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Intelligence Based Tracking for Two Radar Applications

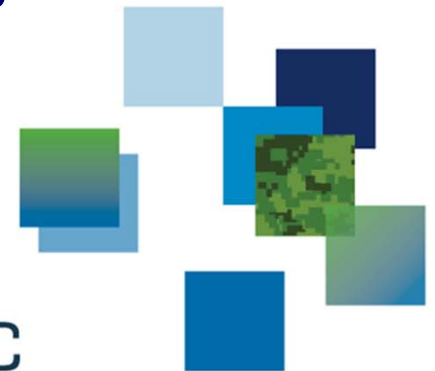
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DRDC | RDDC

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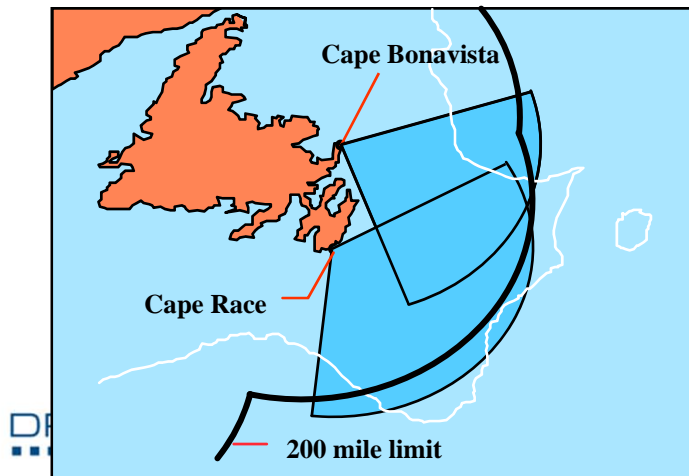
Overview

1. Introduction: HFSWR & ASR
2. Problems and Solutions
3. Real Data Used for Performance Evaluation
4. Testing Results
5. Conclusions

Canadian HFSWR: 3 Generations

- **1989-2002 (1st gen):** Concept study to experimental prototype (2 systems)
- **2003-2005 (2nd gen):** Production built for the Navy Network Program (2 systems)
- 2006-2007: Industry Canada's Spectrum Guidelines, define new requirements
- **2008-2015 (3rd gen):** Software Defined Radar with Spectrum Adaptation (1 system)

East Coast HFSWR sites



Cape Bonavista receive array



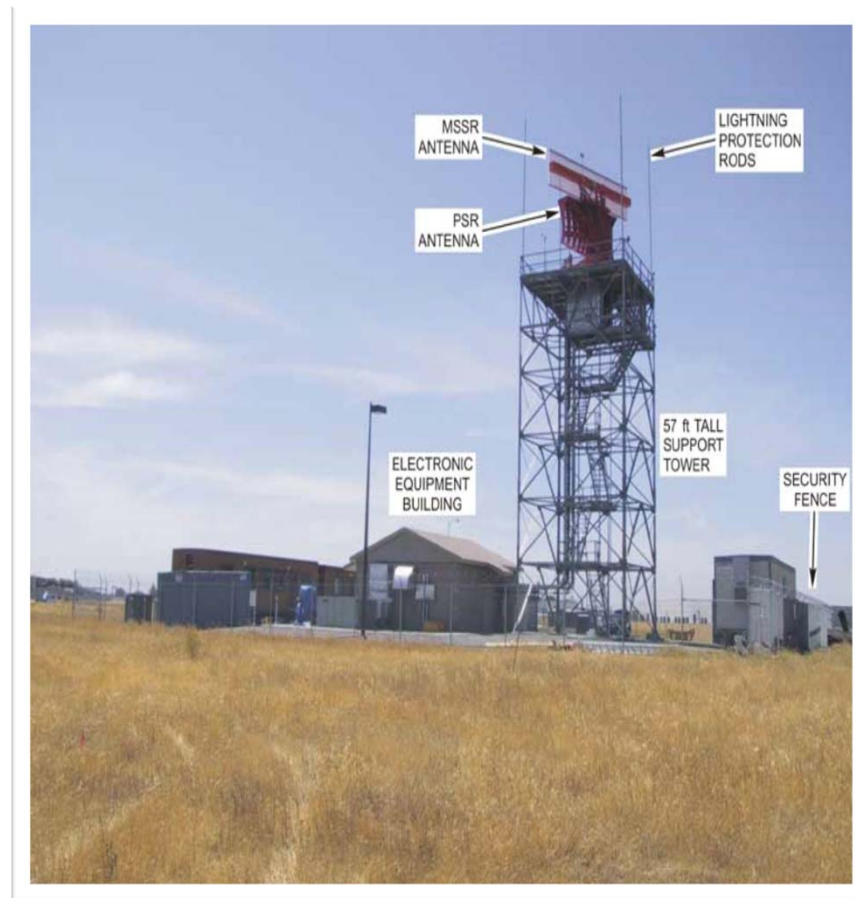
Cape Bonavista transmit array



The 3rd Generation HFSWR



Airport Surveillance Radar (ASR)

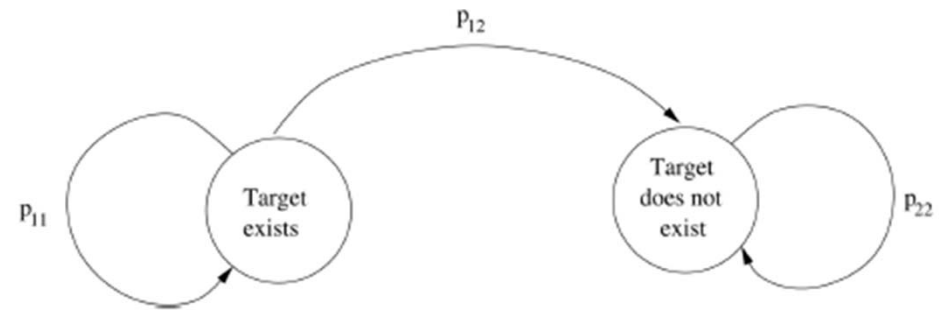


Radar Tracking Issues

- **HFSWR** suffers from heavy unpredictable ionosphere, particularly at night, and sea clutters. Track duplication, track break-up and track seduction in scenarios involving manoeuvring targets, or high clutter/target environments are top issues and enhancements are needed.
- **ASR** When deployed in wind farms, both ASR and military authorities have raised concerns on radar performance.

Radar Tracking Solutions

- Track Quality Tracker (TQT): **HFSWR**
- Map Aided Processing (MAP): **HFSWR, ASR**
- Classification Aided Processing (CAP): **ASR**
- Track Retrodiction Tracker (TRT): **HFSWR**
- Post Tracker Stitching (PTS): **ASR**



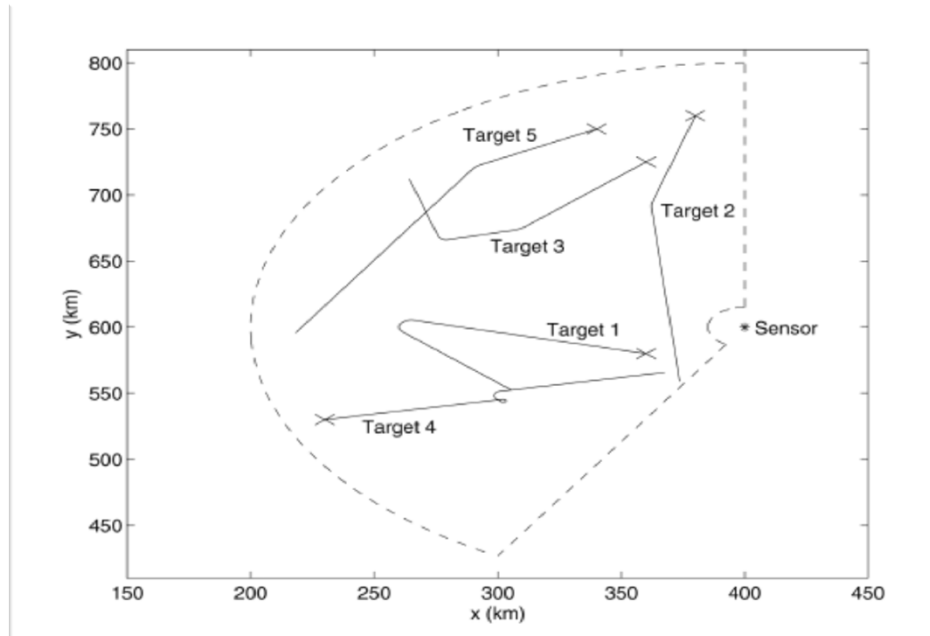
Markov chain of track existence.

- 1) the track is associated with a measurement at time step $k + 1$ (event A_1),
- 2) the track is associated with no measurement at this time (event A_2).

- 1) the target corresponding to the track exists, and the associated measurement is from the target (event A_{11}),
- 2) the target exists but the associated measurement is a false alarm (event A_{12}),
- 3) the target does not exist, and the associated measurement is a false alarm (event A_{13}).

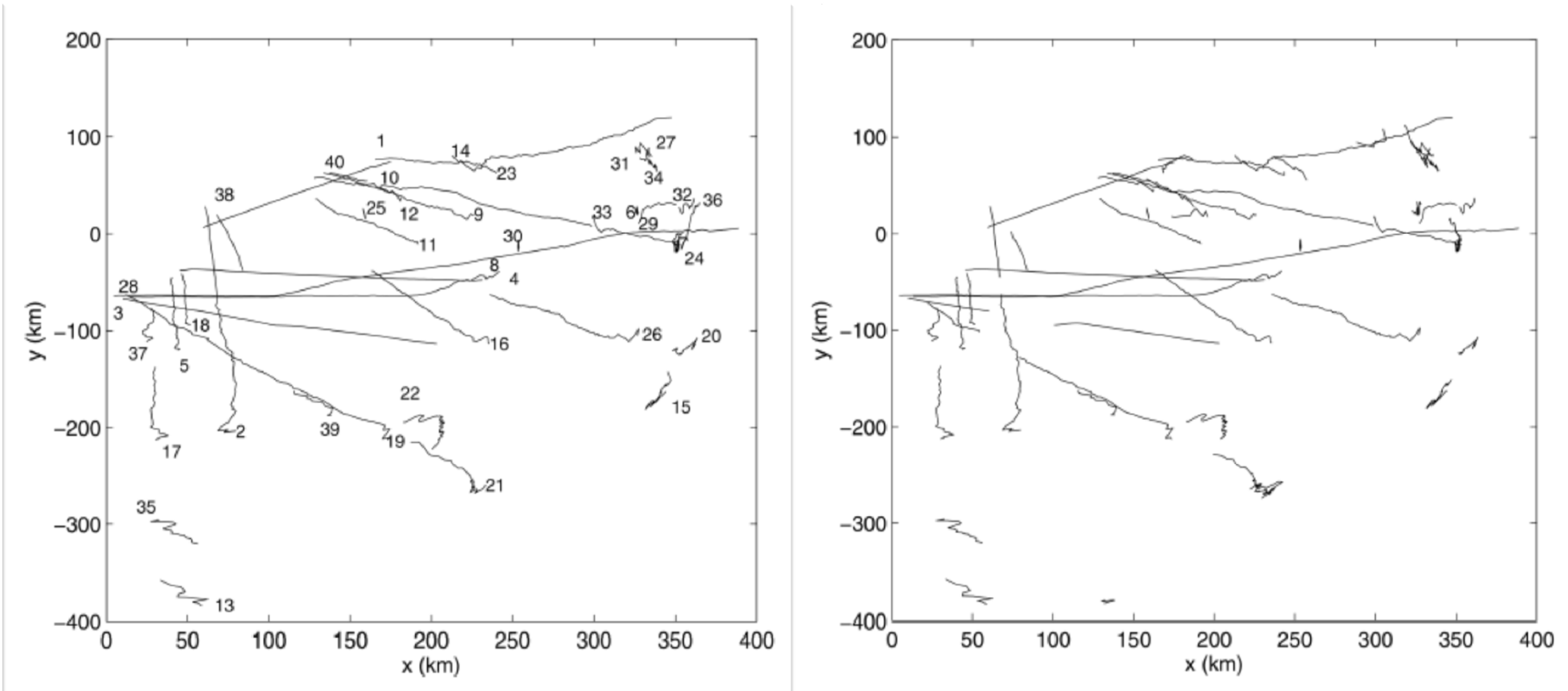
- 1) the target corresponding to the track exists, and it is not detected (event A_{21}),
- 2) the target does not exist (event A_{22}).

Track Quality Tracker (TQT) Results - Simulation

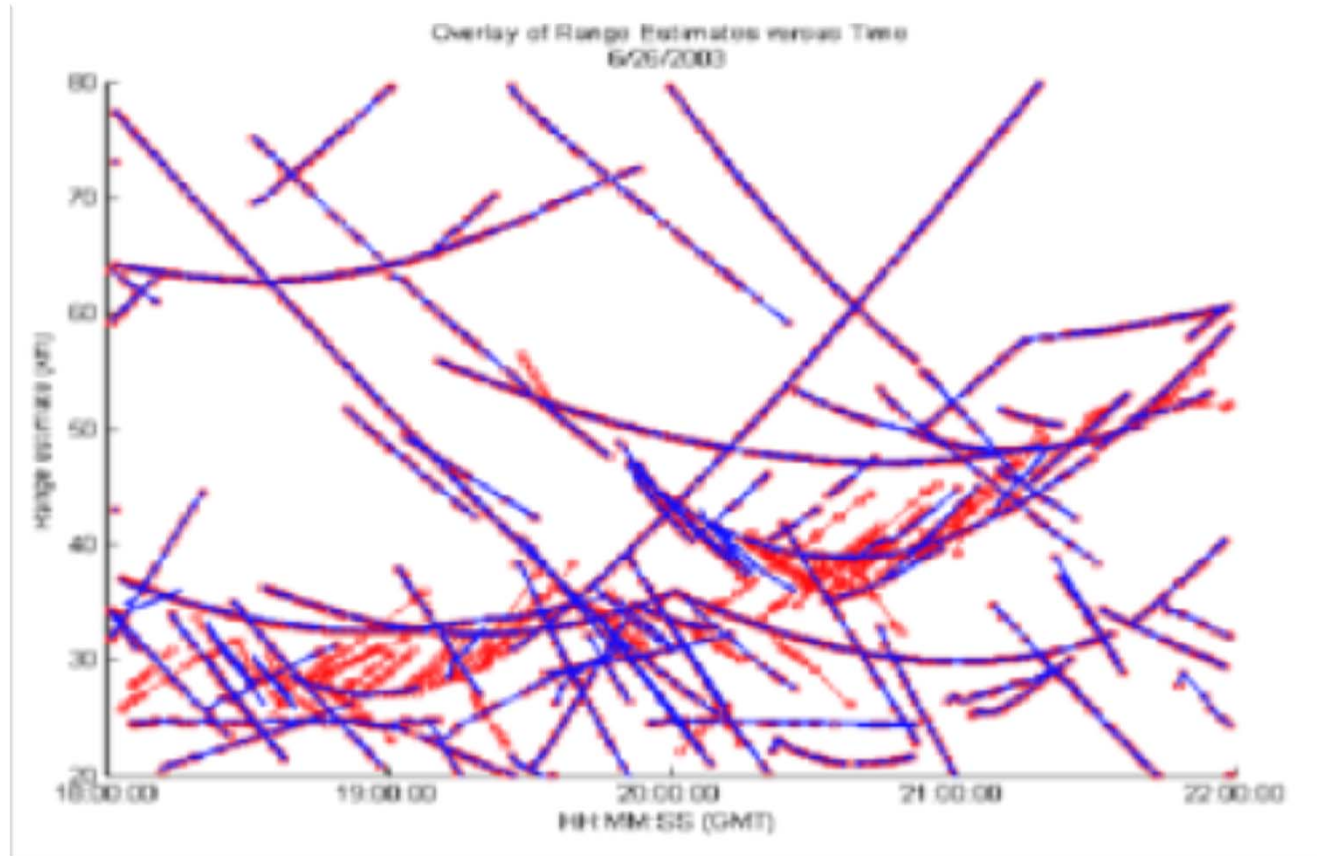


Algorithm	Detection Delay (min)	% of Traj. Tracked	Position RMSE (m)	Velocity RMSE (m/s)	Avg. False Track no./run	Avg. False Track Life (min)
Track Quality	10.12	82.2%	940.7	2.42	1.61	14.02
Fixed logic	10.59	74.6%	987.4	3.02	1.78	24.38

Track Quality Tracker (TQT) – Real Radar Data

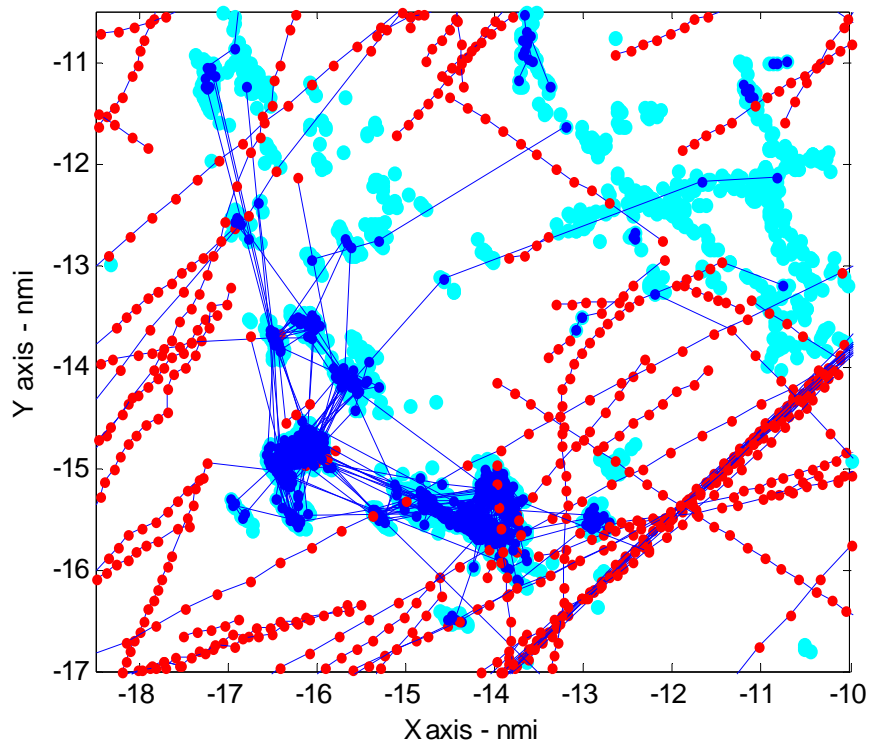


Map Aided Processing (MAP) - HFSWR

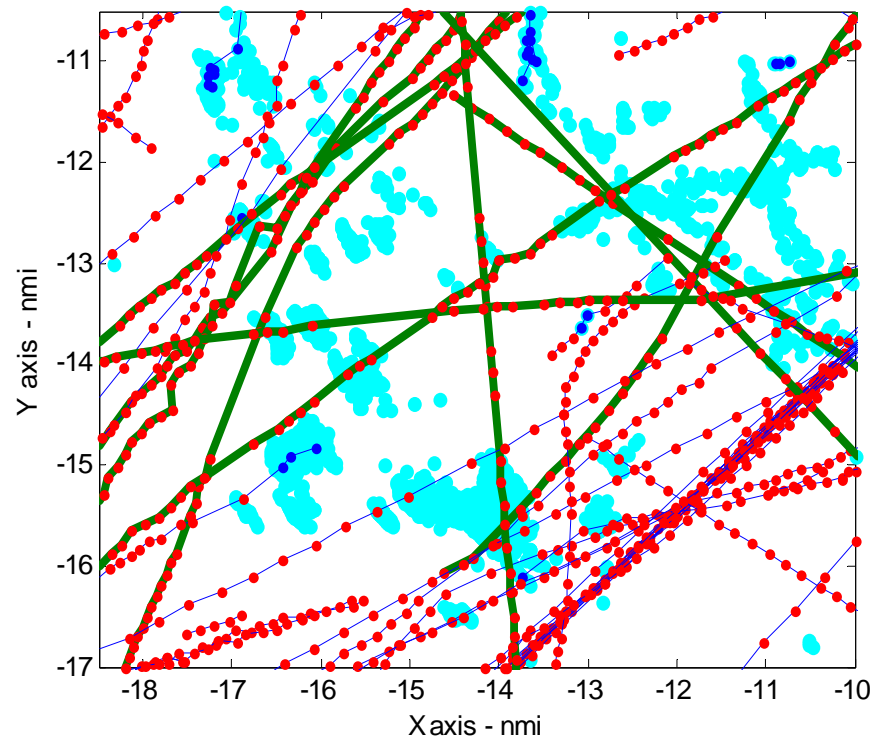


Map Aided Processing (MAP) - ASR

Existing Tracker



New Tracker



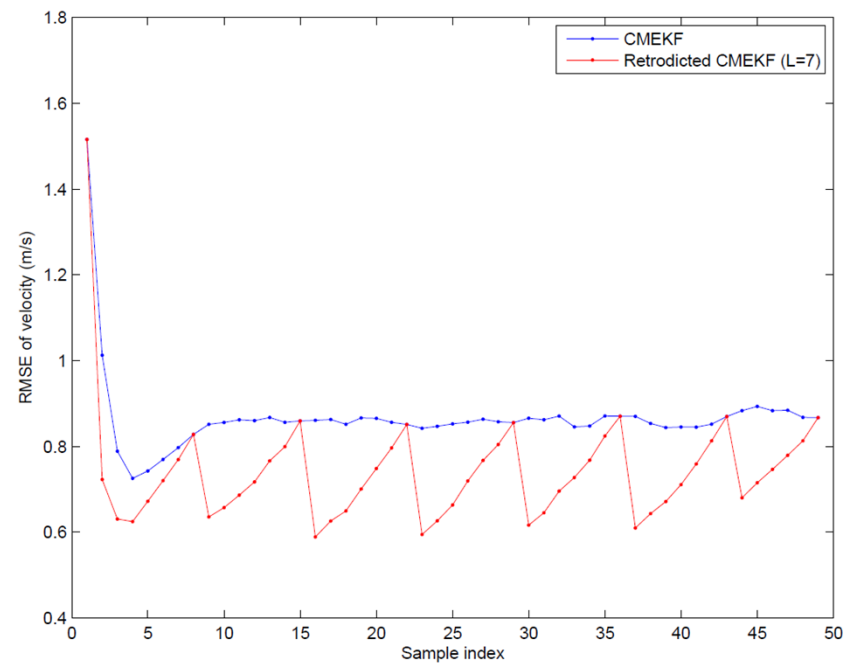
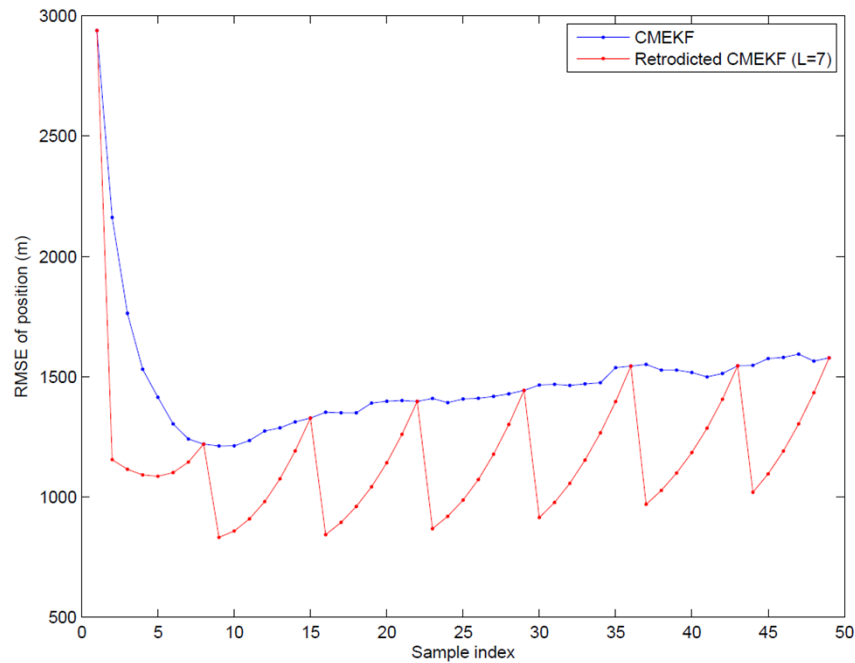
Adaptive gate and coasting: increase track continuity and reduce seduced tracks

Classifier Aided Processing (CAP) - ASR

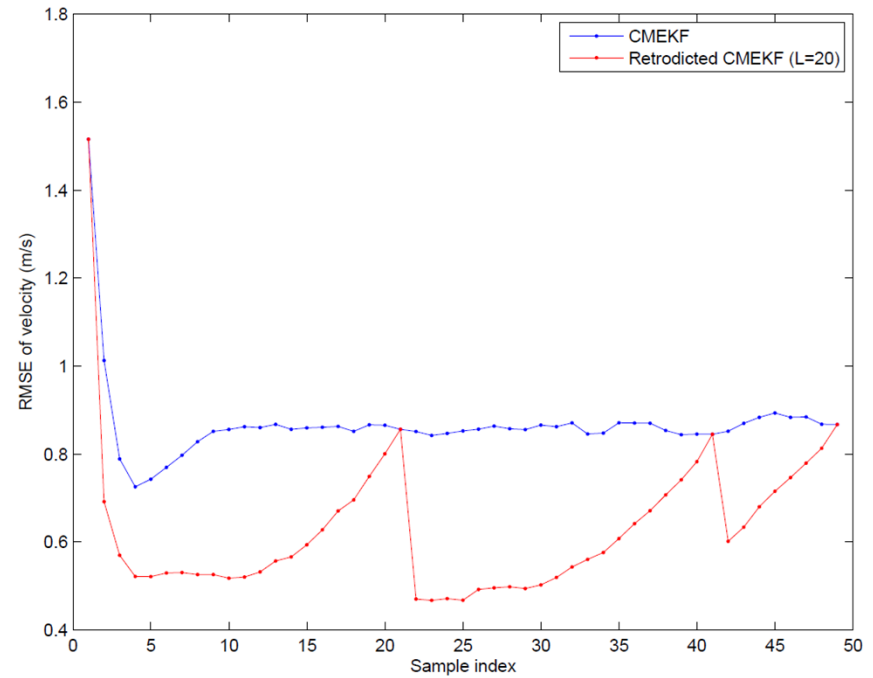
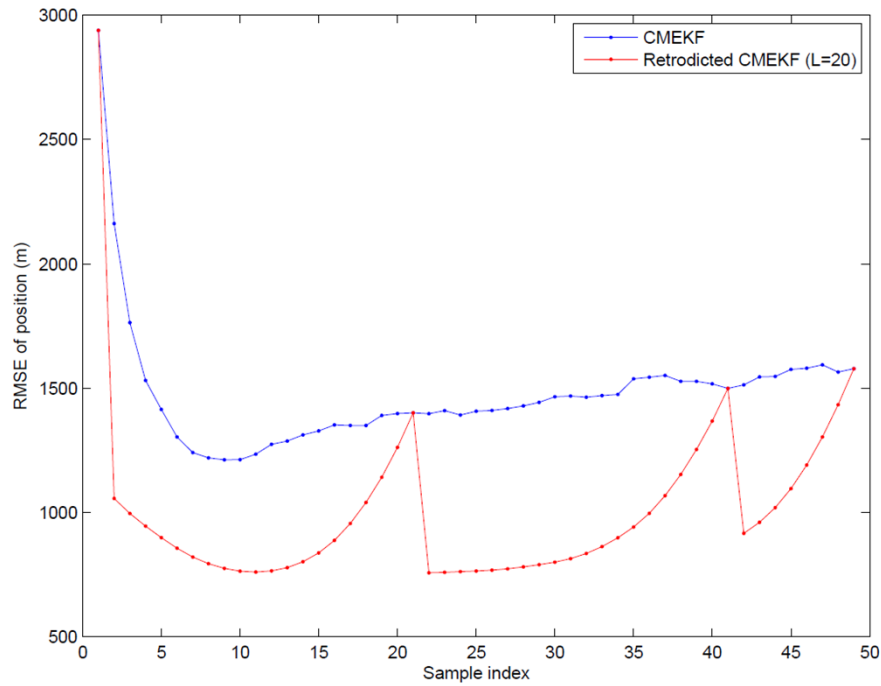
	Existing Tracker	New Tracker	Percentage improvement
False tracks	164	7	96%
Clutter seduced tracks	8	0	100%
Broken tracks	27	14	48%
Clutter seduced and broken tracks	35	14	60%

- Statistics are collected for the Windfarm region
- A total of 50 targets go through the Windfarm region

Track Retrodiction Tracker (TRT) - HFSWR



TRT – Longer Window



Conclusions

- Two radar applications – HFSWR & ASR
- Tracking issues
- Solutions: 5 practical approaches
 - These solutions have been implemented into Raytheon radar products.

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