Advances in Weather Radar Technology
IntuVue RDR-4000M

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• Obsolescence Issues
  – Military aircraft often have a very long life, however, aircraft electronics seem to “age” more quickly than the airframe
  – Changing technology may improve equipment capabilities, but, may also create obsolescence issues
  – Resulting in…
    • Older C-130 Weather Radar systems becoming more difficult to support
Problem Summary

• Capability Issues
  – New technology may extend the capability of the aircraft
  – New roles and missions for the aircraft tend to increase the crew workload
  – Resulting in…
    • The need to make systems more capable but more intuitive and easier to operate
Honeywell’s Solution

• RDR-4000M with IntuVue technology
  – Field tested and combat proven (C-17)
  – Selected by several C-130 operators
  – Improved Weather Detection and Weather Analysis
  – Reduces Pilot/Navigator workload
  – Significant increase in MTBF, overall system reliability and availability
Honeywell’s Solution

- RDR-4000M with IntuVue technology
  - Reduces Logistics Footprint; Lowers O&M costs
  - Shares hardware and technology with other Radar systems on other Civil and Military aircraft
  - Flexible configuration and growth potential
Key Design Features

• Elimination of Waveguide Runs & Switch
  – Reduced Maintenance (leaks, corrosion, switch)
  – Eliminates Waveguide Performance Loss
  – Reduces Installation complexity

• Radar Processor (RP-1M) VS APS-133
  – 60 Lighter (12 vs. 29 lbs), Smaller (3 vs. 8 MCU)
  – Digital Processing – Greater Reliability, Repeatability, and Flexibility
Key Design Features

- **Antenna Drive**
  - Highly Reliable Low RPM Direct Drive Motors reduce Maintenance costs
  - Elimination of Gears increases reliability and availability
  - Faster Scanning & Greater Pointing Accuracy for better weather avoidance and safety
Key Operational Features

- 3-Dimensional weather acquisition for more accurate analysis
- Longer range weather detection (320nm) for better avoidance planning
- Automatic flight path based hazard assessment to reduce pilot workload
- Analysis mode (Constant Altitude) for more accurate analysis
Key Operational Features

• Terrain based ground clutter extraction provides a clear picture of weather for easy analysis
• Improved weather, windshear & turbulence detection reduces deviations
• Skin Paint sector scan mode
• High Resolution Ground Map or Optional Precision Ground Map capability (PGM)
• Advanced Technologies:
  – Pulse Compression
    • Increased detection range & resolution for improved avoidance
  – Higher system sensitivity
    • Increased weather/windshear/turbulence detection performance
  – Direct Drive Antenna Design
    • Improved reliability, reduced maintenance costs and improved availability
RDR-4000M Technology

• Advanced Processing Approach:
  – Ground Clutter Extraction
    • Internal terrain database to remove ground returns
  – 3-D Volumetric Scan Buffer
    • Instant availability of multiple weather views

• Advanced Operational Modes:
  – Automatic Storm Cell threat analysis
    • Weather severity assessment for safe routing
  – Full Coverage Ground Map Mode
    • Multiple GMAP mode selection
Improved Operations
From Higher Reliability

- RDR-4000(M) – System MTBF 5,500 hours
  - Savings in delays, turn backs, and diversions
  - Antenna drive, using low RPM direct drive motors, providing 64,000 MTBF
  - Gearless direct drive antenna motors improve system availability
Highest Safety of Flight
From Weather Issues

• Increased Safety with Turbulence Avoidance
  – First and only system certified to the new enhanced turbulence MOPS criteria
  – Detects hazards along flight path
  – Automated weather detection reduces pilot workload
Ground Clutter Elimination

- Collect RF energy returns from weather
- Store storm data in 3D Buffer
- Use integrated terrain database to extract ground returns from weather
• Aircraft on level flight
  – Display weather at current altitude, Max/-4000 feet
  – Extend the upper and lower limits based on a/c climb or descend rate
  – Displays all primary weather
• Aircraft at cruise altitude (example FL290)
  – Display primary weather from FL250 up to Max (FL600) feet above the aircraft
  – Display secondary and low-level weather hashed
Automatic Mode
Climb

- Aircraft in climb mode
  - Display primary weather in aircraft flight path
  - Show off-flight-path weather as secondary
• **Constant Altitude Mode**
  – Display weather at selected altitude (in this case above current aircraft altitude)
  – Secondary weather and turbulence are suppressed
Map 1 - Full Coverage
Ground Map

- MAP 1
  - 3D buffer of Ground Returns
  - No tilt adjustment required
  - “normalized radar cross-section” display
  - Suitable for detection of terrain features, coastlines and large bodies of water
  - Optimized for longer ranges
Map 2 – High Resolution Ground Map

• MAP 2
  – Real beam mapping mode
  – Automatic tilt set by range/altitude
    • Set to maximize display coverage
    • Different Pilot / Copilot range selection provided by alternate scans
  – High resolution optimized for shorter range
Optional Map Mode
Precision Ground Map

- RDR-4000(M) Doppler Beam Sharpening (DBS)
  - Airport 4X zoom
  - 4nm miles
Skin Paint Mode

- **SKIN Paint**
  - Manual Sector Scan
    - Left, Center, or Right
    - Full scan (± 45°) each sector
      - Sectors centered at -35°, 0°, +35°
    - TILT knob active for ± 15°
  - Crew controlled Tilt for search
Summary

- RDR-4000M provides latest digital technology and best value today
  - Auto Mode weather detection significantly reduces pilot workload
  - Analysis capability to determine extent of hazardous conditions
  - Significant increase in weather detection performance
  - Skin Paint sector scan
  - High resolution or optional Precision Ground Mapping
  - New platform capable of further Growth
Summary

• Major components in USAF inventory
• Component commonality with many Civil Air Transport aircraft
• Lower cost, smaller size, less weight and less power consumption versus other legacy systems
• Higher reliability for maintenance cost savings and improved availability
RDR-4000M C-17 Installation

• APS-150/RDR-4000M Radome Installation
  – Antenna Drive Assembly
  – Flat Plate Antenna
  – Transmitter/Receiver
  – ≈36 lbs
  – No special handling equipment
  – Reliable Direct Drive Motors
  – Waveguide runs – replaced by Coaxial cable
Thank You

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