Systems Based on Software Designed Instrumentation for Wideband Signal Analysis and Recording

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- AESA
- Waveform Diversity
- LPI and Frequency Agility
- Cognitive

Identification, Classification and Localization of the Emitters
ELINT - Enabling Technology

Electronic Support Measures

Signal Acquisition

- Receiver
  - High Sensitivity
  - Wide Instantaneous Bandwidth

Signal Detection and Classification

- Signal Analysis and Recording
  - Real-Time Signal Processing
  - Real-Time Recording

Emitter Localization

- System Architecture
  - Multichannel Phase Aligned Receiver
  - Real-Time Signal Processing
NI’s Approach for Deploying ELINT Systems

- Vector Signal Analyzers (VSA)
- IF Digitizer
- Signal Conditioning
- Down-Converter
- RF/Microwave
- ADC
- IF/Baseband
- Signal Analysis
  - RTSA
  - Trigger Mask
  - Channelizer
- Data Link
- Data Storage
- Solid State HD
- FPGA Module
- PXIe Chassis
- CPU
- FlexRIO
- Signal Decoding
- Signal Classification
Real-Time Spectrum Analyzer (RTSA)

- Gapless persistence, spectrogram, and trace statistics (max hold, min hold, average) calculated on FPGA
- Process up to 2 M FFTs/s using overlapped, windowed FFTs
- Real-time frequency mask triggering
- 100% probability of intercept (POI) minimum duration options:
  - 1 µs or >15 µs
- Source available upon request (Export Controlled – US Dep. of Commerce)
Real-Time Signal Analyzer and Recorder for ELINT

- 765 MHz RTBW
- 3.2 GB/s
- Peer-to-Peer
Novator - Wide-Band Receiver
Decodio: «Unique State-Of-The-Art Broadband Signal Detection, Extraction & Monitoring»

«All-In-One»
SIGINT / COMINT Spectrum Monitoring/QoS

- Fast Detection
- Identification
- Classification
- Visualization
- Recording
- Distributed Architecture
- Remote Control
Importance of Radar Emitter Parameters During Signal Processing

Wide Instantaneous Bandwidth and Real-Time Signal Processing are Enabling Technology for Processing Modern Radar Signals
Direction Finding

Angle-of-Arrival Measurement Techniques

- Scanning Beam
  - Slow Response
  - Low Probability of Intercept

- Amplitude Comparison
  - Very Common, Low Cost
  - Small Size
  - Relatively Low Resolution
  - One RF Path per Band/Sector

- Phased Interferometer or Array
  - Very High Resolution
  - High Cost
  - Larger Size
  - 3-5 Antennas/RF Paths per Band/Sector
  - Conformal Arrays Possible

Engineering Challenges

- Multi-channel Phase Aligned Receiver
- Real-Time Signal Processing

Multi-Channel Phase Aligned Measurement System

NI’s Approach

- Shared Local Oscillator For Correlated Phase Noise
- Aligned sample clocks Minimizes Ch-to-Ch Delay
- IF Filter in FPGA Removes Group Delay
4-Channel Phase-Coherent Acquisition System

- **Channel Phase Coherent Acquisition System**

  - IF Receiver (Master)
    - Synchronized ADCs via T-Clk
    - Multichannel RAID streaming
    - CPU for processing and controlling the Slave via MXI link

  - Downconverters (Slave)
    - LO sharing for phase coherency
    - Controlled via MXI link from the master

- Frequency Band up to 26.5 GHz
- IBW up to 765 MHz
ATCA-3671 FPGA Module

- 4 Virtex-7 690T FPGAs
  - 14,400 total DSP slices
  - 64 GB DDR3 DRAM
- Cabled PCI Express Gen. 3 x8 connectivity to each FPGA
- Up to 161.6 GB/s high-speed serial connectivity through RTM and AIO
- 4 ATCA IO (AIO) module slots
- Up to 5.6 GS/s analog I/O
- Programmable with LabVIEW FPGA module or BEEcube Platform Studio (BPS)
Elettronica GmbH – CESAR

Using multiple new generation NI FlexRIO modules in combination with NI broadband high-performance digitizers and a modified NI 8260 PXI Express in-chassis data streaming module to create the COMINT and ELINT Signal Analyzer and Recorder (CESAR), a compact device to record and evaluate ELEcTronic signal INTeLLigence (ELINT) signals.

Passive Radar System

Digital beam forming to determine the direction of arrival of signals
Adaptive filtering to cancel any unwanted direct signal returns
Cross-correlation of the reference channel with the surveillance channels

“We chose NI products is because of the user-friendly environment to develop the software”

—Dr. Riccardo Mancinelli, ni.com
ELINT - Enabling Technology

Conclusion

Signal Acquisition
- Wide-Band Receiver

Signal Detection and Classification
- Real-Time Signal Analysis and Recording

Emitter Localization
- Modular System Architecture