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RTCA Special Committee 186, Working Group 3

ADS-B 1090 MHz MOPS

Meeting #2

1090 MHz Radio Frequency Measurement Facility (RMF) Enhanced Reception Technique Analysis

Data Analysis of Appendix I, Table I-1 Combining Odd and Even Outputs

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Summary
The data contained in this presentation shows the benefit derived from using an altered table to combine the odd and even outputs of the 5-5 multiple amplitude enhanced bit and confidence declaration approach.

Background

The data contained in this presentation shows the benefit derived from using an altered table to combine the odd and even outputs of the 5-5 multiple amplitude enhanced bit and confidence declaration approach. The 5-5 multiple amplitude approach is a 10 MHz sampling variation of the 4-4 approach defined in Appendix I. The data was processed off-line using a software implementation of an enhanced reception technique developed to analyze the data collected using the 1090 MHz Radio Frequency Measurement Facility (RMF). The data samples processed for this presentation are two 2-minute samples recorded aboard N40 on May 24, 2000, one starting at 10:56:25 GMT and the other starting at 12:25:00 GMT.

The Combination Tables

Below are the three tables tested. The first table is the original table that is defined in Table I-1 in Appendix I.

Original Odd and Even Combination Table

Odd (1,3,5,7,9) **Even (2,4,6,8,10)**

	H1	**M1**	**L1**	**H0**	**M0**	**L0**
H1	H1	H1	H1	L0	H1	H1
M1	H1	H1	L1	H0	L0	L1
L1	H1	L1	L1	H0	L0	L0
H0	L0	H0	H0	H0	H0	H0
M0	H1	L0	L0	H0	H0	L0
L0	H1	L1	L0	H0	L0	L0

Alternative Odd and Even Combination Table 1

Odd (1,3,5,7,9) **Even (2,4,6,8,10)**

	H1	**M1**	**L1**	**H0**	**M0**	**L0**
H1	H1	H1	H1	L0	**L1**	H1
M1	H1	H1	L1	**L0**	L0	L1
L1	H1	L1	L1	H0	L0	L0
H0	L0	**L0**	H0	H0	H0	H0
M0	**L1**	L0	L0	H0	H0	L0
L0	H1	L1	L0	H0	L0	L0

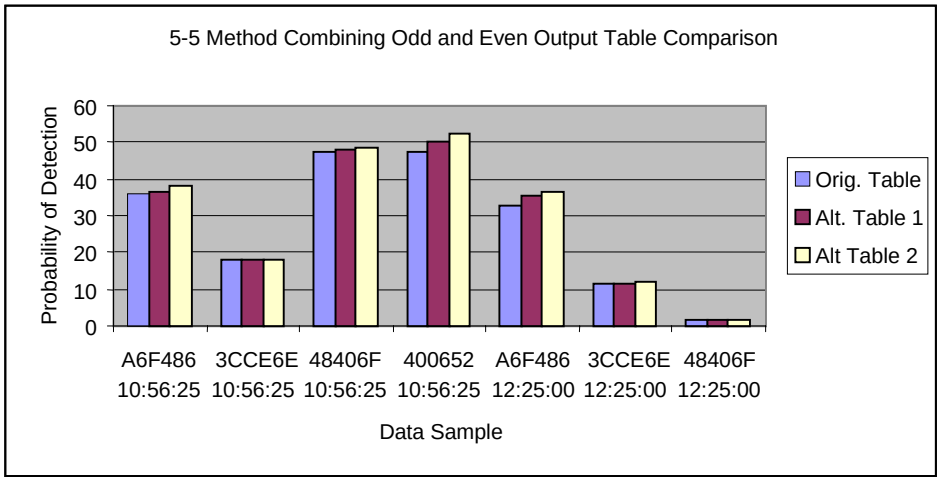
Alternative Odd and Even Combination Table 2

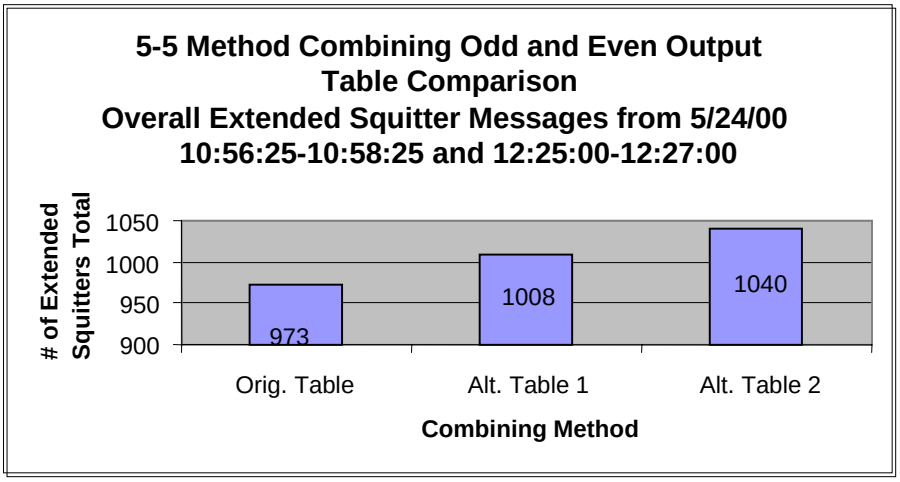
Odd (1,3,5,7,9) **Even (2,4,6,8,10)**

	H1	**M1**	**L1**	**H0**	**M0**	**L0**
H1	H1	H1	H1	L0	**L1**	**L1**
M1	H1	H1	L1	**L0**	L0	L1
L1	H1	L1	L1	**L0**	L0	L0
H0	L0	**L0**	**L0**	H0	H0	H0
M0	**L1**	L0	L0	H0	H0	L0
L0	**L1**	L1	L0	H0	L0	L0

The following data shows the quantity of extended squitter messages that were successfully decoded from the data samples. For each aircraft, the number of messages decoded and the reception probability based on an expected transmission rate of 4.2 messages per second is shown.

RMF EXTENDED SQUITTER RECEPTION – FRANKFURT 5/24/00										
N40 Altitude = 22000										
					CNT	CNT	CNT	PROB.	PROB.	PROB.
TIME	ADDRESS	AIRCRAFT	ALTITUDE	RANGE (nm)	ORIG. TABLE	ALT. TABLE1	ALT. TABLE2	ORIG. TABLE	ALT. TABLE1	ALT. TABLE2
10:56:25 – 10:58:25 GMT	A6F486	Wiesbaden Ground Site	Wiesbaden Ground Site	14 - 21	180	183	191	36	36.6	38.2
10:56:25 – 10:58:25 GMT	3CCE6E	FII Flight Inspection International, Germany	Unknown	unknown	90	90	91	18	18	18.2
10:56:25 – 10:58:25 GMT	48406F	NLR National Aerospace Laboratory, The Netherlands	325 - 4050	18 - 22	238	241	244	47.6	48.2	48.8
10:56:25 – 10:58:25 GMT	400652	British Airways	36950	58 - 82	237	252	262	47.4	50.4	52.4
12:25:00 – 12:27:00 GMT	A6F486	Wiesbaden Ground Site	Wiesbaden Ground Site	11 - 13	165	178	183	33	35.6	36.6
12:25:00 – 12:27:00 GMT	3CCE6E	FII Flight Inspection International, Germany	22000	70 - 76	56	56	61	11.2	11.2	12.2
12:25:00 – 12:27:00 GMT	48406F	NLR National Aerospace Laboratory, The Netherlands	19900	163	7	8	8	1.4	1.6	1.6
				TOTAL=	973	1008	1040			


5-5 Method Combining Odd and Even Output Table Comparison
Probability of Detection
60
50
40
30
20
10
0
A6F486 10:56:25
3CCE6E 10:56:25
48406F 10:56:25
400652 10:56:25
A6F486 12:25:00
3CCE6E 12:25:00
48406F 12:25:00
Data Sample
Orig. Table
Alt. Table 1
Alt Table 2


5-5 Method Combining Odd and Even Output Table Comparison
Overall Extended Squitter Messages from 5/24/00 10:56:25-10:58:25 and 12:25:00-12:27:00
# of Extended Squitters Total
1050
1000
950
900
973
1008
1040
Orig. Table
Alt. Table 1
Alt. Table 2
Combining Method

The following data shows a sample of messages that were successfully decoded using alternative table 2 compared to the same message that could not be decoded using the original table.

Example Messages Lost			
METHOD	UNCORRECTED_DATA	CORRECTED_DATA	CONFIDENCE_DATA
H1+M0=H1	8DA6F4866005CCC9E9B6841A67DC	8DA6F4866005CCC9E9B6841A67DC	FFFFFFFFFFFFFFFFFFFFFFFFFFFF
H1+L0=L1	8DA6F4866005CCC9E9B6841A67DC	8DA6F4866005CCC9E9B6841267DC	FFFFFFFFFFFFFFFFFFFFFFF7FFFF
H1+M0=H1	8F40065290BDF1933D7364AFBDA1	8F40065290BDF1933D7364AFBDA1	FFFFFFFFFFFFFFFFFFFF7FFFECA
H1+L0=L1	8F40065290BDF1933D7364AFBDA1	8F40065290BDF1933D7364AFBC24	FFFFFFFFFFDFFFFFFFFF7FFFBE40
H1+M0=H1	8D4066529901CC8F300500531186	8D4066529901CC8F300500531186	FDFFFFFFFFFFFFFFFFFFFFFFFFFF
H1+L0=L1	8D4066529901CC8F300500531186	8F4006529901CC8F300500531186	FDFF9FFFFFFFFFFFFFFFFFFFFFFF
H1+M0=H1	8DA6F4876005CCC9E9B6841267DC	8DA6F4876005CCC9E9B6841267DC	FFFFFFFFFFFFFFFFFFFFFFFFFFFF
H1+L0=L1	8DA6F4876005CCC9E9B6841267DC	8DA6F4866005CCC9E9B6841267DC	FFFFFFFEFFFBFFFFFFFFFFFFFFFF