 65dB

Supporting Hardware – NI System

3 NI Flex Rio 7965R FPGA and NI 5781 Baseband transceiver create 5 local oscillators waveforms with constant starting phase
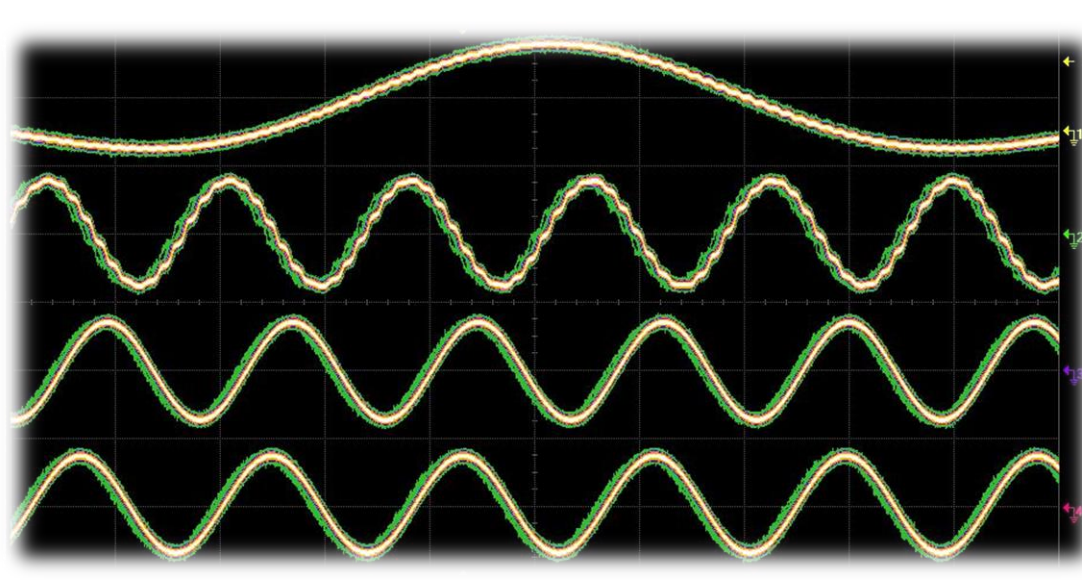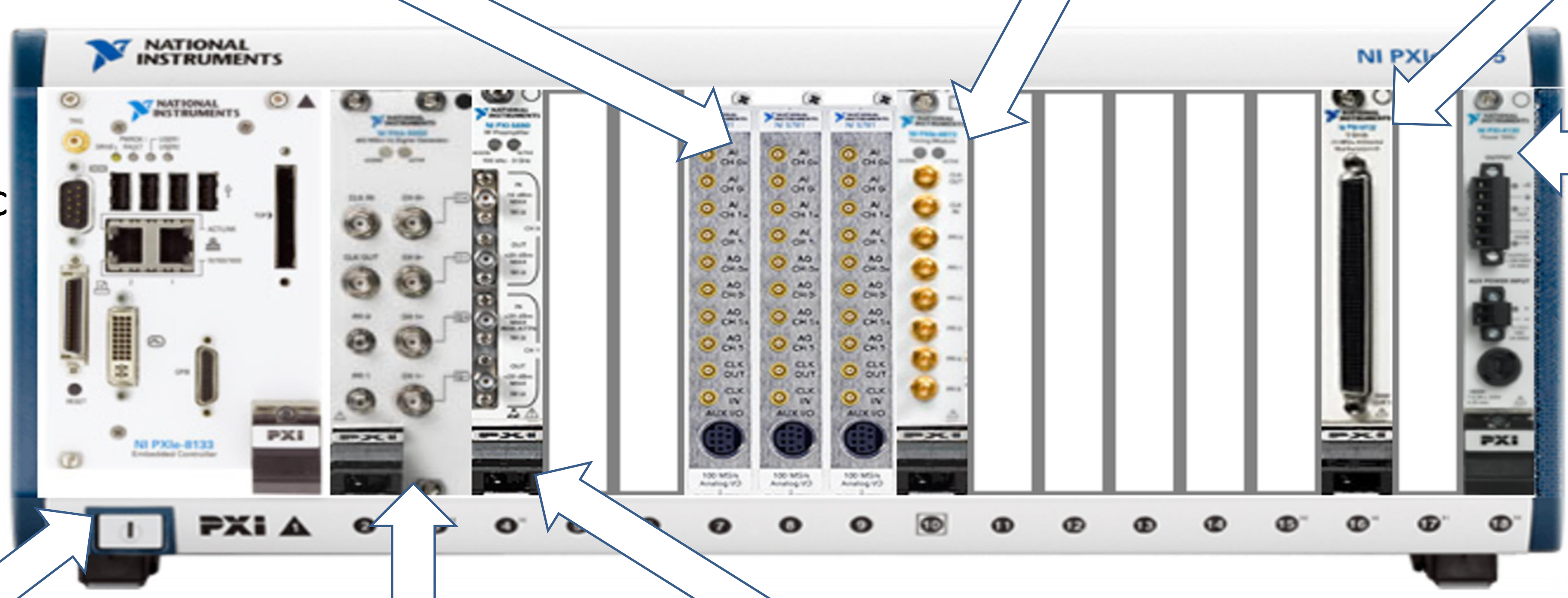
NI 6672 timing and synchronization module distribute clock and trigger signals

NI 6123 4 channels simultaneous A/D @ 250Ksamp/sec per channel

NI 4130 Power supply to Pulse Xampler

System Challenges:
- Start all devices at the same time with skew less then 1nsec
- Good synchronization- Low clock jitter and small clock drifts between devices
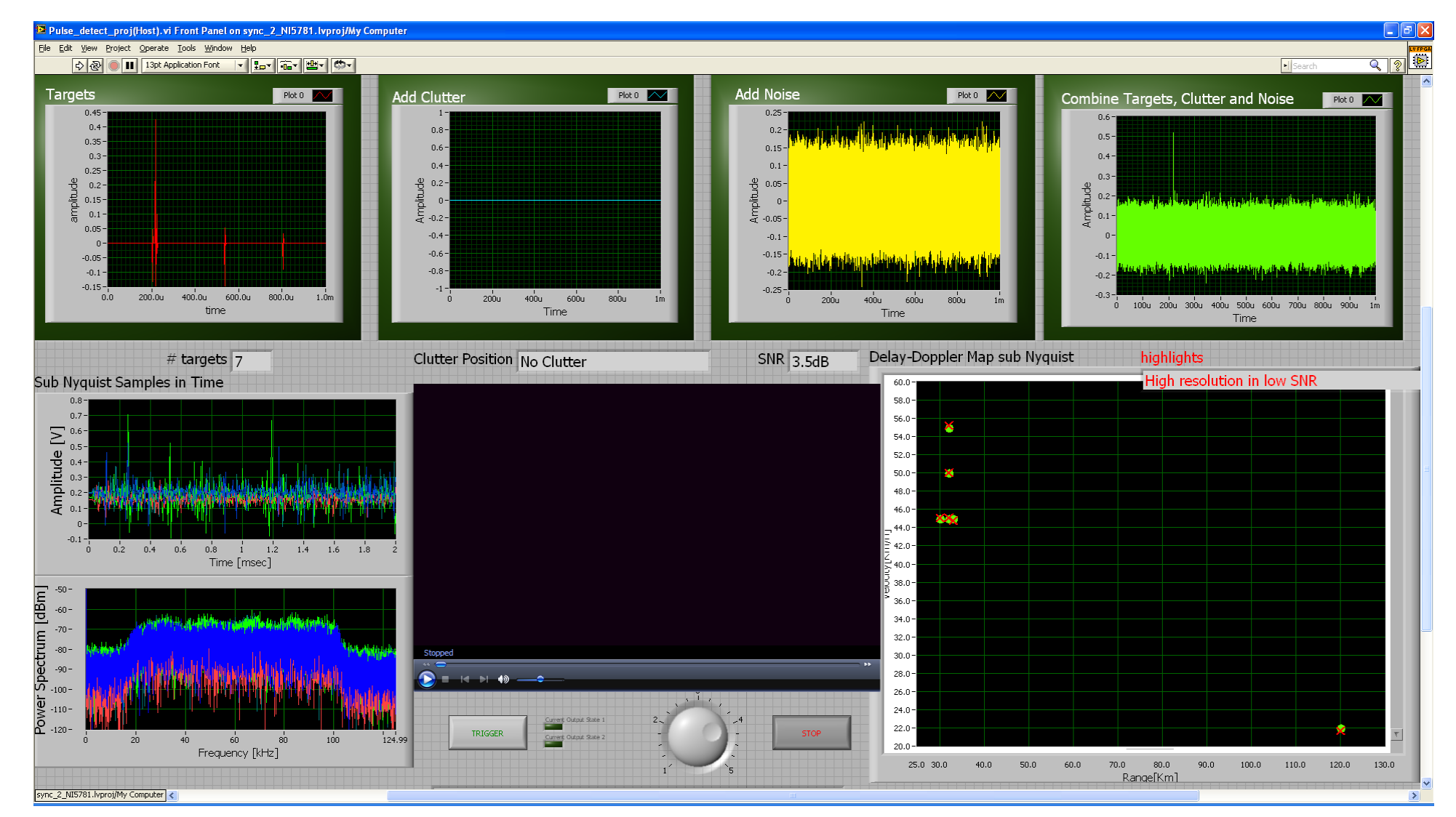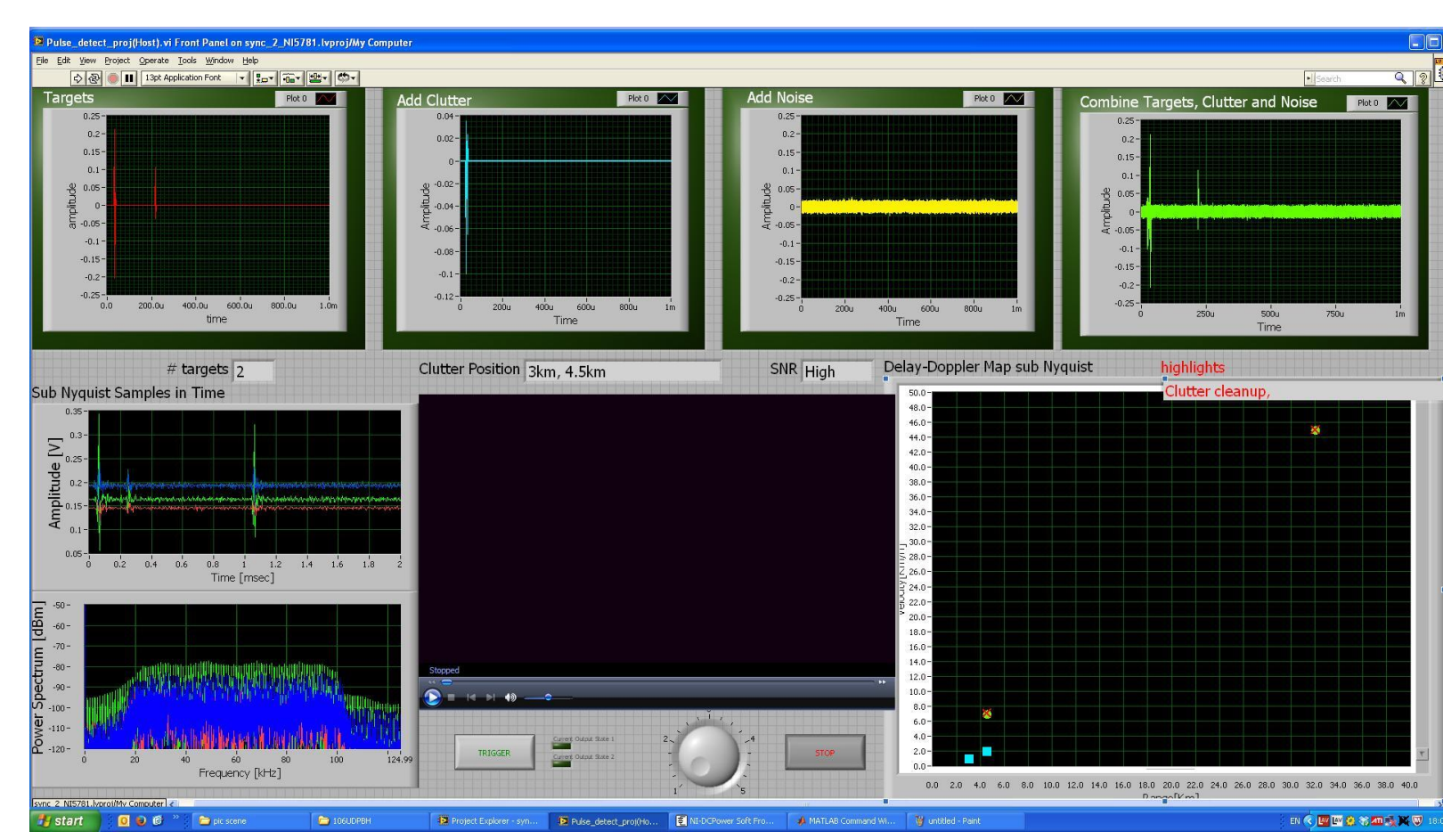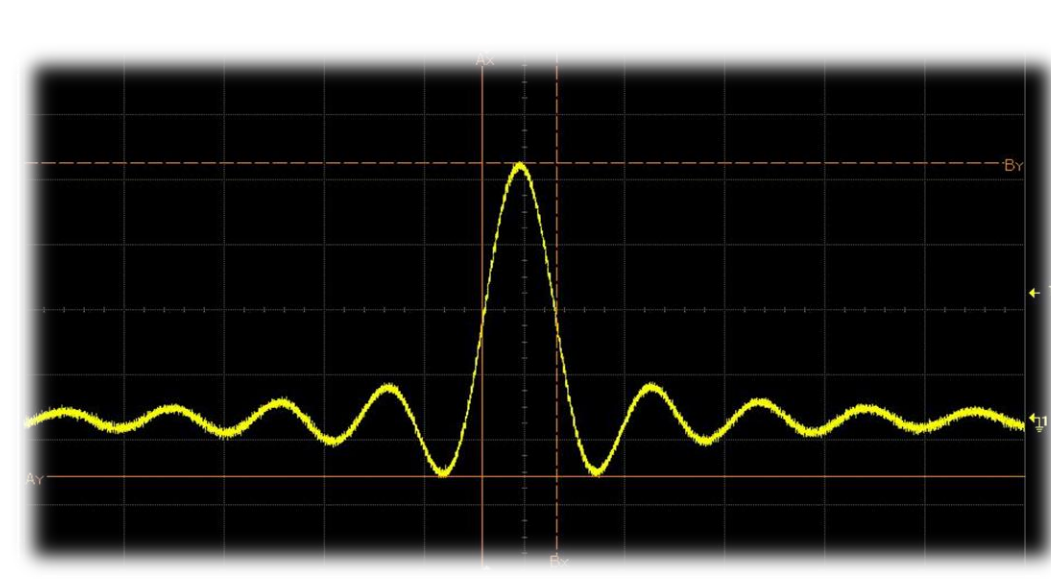- Connectivity- AWR RF simulation environment to LabView

NATIONAL INSTRUMENTS   NI PXI

NI 8133 I7 controller
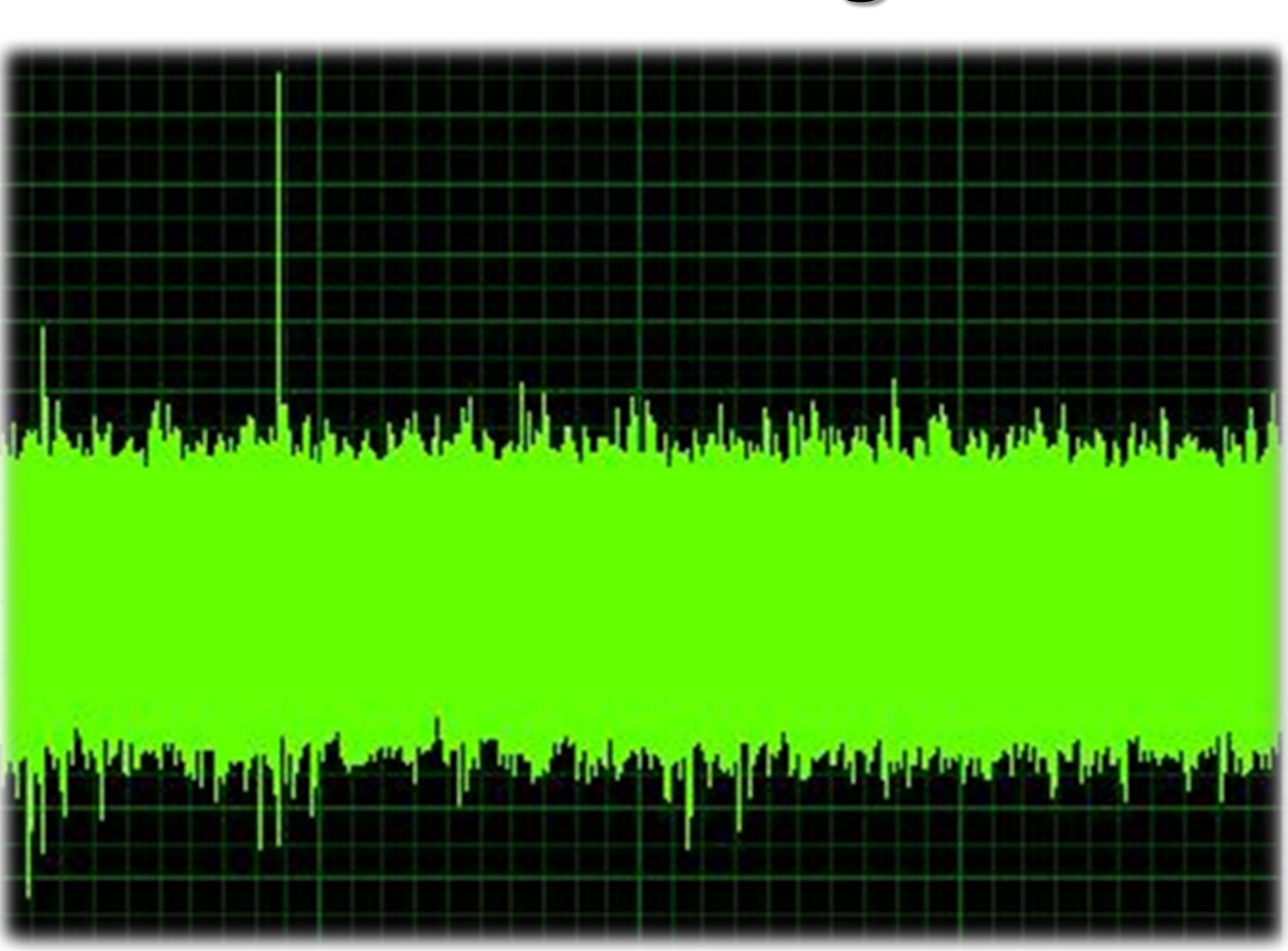Run AWR , LabView and MATLAB script

NI 5451 Arbitrary Waveform Generator
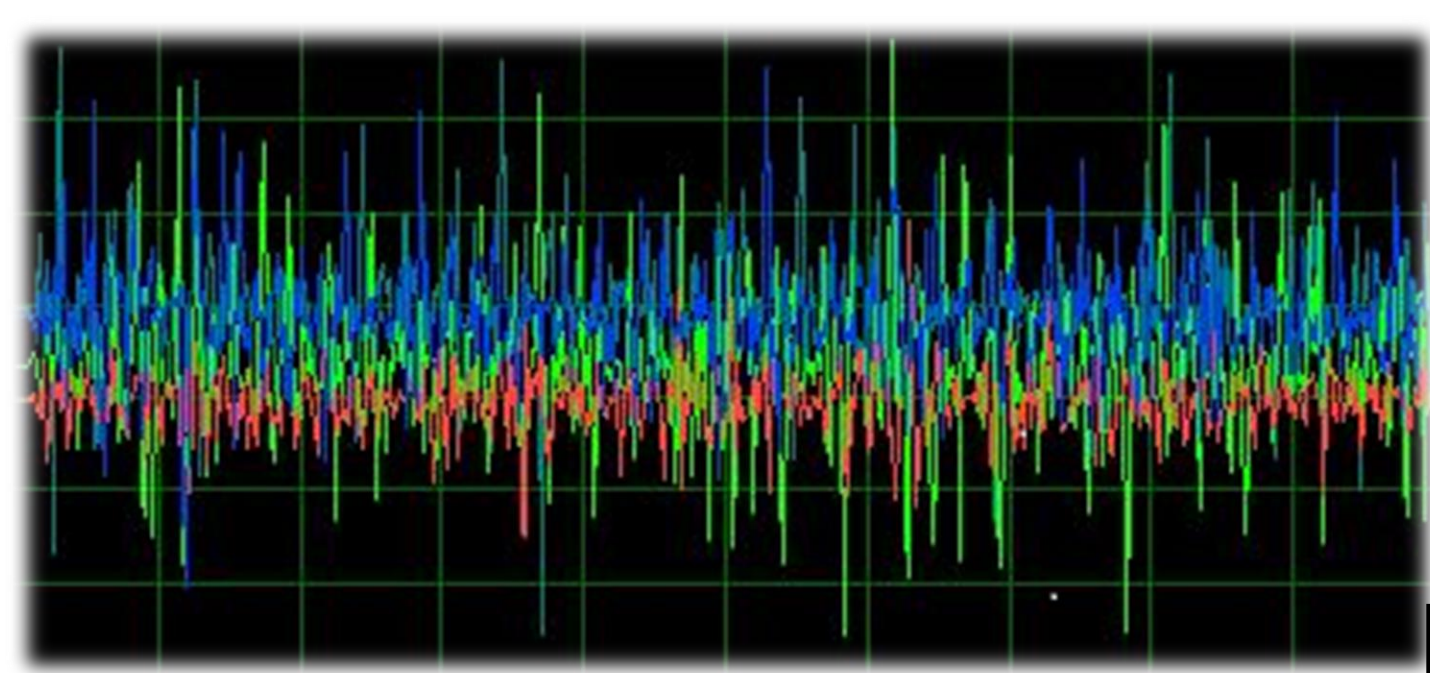
NI 5690 RF amplifier

LabView based GUI Software

Measurements Results

RF signal – 10 MHZ width
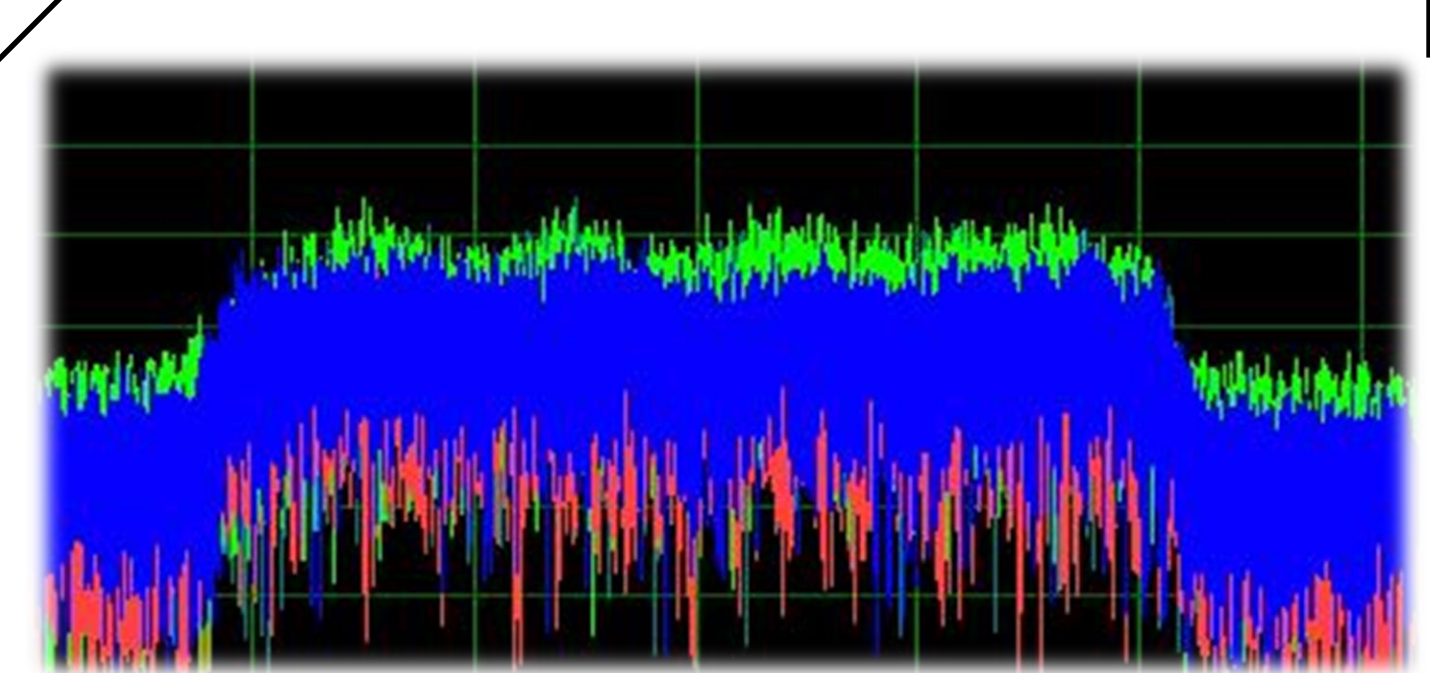Average SNR=0dB include 2 clutter targets

4 channels sampled at 250 kHz each

Delay-Doppler Map

Delay-Doppler Map sub Nyquist   highlights
Target in clutter range and 3 km/h above clutter doppler

Targets detected

Clutter filtered

Xampling

DFT for each channel

Estimation Algorithm