Aircraft Geometric Height Measurement Element (AGHME) Constellations

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AGHME Constellation
Multi-lateration Functionality

- Timestamp difference of arrival time of common signal from airframe
- Algorithm to produce “matched set” of timestamps to input into geometric height model
- Geometric heights converted into pressure altitudes via Tech Center developed process
- Compute final “ASE” of airframe
Total System Flow

AGHME CONSTELLATION

AGHME ELEMENT 1
AGHME ELEMENT 2
AGHME ELEMENT 3
AGHME ELEMENT 4
AGHME ELEMENT 5

LCN

Geometric Height Model

ASE Generator
AGHME Constellation

- Proven system design
- Running in the field 24/7 operation
- Rugged and reliable
- Perfect in-field laboratory to monitor and experiment with ADS-B issues
Time Standard

- Standards Provide 10 MHz Reference
- GPS Receiver Timing Solution
  - Real-Time Solution
  - Better fits a large scale model
- Unique solution
  - Use WAAS geosync satellite for timing solution
    - Live implementation of Commonview solution
AGHME Time Specifications

- 2 nanosecond resolution
- 5 nanosecond accuracy
Receipt Time Analysis

• Highly accurate timestamp tool
  ✦ Point on rising edge of P1 (Shotgun blast)
    • 3 db down from pulse average amplitude

• Software that analyzes .5 Gbytes of data for 1 sec
  ✦ Classic
    • Detect preamble (8 usec 4 pulse set)
    • Decode Mode S message by chip analysis
    • Mode S Reception time is rising edge of P1
      ✦ Known time relationship between P1, P2, P3, and P4 of preamble
      ✦ Allows normalizing pulses and take average of 4 pulses
Bench Test Setup

- GPS Receiver
- 10 MHz Ref
- ARB
- Attenuator
- 1090 Mhz Receiver
- High Speed Digitizer
- Host PC
Mode S Format

Preamble 8 usecs

DATA BLOCK
56 or 112 usecs

BIT 1 BIT 2 BIT 3 BIT 4 *** *** BIT N-1 BIT N
1 0 1 0 1 0 1 0 1 0 1 0 1 0

500 Clocks
1750 Clocks
2250 Clocks
4000 Clocks

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Receipt Time Analysis

Classic Procedure  db0
P1  3db down on rising edge from pulse amplitude
P1-P4  Average of 4 preamble pulses
Pulse amplitude  207 – 238  DS500 counts
Yield:  11,625
Receipt Time Analysis

Classic Procedure  db3
P1  3db down on rising edge from pulse amplitude
P1-P4  Average of 4 preamble pulses
Pulse amplitude  186 – 215  DS500 counts
Yield:  11611, 14 missed preambles
Receipt Time Analysis

Classic Procedure  db6
P1  3db down on rising edge from pulse amplitude
P1-P4  Average of 4 preamble pulses
Pulse amplitude  154 – 178  DS500 counts
Yield:  11575, 50 missed preambles
Classic Procedure  db9
P1  3db down on rising edge from pulse amplitude
P1-P4  Average of 4 preamble pulses
Pulse amplitude  120 – 140  DS500 counts
Yield:  10320, 1305 missed preambles
Receipt Time Analysis

New Procedure: Average of all pulses in Mode S message
Uses Inter pulse timing rule sets
Yield: 11,625