



4-1981

Multi-Scan Correlation to Separate Radar Tracks from False Alarms

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Recommended Citation

Greenberg, R. I.; Thurber, R. E.; and Prengaman, R. J.. Multi-Scan Correlation to Separate Radar Tracks from False Alarms. Illinois State Academy of Science Annual Meeting, , , 1981. Retrieved from Loyola eCommons, Computer Science: Faculty Publications and Other Works,

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MULTI-SCAN CORRELATION TO SEPARATE RADAR TRACKS FROM FALSE ALARMS

- I. BACKGROUND
- II. MULTI-SCAN ALGORITHM
- III. RESULTS

I. BACKGROUND

DESIRE 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 ($\approx .5$)

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.

$$P_{FA} \text{ (OUTPUT)} \approx P_{FA}^3 \text{ OR } P_{FA}^4$$

WHILE BASIC TARGET DETECTION SENSITIVITY IS MAINTAINED.

NOTE: FOR P_{FA} ON THE ORDER OF 10^{-3} OR 10^{-4} , $\binom{8}{K} P_{FA}^K (1-P_{FA})^{8-K} \approx P_{FA}^K$

A. CORRELATION PROCESSING USING LINKED LISTS

-BEARING ORDERED CORRELATION UNDESIRABLE

-INSTEAD DIVIDE VIEWING AREA IN A PRIMARILY RANGE-ORIENTED MANNER

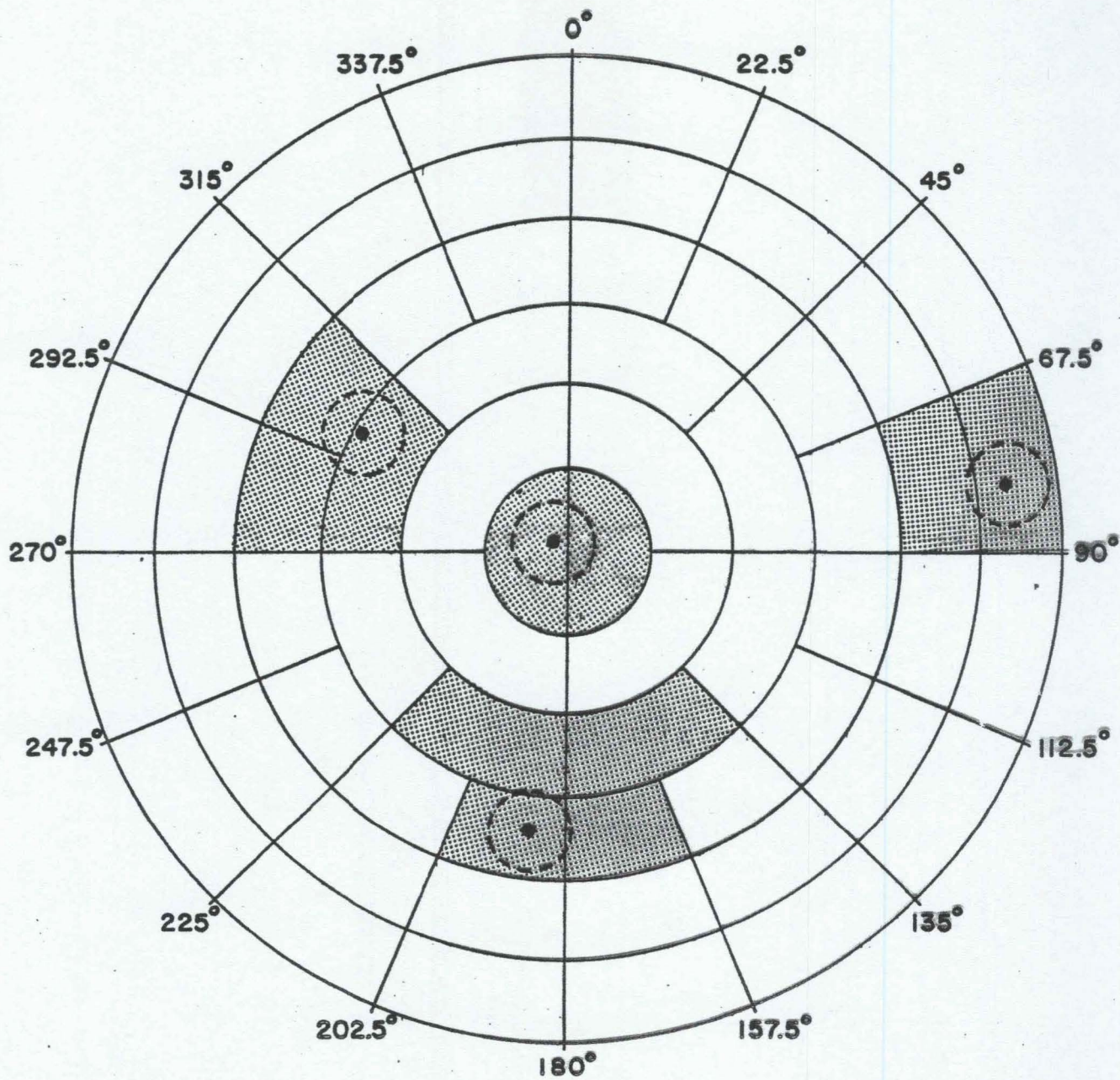


Figure I Contact Correlation Zones

FUNDAMENTAL DISTANCE

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

DEPENDS ON:

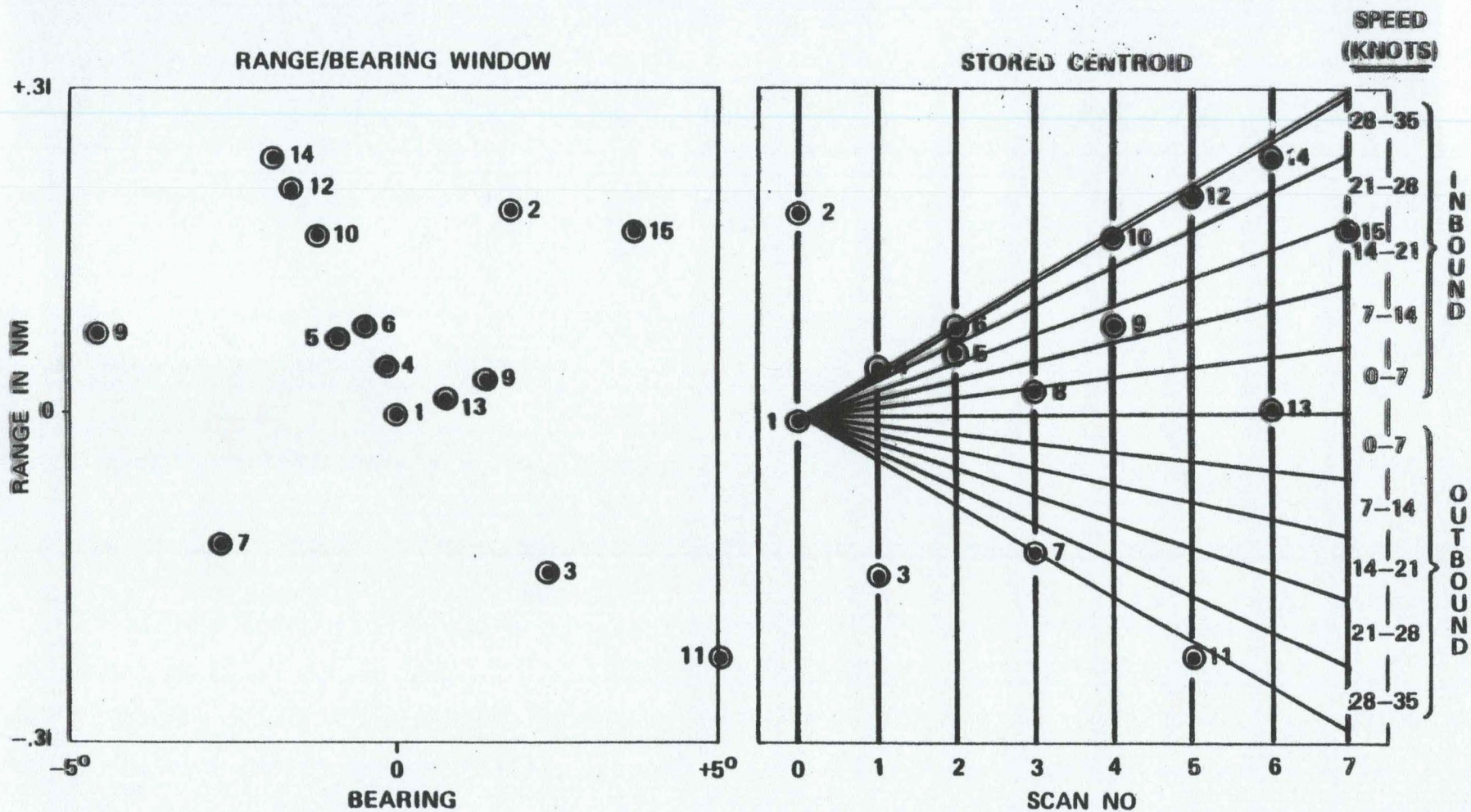
1. NUMBER OF SCANS IN HISTORY
2. SCAN PERIOD OF RADAR
3. MAXIMUM TARGET VELOCITY

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 Δ SCAN IS SET IN THE PROFILES COVERING THE VELOCITY RANGE FROM $(\Delta R - 2\alpha)/\Delta$ SCAN TO $(\Delta R + 2\alpha)/\Delta$ SCAN

MULTI-SCAN CORRELATION



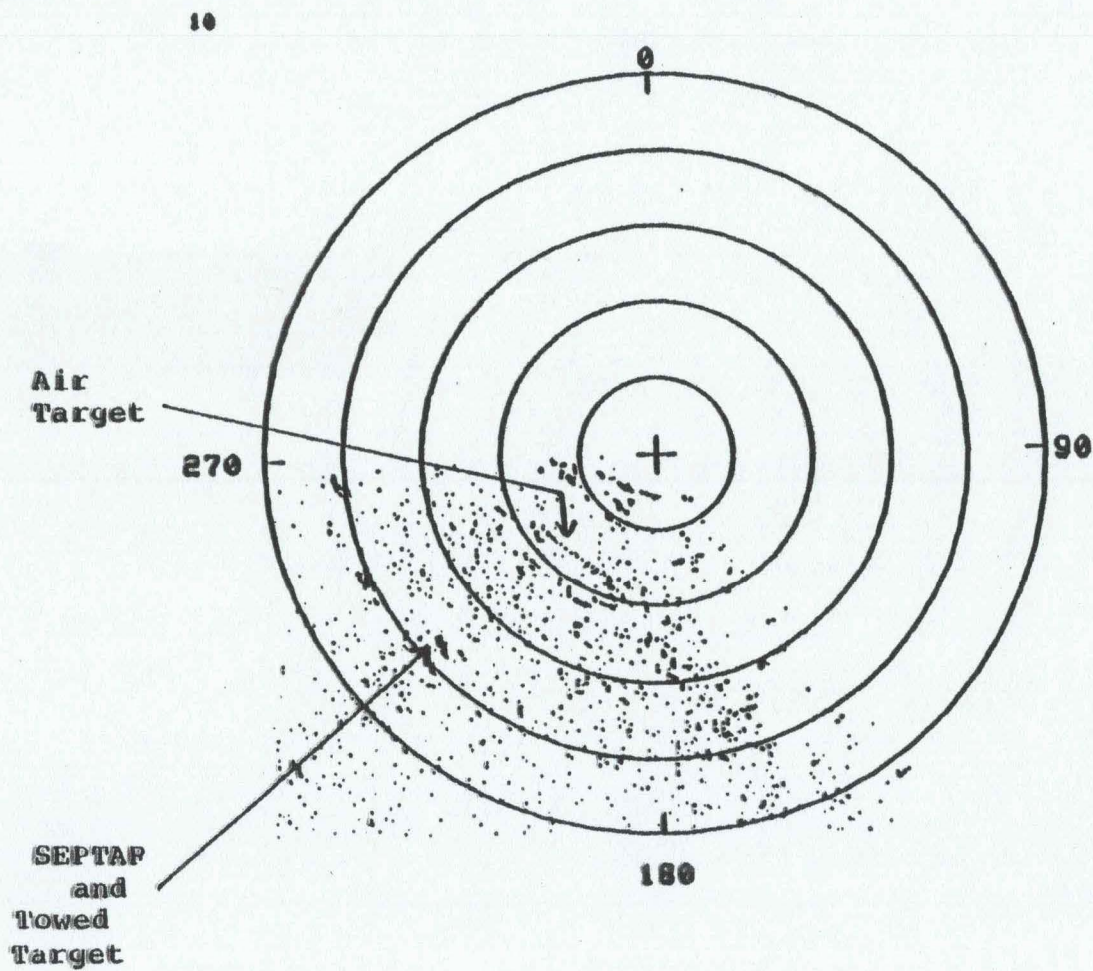
0-2623
AUG 80

C. OUTPUT DECISION

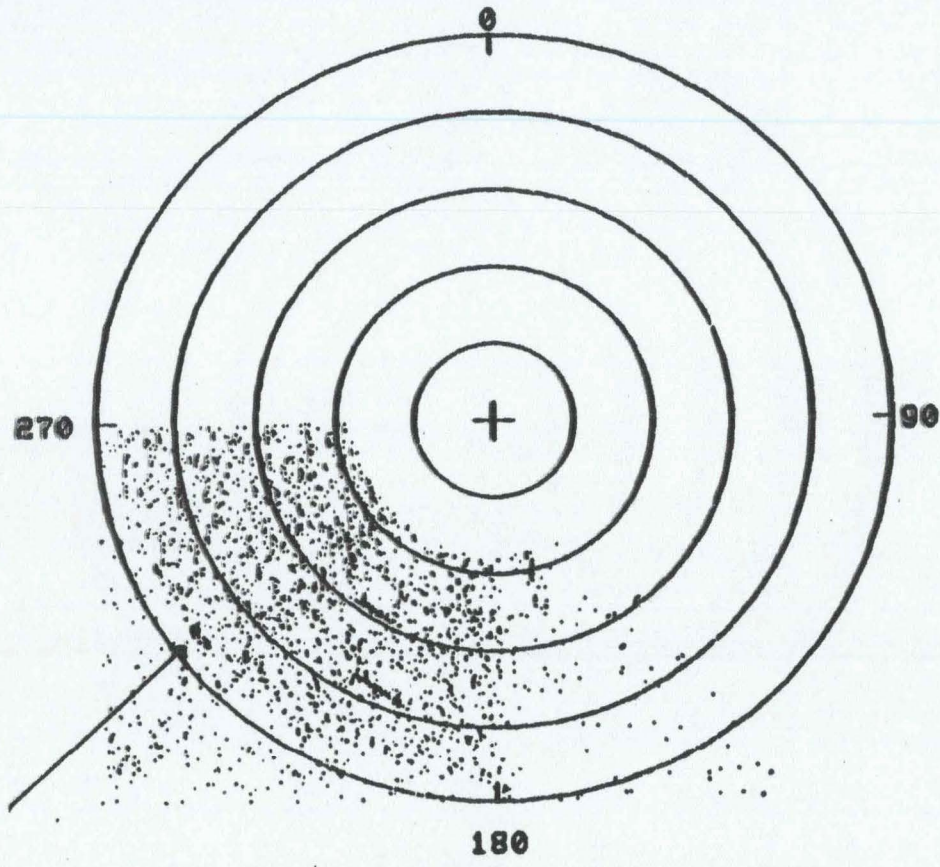
- A QUALITY LEVEL IS ASSIGNED TO EACH BIT PATTERN BASED ON PROBABILITY OF RESULTING FROM FALSE ALARMS.
 - PROBABILITY OF PATTERN RESULTING FROM FALSE ALARMS IS APPROXIMATELY THE PRODUCT OF $NK P_{FA}$ OVER ALL N SUCH THAT BIT N IS SET.
 - PATTERNS TEND TO SEGREGATE ACCORDING TO NUMBER OF BITS SET.
 - 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 NM Full Range
2 NM Range Rings
Unfiltered MTI Data
25 Scans of Data

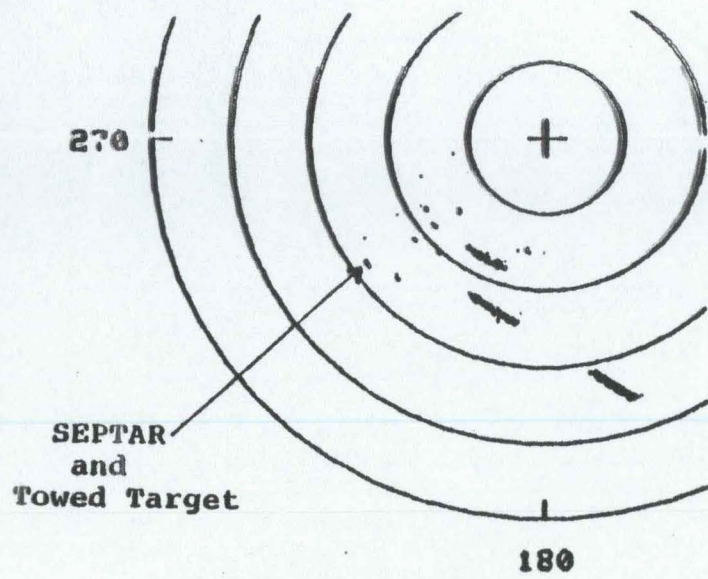


6/12/80
11:00 AM
9 NM Full Range
100 Scans of Data

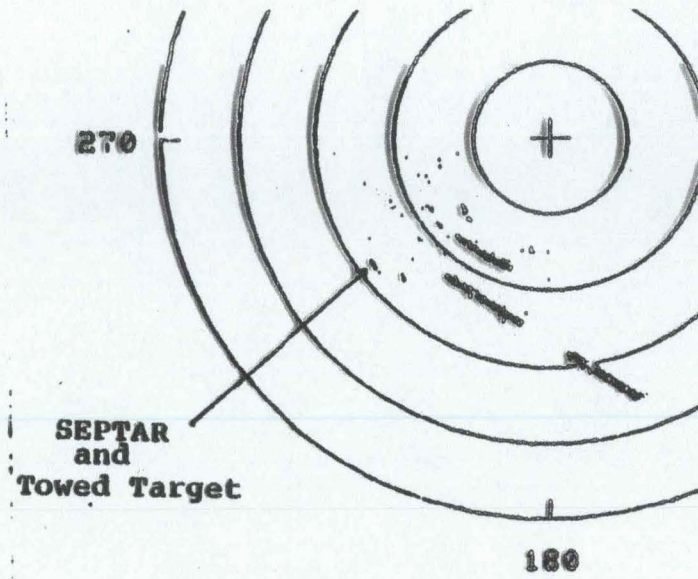


SEPTAR
and
Towed
Target

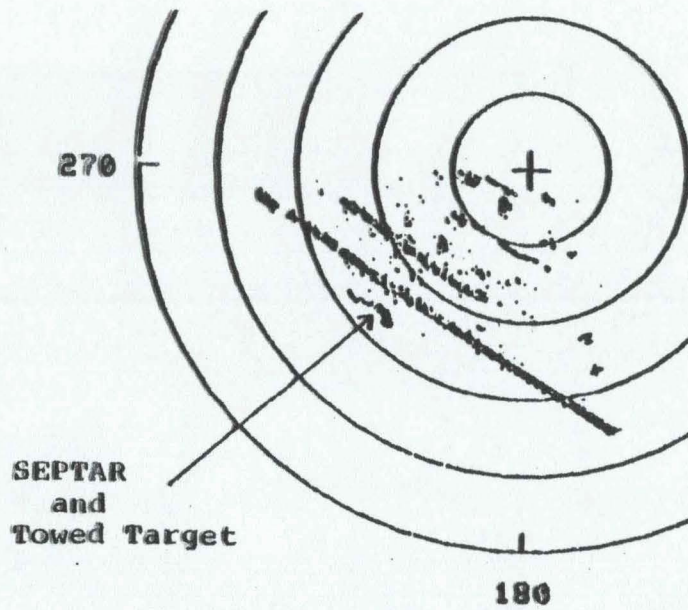
Unfiltered MTI Data



100 Scans of Data

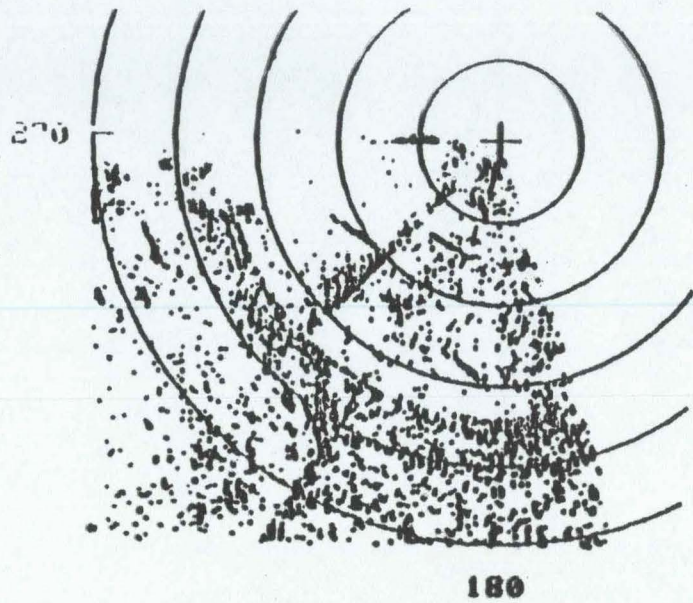


200 Scans of Data



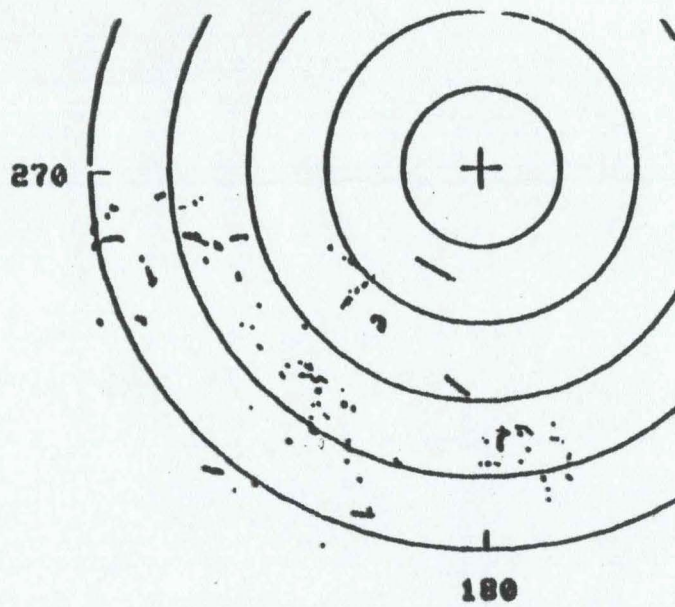
1000 Scans of Data

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

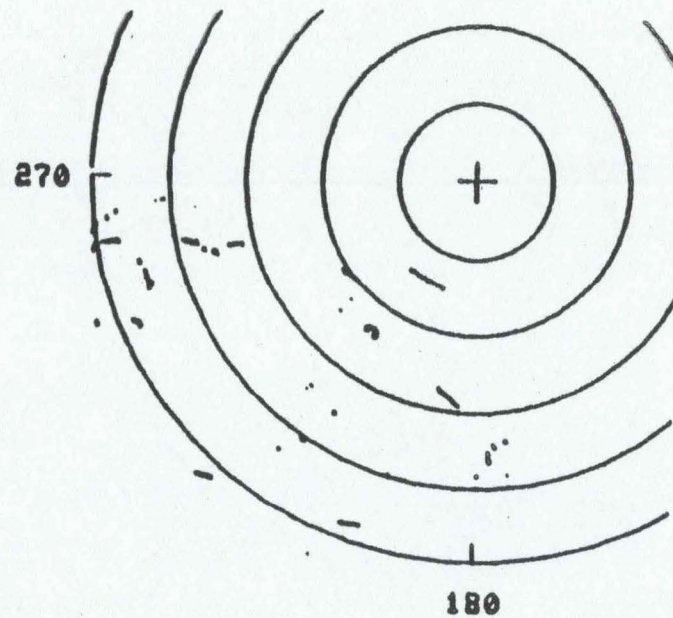


6/11/80
 11:00 AM
 25 NM Full Range
 5 NM Range Rings
 175 Scans of Data
 Both Channels

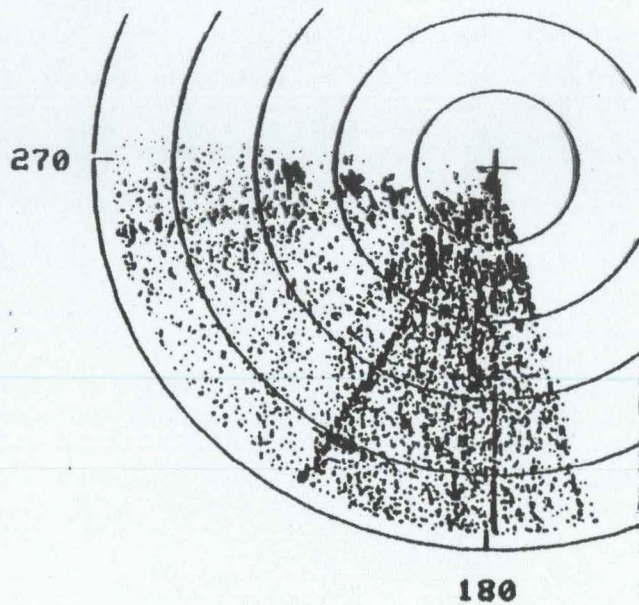
Unfiltered



Filtered 3/8 Hits

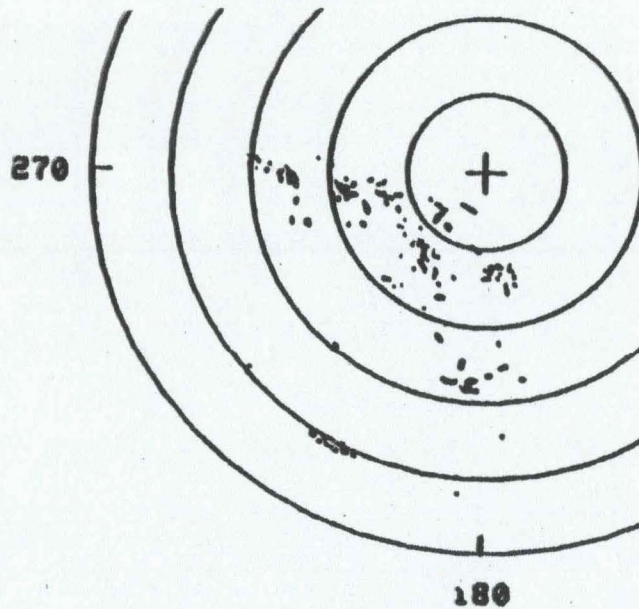


Filtered 4/8 Hits

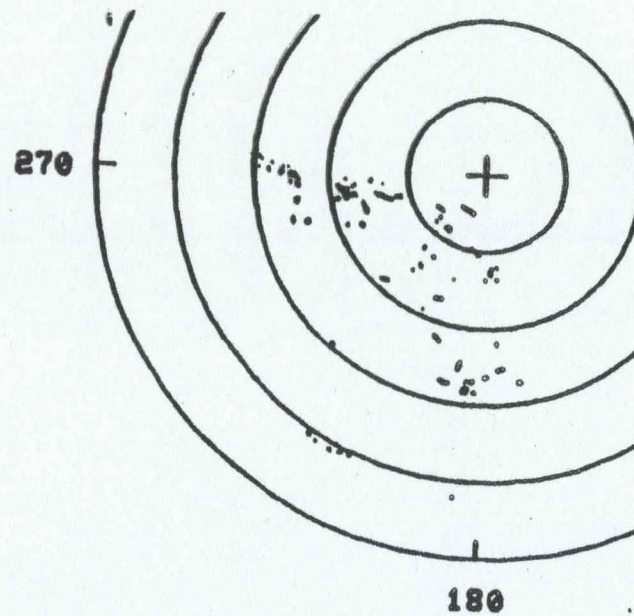


6/11/80
11:00 AM
70 NM Full Range
14 NM Range Rings
175 Scans of Data
Both Channels

Unfiltered



Filtered 3/8 Hits



Filtered 4/8 Hits