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Multi-Scan Correlation to Separate Radar Tracks from False Alarms

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MULTI-SCAN CORRELATION TO SEPARATE RADAR TRACKS FROM FALSE ALARMS

I. BACKGROUND

II. MULTI-SCAN ALGORITHM

III. RESULTS
I. BACKGROUND

DESIRED EXTRACTION OF SURFACE TARGETS IN SPIKEY SEA CLUTTER ENVIRONMENTS WHEN THE SIGNAL-TO-CLUTTER RATIO IS MODERATE OR SMALL.

MULTI-SCAN CORRELATION IS CHOSEN BASED ON THE FOLLOWING CONSIDERATIONS:

1. SIGNIFICANT DETECTION PERFORMANCE GAINS ACHIEVABLE BY OPERATING AT HIGH FALSE ALARM RATE
2. NEW TECHNIQUES PROVIDE ABILITY TO WORK AT STABLE HIGH FALSE ALARM RATE
3. DESIRE LONG TERM DISPLAY AND, THEREFORE, A VERY LOW OUTPUT FALSE ALARM RATE
4. TARGET RETURNS MAY HAVE ONLY A MODERATE DETECTION PROBABILITY (~0.5)
II. MULTI-SCAN ALGORITHM

A. MULTI-SCAN CORRELATION USING LINKED LISTS OF CONTACTS IN VARIOUS RANGE AND BEARING ZONES

B. UPDATE OF A VELOCITY PROFILE MASK

C. AN OUTPUT DECISION BASED ON UPDATES OF THE MASK
CRUX OF MULTI-SCAN CORRELATION CONCEPT

3 OR 4 DETECTIONS OVER AN 8 SCAN INTERVAL ARE REQUIRED TO DECLARE DETECTIONS VALID.

\[ P_{FA} (\text{output}) = P_{FA}^3 \text{ OR } P_{FA}^4 \]

WHILE BASIC TARGET DETECTION SENSITIVITY IS MAINTAINED.

NOTE: FOR \( P_{FA} \) ON THE ORDER OF \( 10^{-3} \) OR \( 10^{-4} \), \( (8)P_{FA}^K(1-P_{FA})^{8-K} = P_{FA}^K \)
A. CORRELATION PROCESSING USING LINKED LISTS

-BEARING ORDERED CORRELATION UNDESIRABLE

-INS stead DIVIDE VIEWING AREA IN A Primarily RANGE-ORIENTED MANNER
Figure I  Contact Correlation Zones
FUNDAMENTAL DISTANCE

THE MAXIMUM DISTANCE A TARGET CAN TRAVEL DURING THE SCAN HISTORY.

DEPENDS ON:
1. NUMBER OF SCANS IN HISTORY
2. SCAN PERIOD OF RADAR
3. MAXIMUM TARGET VELOCITY
### Index File

(LOCATION OF MOST RECENT CONTACT IN ZONE)

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### Multi-Scan Memory

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INITIAL
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Correlation Processing
B. UPDATE OF VELOCITY PROFILE MASK

VELOCITY PROFILES COVERING DIFFERENT SEGMENTS OF THE VELOCITY RANGE ARE CONSTRUCTED IN THE RANGE ONLY DIMENSION.

THE BIT CORRESPONDING TO \( \Delta \text{SCAN} \) IS SET IN THE PROFILES COVERING THE VELOCITY RANGE FROM \( (\Delta R - 2\alpha)/\Delta \text{SCAN} \) TO \( (\Delta R + 2\alpha)/\Delta \text{SCAN} \).
MULTI-SCAN CORRELATION

RANGE/BEARING WINDOW

STORED CENTROID

SPEED (KNOTS)

INBOUND

OUTBOUND

RANGE IN NMI

BEARING

SCAN NO

0-7

7-14

14-21

21-28

28-35

0 1 2 3 4 5 6 7

1 2 3 4 5 6 7

10 12 14

0-2623

AUG 80
C. OUTPUT DECISION

- A QUALITY LEVEL IS ASSIGNED TO EACH BIT PATTERN BASED ON PROBABILITY OF RESULTING FROM FALSE ALARMS.
- PROBABILITY OF PATTERN RESULTING FROM FALSE ALARMS IS APPROXIMATELY THE PRODUCT OF $NKP_{FA}$ OVER ALL $N$ SUCH THAT BIT $N$ IS SET.
- PATTERNS TEND TO SEGREGATE ACCORDING TO NUMBER OF BITS SET.
- THE SET OF WEIGHTINGS GIVEN BY THE VALUES OF $N$ PROVIDES FOR FINER DIFFERENTIATION WITHIN EACH GROUP.

- EACH PROFILE IS CHECKED TO SEE IF THE BIT PATTERN QUALITY LEVEL EXCEEDS THE THRESHOLD FOR THE GIVEN PROFILE, AND THE CONTACT IS ACCEPTED OR REJECTED.
PMTC CENTROID DISPLAY

6/12/80
12:00 AM
10 NN Full Range
2 NN Range Rings
Unfiltered MTI Data
25 Scans of Data

Air Target

SEPTAP and Towed Target
100 Scans of Data

200 Scans of Data

6/12/80
11:00 AM
15 NM Full Range
3 NM Range Rings
Filtered MTI Data
4/8 hits Required

1000 Scans of Data
6/11/80
11:00 AM
25 HM Full Range
5 NM Range Rings
175 Scans of Data
Both Channels
6/11/80
11:00 AM
70 NM Full Range
14 NM Range Rings
175 Scans of Data
Both Channels

Unfiltered

Filtered 3/8 Hits

Filtered 4/8 Hits