Data Acquisition and Processing System for Airborne Wind Profiling with a Pulsed, 2-Micron, Coherent-Detection, Doppler Lidar System

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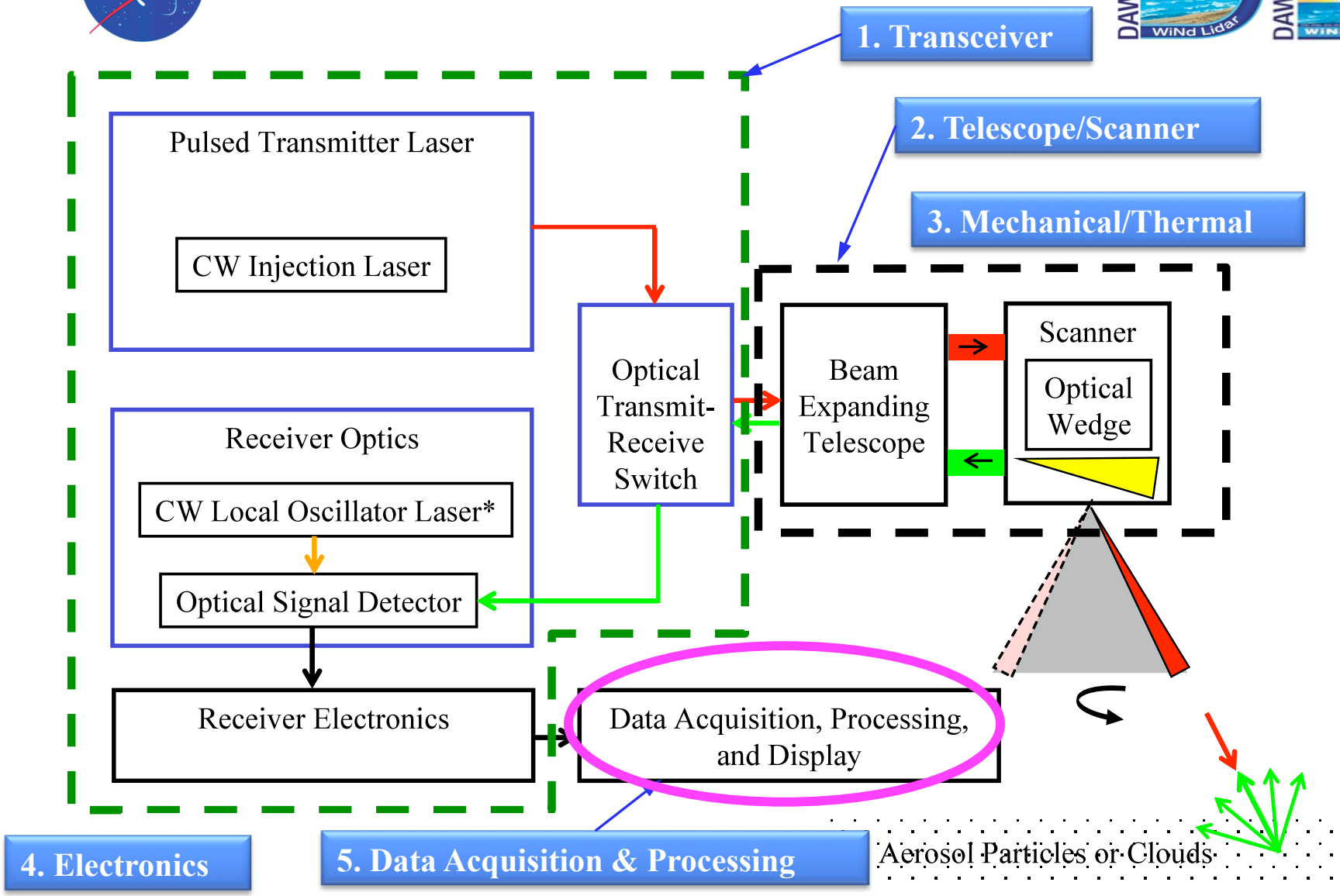
System Review



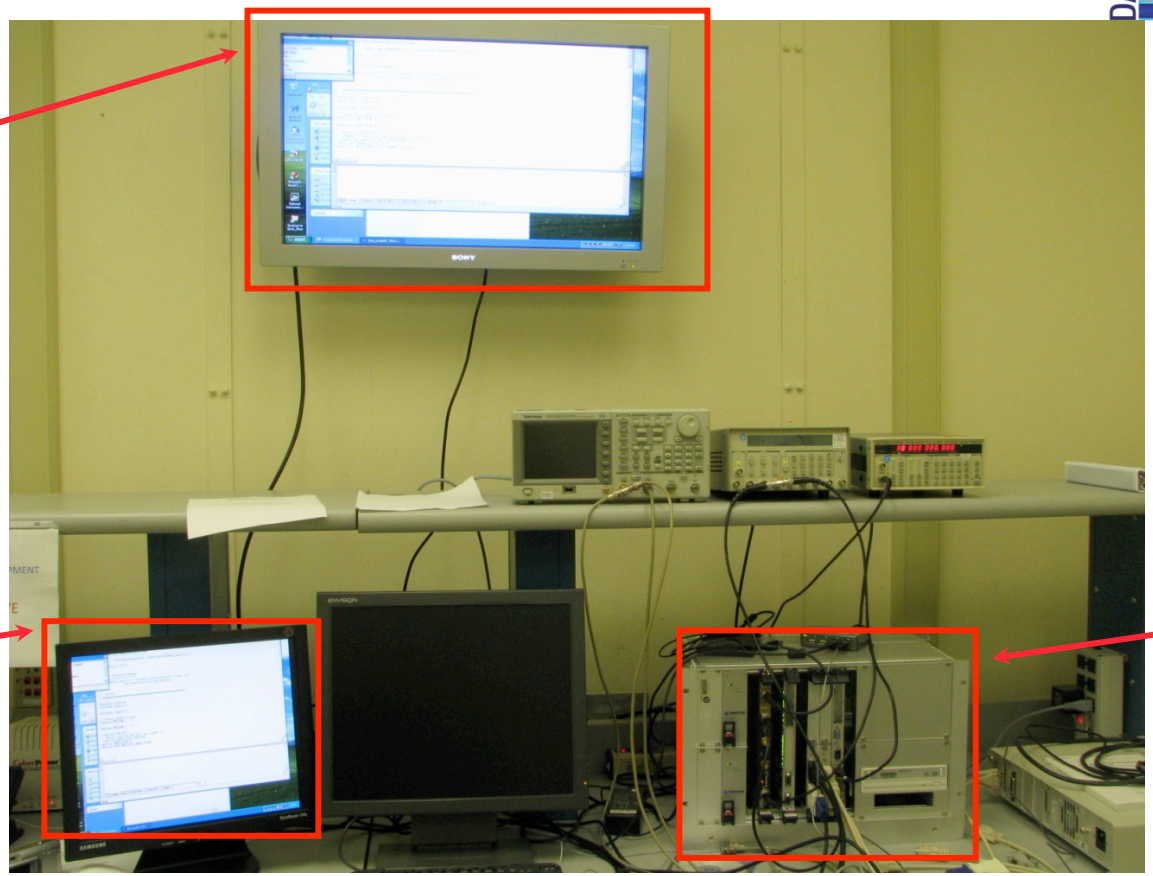
DFRC's DC-8 Airborne Laboratory

Baseline DAPD System

Display Configuration

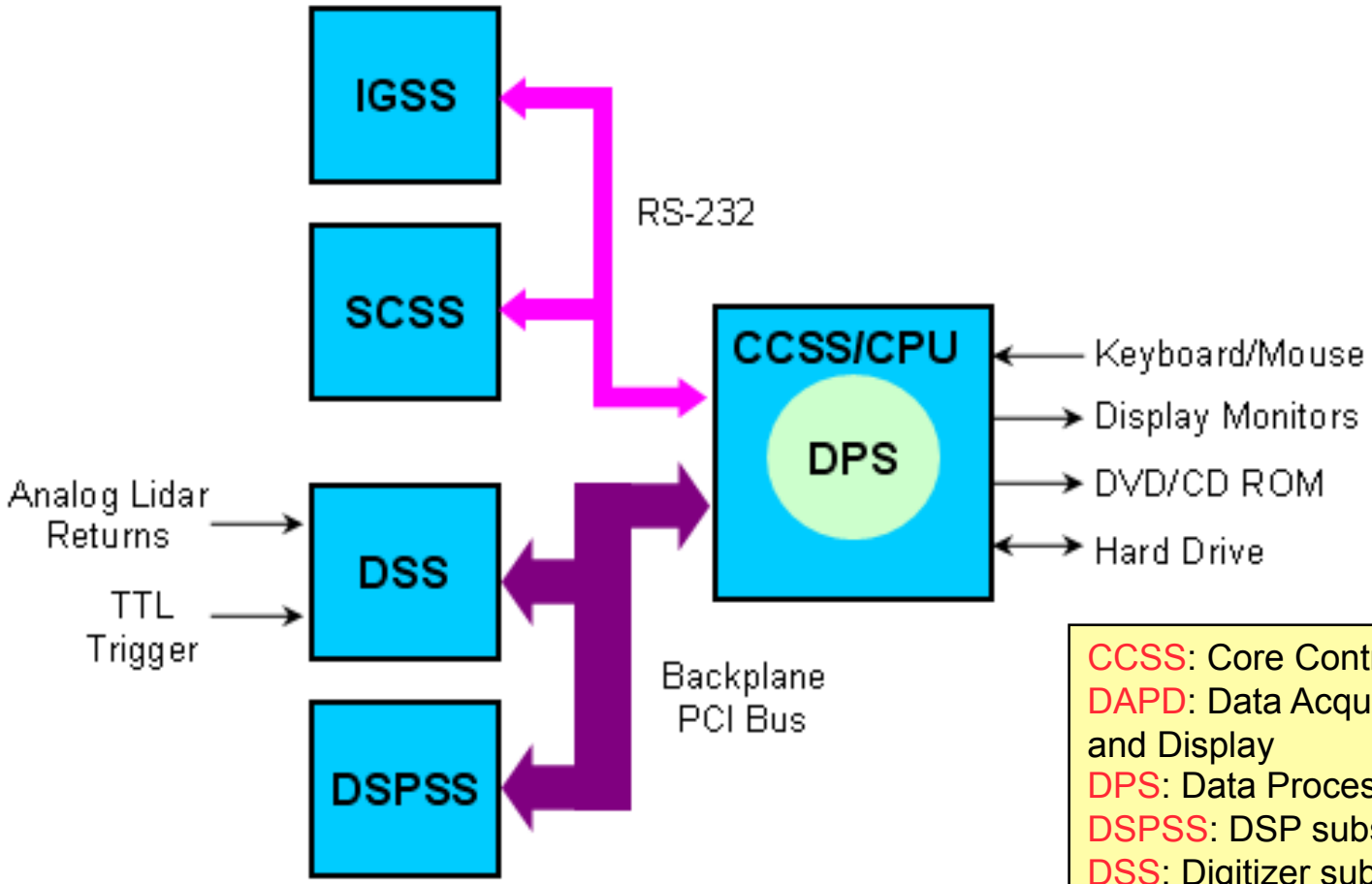
Overhead Display

Operator's Display



DAPD System

Baseline DAPD System



CCSS: Core Control subsystem
DAPD: Data Acquisition, Processing, and Display
DPS: Data Processing Software
DSPSS: DSP subsystem
DSS: Digitizer subsystem
IGSS: INS/GPS subsystem
SCSS: Scanner subsystem

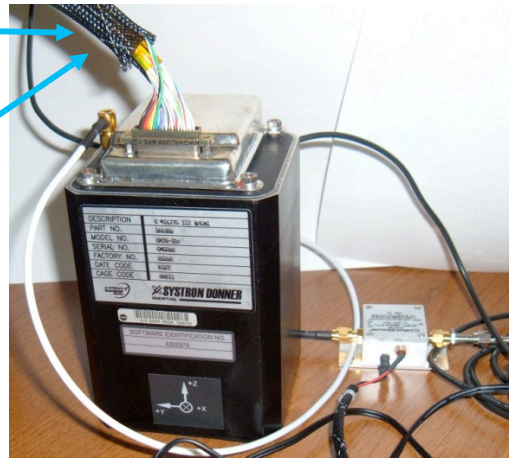
INS/GPS Subsystem (IGSS)

LabVIEW Interface

RS-232

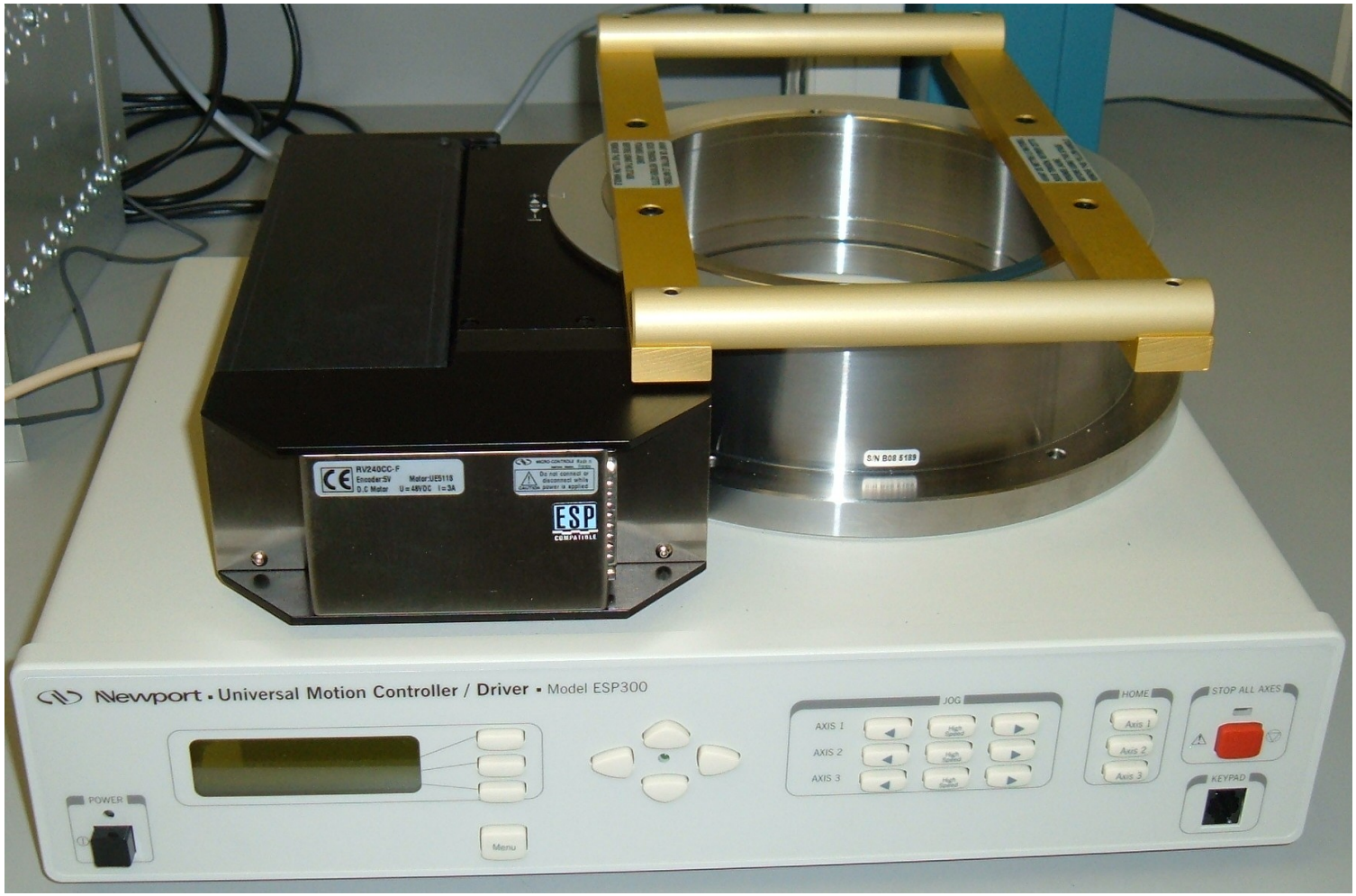
Manufacturer's Generic Interface for Comparison

RS-232

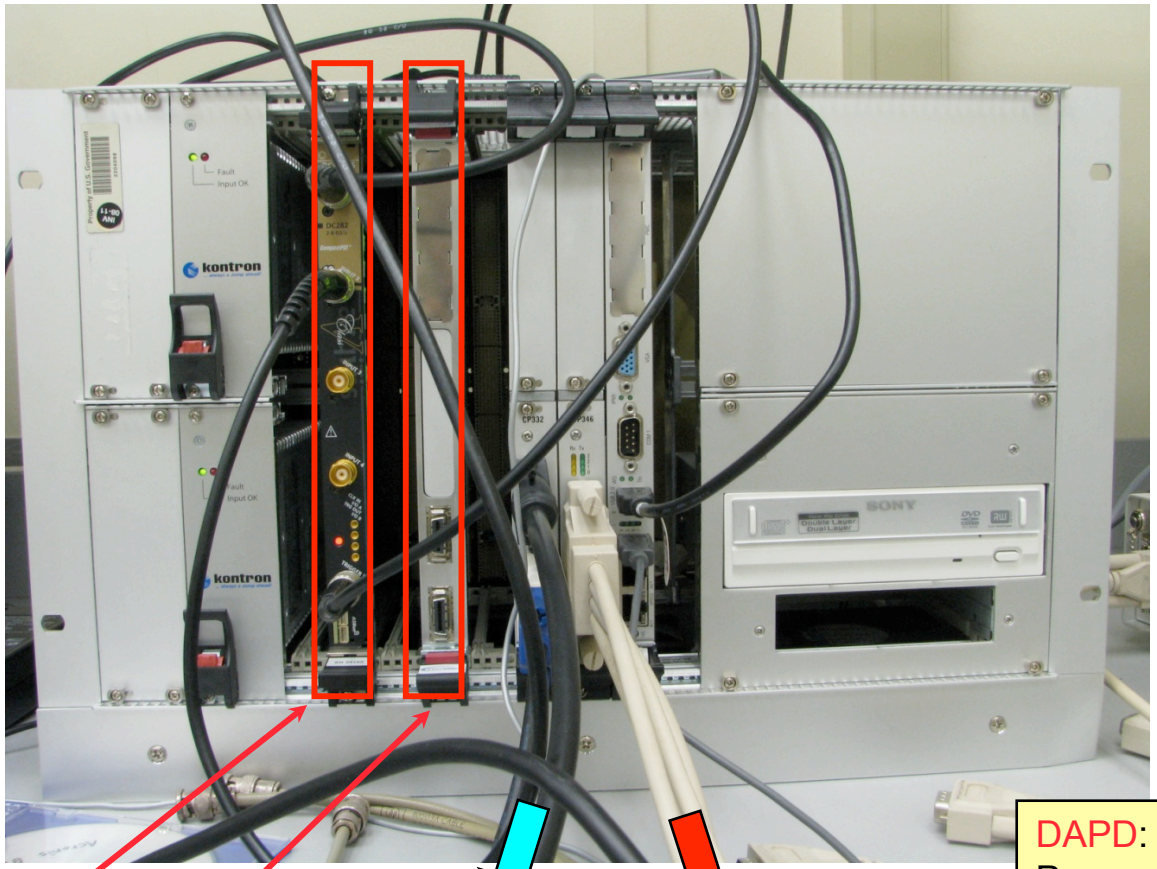


GPS/INS unit with antenna amplifier shown on right

Scanner Subsystem (SCSS)



Baseline DAPD System



DSS **DSPSS** Displays **IGSS and SCSS**

DAPD: Data Acquisition, Processing, and Display
DSPSS: DSP subsystem
DSS: Digitizer subsystem
IGSS: INS/GPS subsystem
SCSS: Scanner subsystem

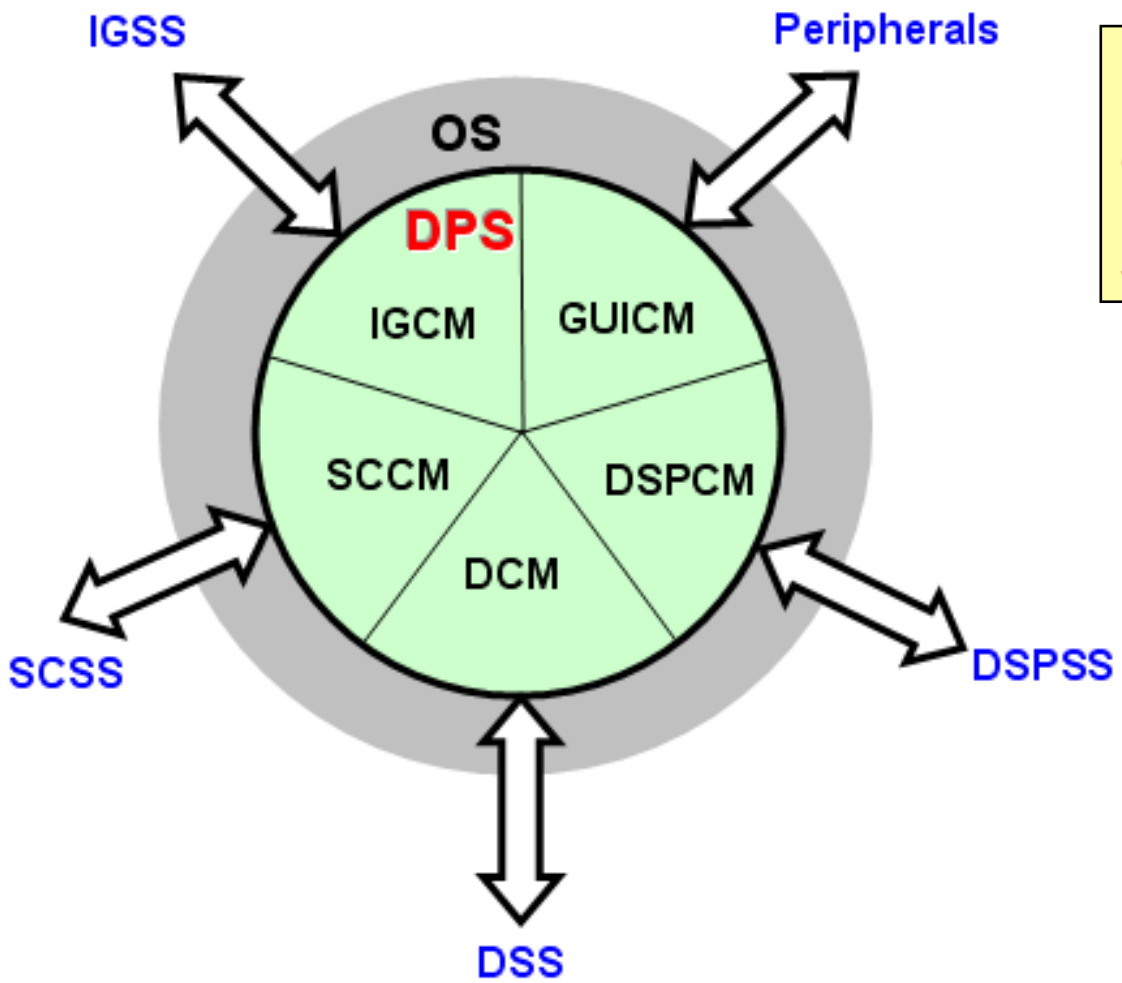
Development Phases

- Procurement of Subsystems
- System Integration
- Subsystem Testing
- Control Module Development for Each Subsystem
- Control Module Integration
- Algorithm Implementation
- User Interface Design
- Bug Fixes and Enhancement of Features
- Software Documentation – Test Report and Verification Matrix Design

System Integration

- Order of subsystem installation
- Order of software installation
- Software and hardware conflict
- List of SW:
  - XP, VC++, VDSP++, Office, Adobe, Network Driver, LabVIEW, LabWindows/CVI, Measurement Studios, Update Patches, BIOS Updates
- System image backup
- Time-consuming but a critically important process

DPS (Data Processing Software)



DCM: Digitizer Control Module
DSPCM: DSP Control Module
GUICM: GUI Control Module
IGCM: INS/GPS Control Module
SCCM: Scanner Control Module

DSPSS: DSP subsystem
DSS: Digitizer subsystem
IGSS: INS/GPS subsystem
SCSS: Scanner subsystem

Subsystem Testing - DSP

- Survey of DMA transfer code
- Identify the strategy of DMA for our application
- Realization of strategy into code
- Errors, bugs, and missing information
  - Tech support turnaround time 3-5 days
- DMA testing
- Core of DPS – “EVERYTHING” has to be tested. ZERO ERROR TOLERANCE.
- Develop the fastest data architecture.

Subsystem Testing – DSP (cont'd)

```
loop 0 = 0.0160000 [sec]
loop 1 = 0.0310000 [sec]
loop 2 = 0.0310000 [sec]
loop 3 = 0.0320000 [sec]
loop 4 = 0.0310000 [sec]
loop 5 = 0.0310000 [sec]
loop 6 = 0.0310000 [sec]
loop 7 = 0.0320000 [sec]
loop 8 = 0.0310000 [sec]
loop 9 = 0.0150000 [sec]
```

```
loop 0 = 0.0150000 [sec]
loop 1 = 0.0160000 [sec]
loop 2 = 0.0310000 [sec]
loop 3 = 0.0160000 [sec]
loop 4 = 0.0150000 [sec]
loop 5 = 0.0160000 [sec]
loop 6 = 0.0310000 [sec]
loop 7 = 0.0160000 [sec]
loop 8 = 0.0150000 [sec]
loop 9 = 0.0160000 [sec]
```

```
loop 0 = 0.1090000 [sec]
loop 1 = 0.1250000 [sec]
loop 2 = 0.1100000 [sec]
loop 3 = 0.1090000 [sec]
loop 4 = 0.1090000 [sec]
loop 5 = 0.1250000 [sec]
loop 6 = 0.1100000 [sec]
loop 7 = 0.1090000 [sec]
loop 8 = 0.1100000 [sec]
loop 9 = 0.1090000 [sec]
```

```
loop 0 = 0.0310000 [sec]
loop 1 = 0.0160000 [sec]
loop 2 = 0.0470000 [sec]
loop 3 = 0.0310000 [sec]
loop 4 = 0.0160000 [sec]
loop 5 = 0.0150000 [sec]
loop 6 = 0.0320000 [sec]
loop 7 = 0.0150000 [sec]
loop 8 = 0.0160000 [sec]
loop 9 = 0.0310000 [sec]
```

```
loop 0 = 0.1090000 [sec]
loop 1 = 0.1250000 [sec]
loop 2 = 0.1100000 [sec]
loop 3 = 0.1090000 [sec]
loop 4 = 0.1090000 [sec]
loop 5 = 0.1250000 [sec]
loop 6 = 0.1100000 [sec]
loop 7 = 0.1090000 [sec]
loop 8 = 0.1100000 [sec]
loop 9 = 0.1090000 [sec]
```

```
loop 0 = 0.0310000 [sec]
loop 1 = 0.0310000 [sec]
loop 2 = 0.0470000 [sec]
loop 3 = 0.0310000 [sec]
loop 4 = 0.0470000 [sec]
loop 5 = 0.0310000 [sec]
loop 6 = 0.0320000 [sec]
loop 7 = 0.0460000 [sec]
loop 8 = 0.0320000 [sec]
loop 9 = 0.0310000 [sec]
```

```
loop 0 = 0.0160000 [sec]
loop 1 = 0.0310000 [sec]
loop 2 = 0.0160000 [sec]
loop 3 = 0.0160000 [sec]
loop 4 = 0.0310000 [sec]
loop 5 = 0.0150000 [sec]
loop 6 = 0.0160000 [sec]
loop 7 = 0.0310000 [sec]
loop 8 = 0.0160000 [sec]
loop 9 = 0.0160000 [sec]
```

Subsystem Testing – Digitizer

- LabVIEW and C code for testing
- Long calibration time – almost 4 minutes
- Customization of calibration procedure
- Pre-trigger test

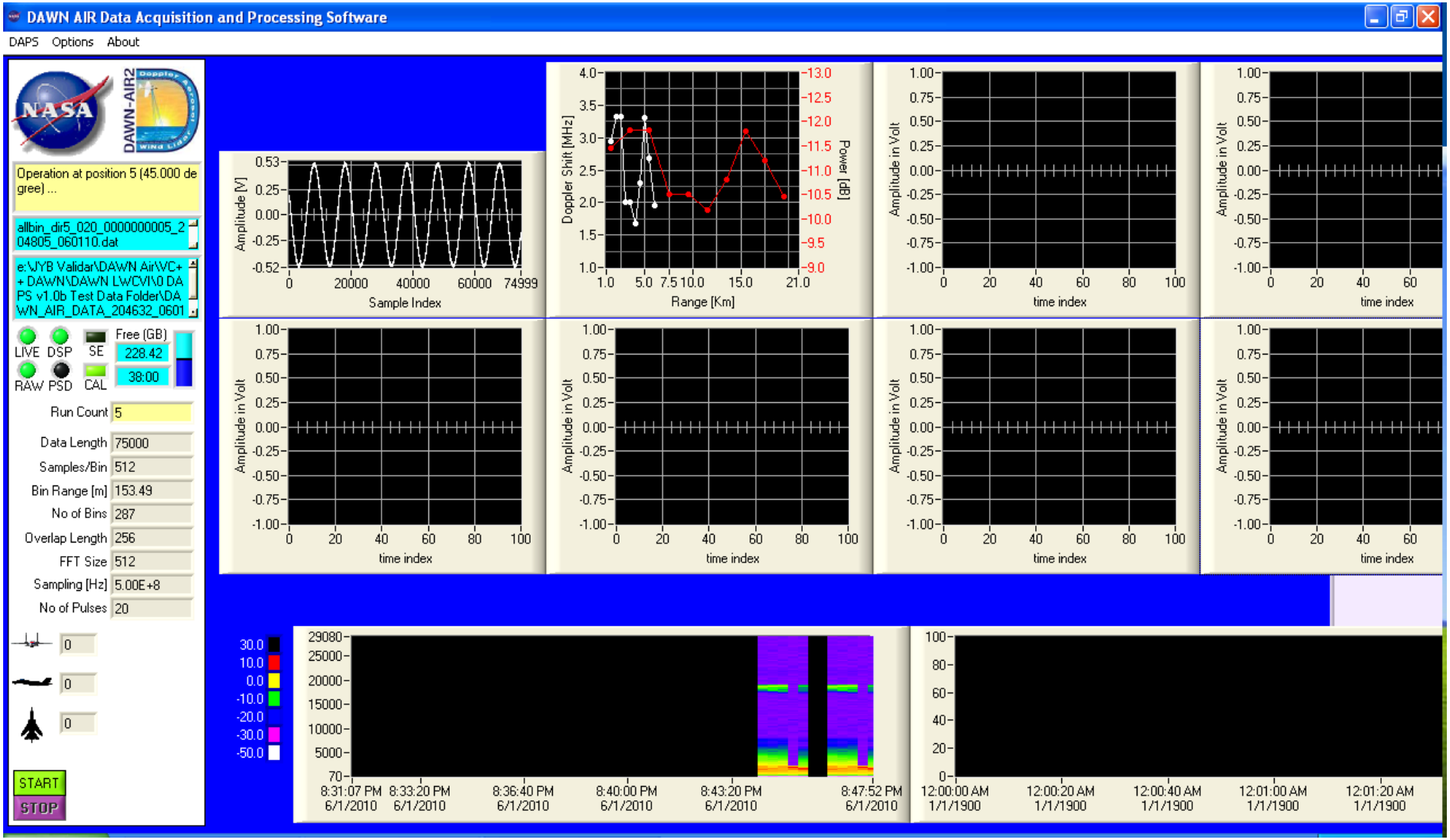
Subsystem Testing – Scanner

- Identify control commands.
- Implementation of commands in C.
- Time delay in homing
- Strategy in motor control

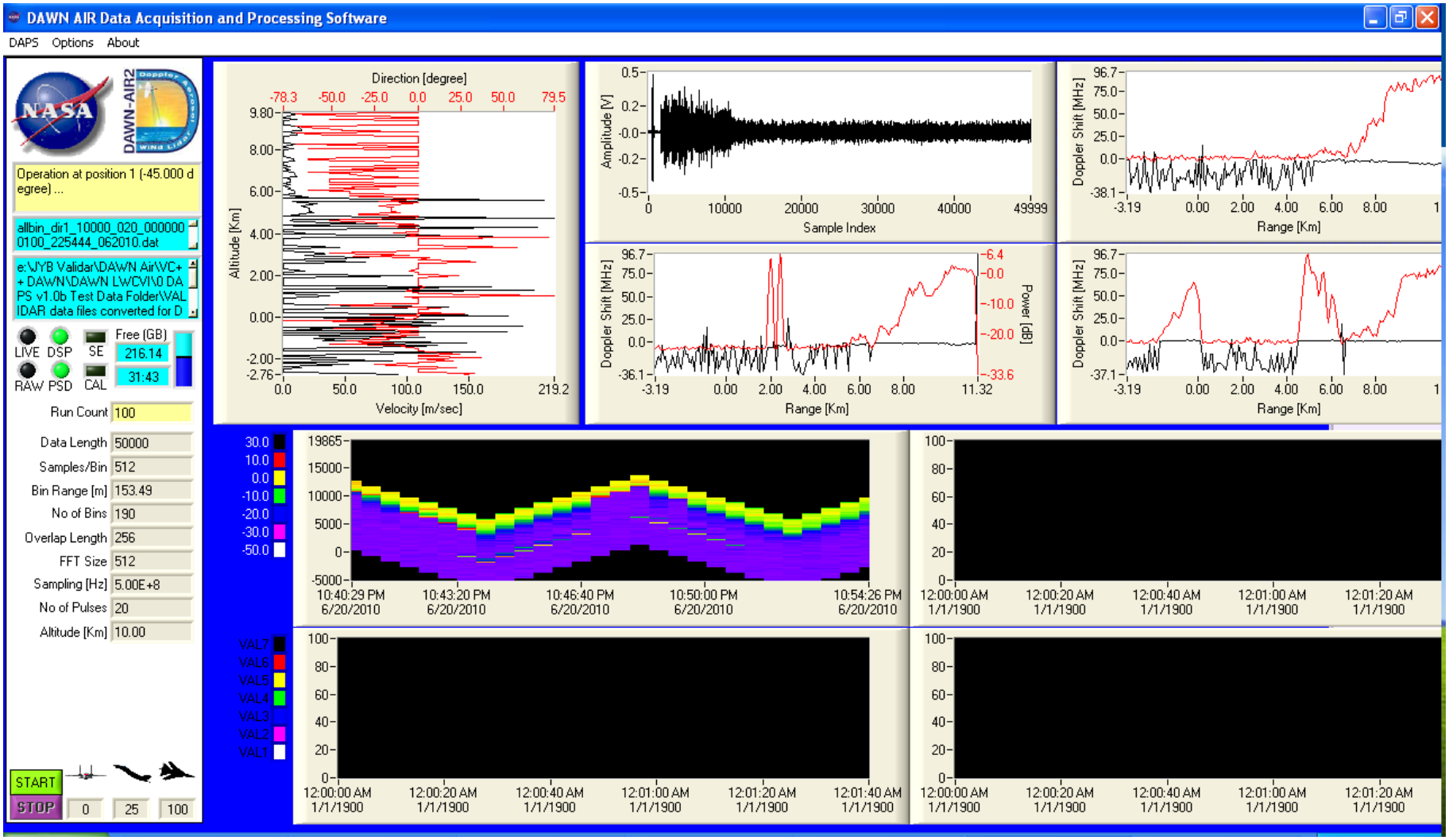
Subsystem Testing – INS/GPS

- Identify functionalities and control commands.
- LabVIEW program to test commands.
- Implementation in C.
- Field test in a vehicle.
- Need for strategy in sending commands and polling responses.
- Need for strategy in data extraction.

Overhead Display Layout



Overhead Display Layout



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