Combining Hypothesis Testing and Target Clustering

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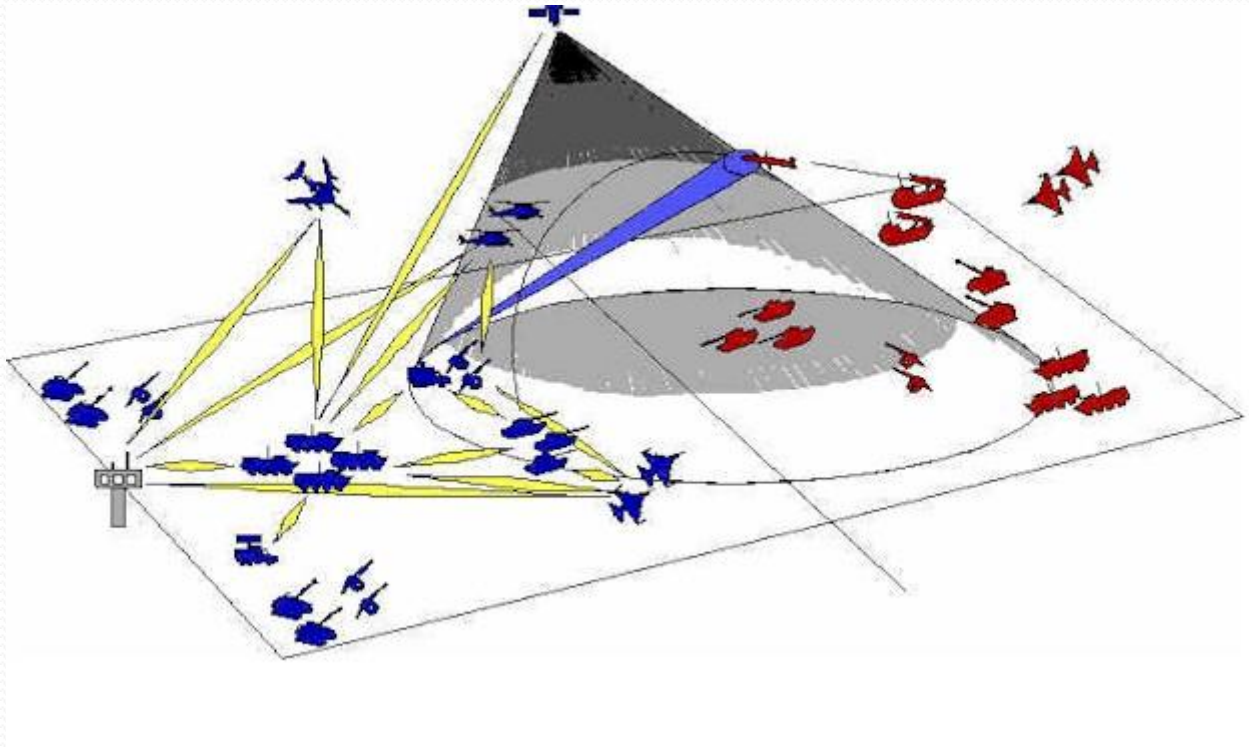
Background: Article

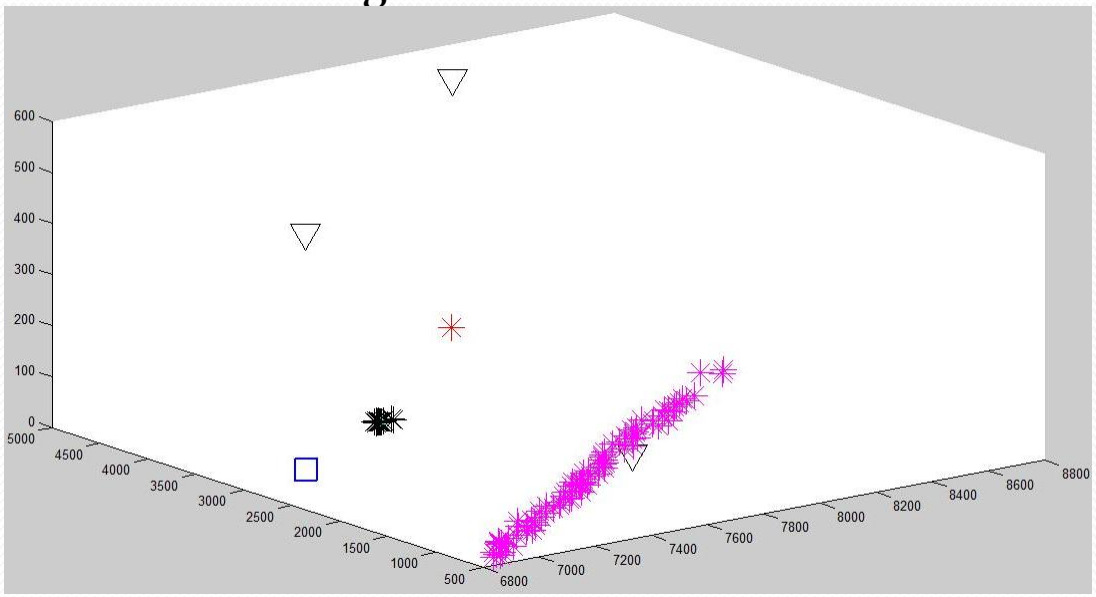


Article Highlights

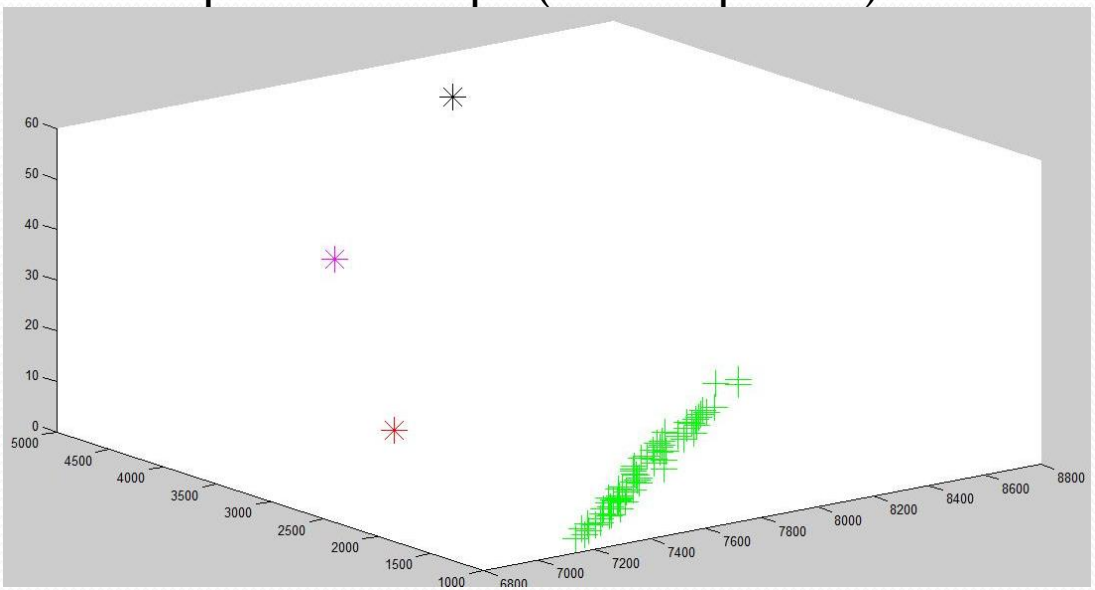
- WASMs(Wide Area Search Munitions)
- Problems
- A single target is identified as multiple targets
- Two distinct targets indentified as the same target
- Utilize a newly proposed target clustering method
- Returned 95% accuracy in less than 10 seconds, as opposed to k-means clustering which only returned 80% accuracy when given the same amount of time

Results

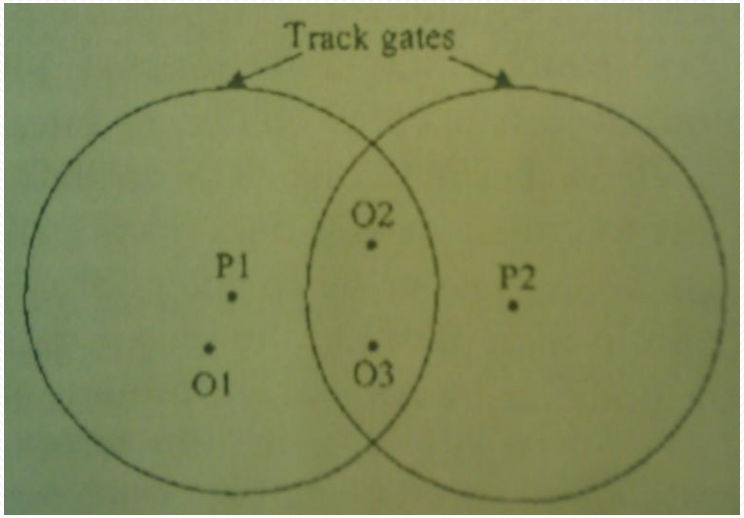
Target Clustered



Supervisor Graph (True Depiction)

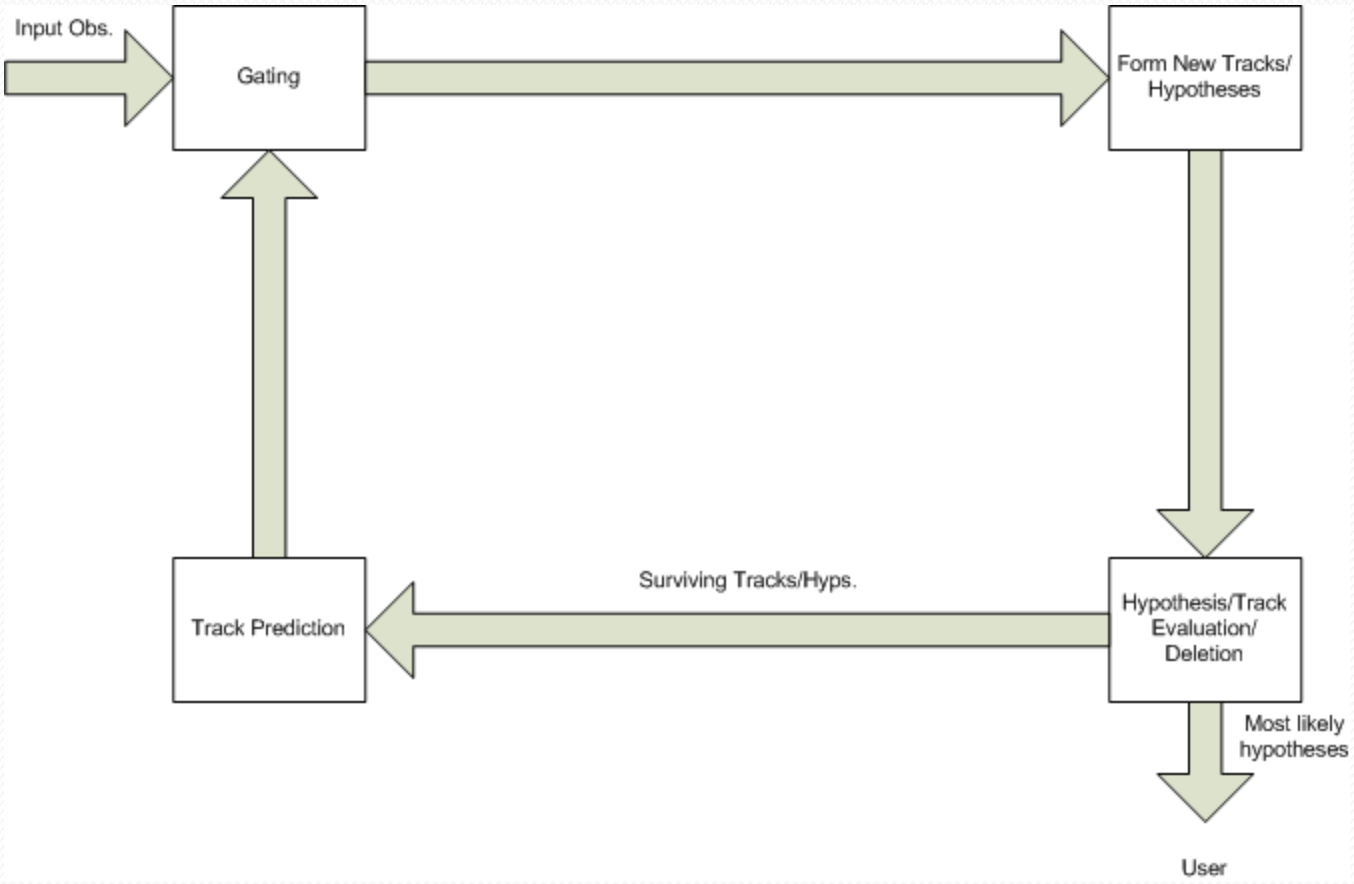


Typical Data Association Conflict



O1,O2,O3= Observation positions
P1,P2=Predicted target position

Multiple Hypothesis Tracking



MHT Hypotheses

- Reid's Algorithm

Example:

T3(T1,O1)= track 3 formed from the association of T1 with O1

T4(T2,O2),T5(T2,O3), New Tracks formed from O1,O2,O3=NT1,NT2,NT3

3 of the 10 possible Hypotheses:

H1:T1,T2,NT1,NT2,NT3

H2:T3,T4,NT3

H3:T3,T5,NT2

MHT Tree

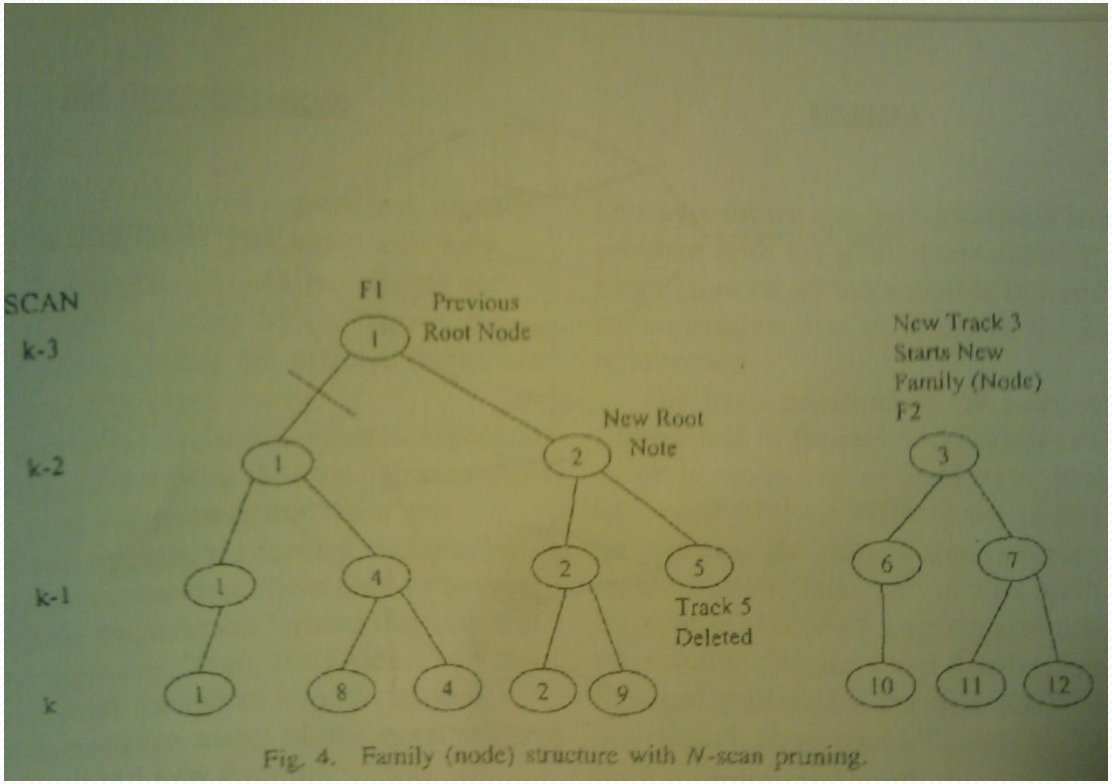


Fig. 4. Family (node) structure with N-scan pruning.

Eliminating Branches

- Likelihood Ratio $LR = \frac{p(D|H_1)P_0(H_1)}{p(D|H_0)P_0(H_0)} \triangleq \frac{P_T}{P_F}$
- Log likelihood ratio $LLR = ln[P_T|P_F]$
- Probability of a True Target $P_T = e^{LLR}/[1 + e^{LLR}]$
- Track Score at scan k

$$L(k) = L(k-1) + \Delta L(k)$$

$$\Delta L(k) = \begin{cases} \ln\left(1 - \widehat{P_D}\right); no\ update\ on\ scan\ k \\ \Delta L_u(k); track\ update\ on\ scan\ k \end{cases}$$

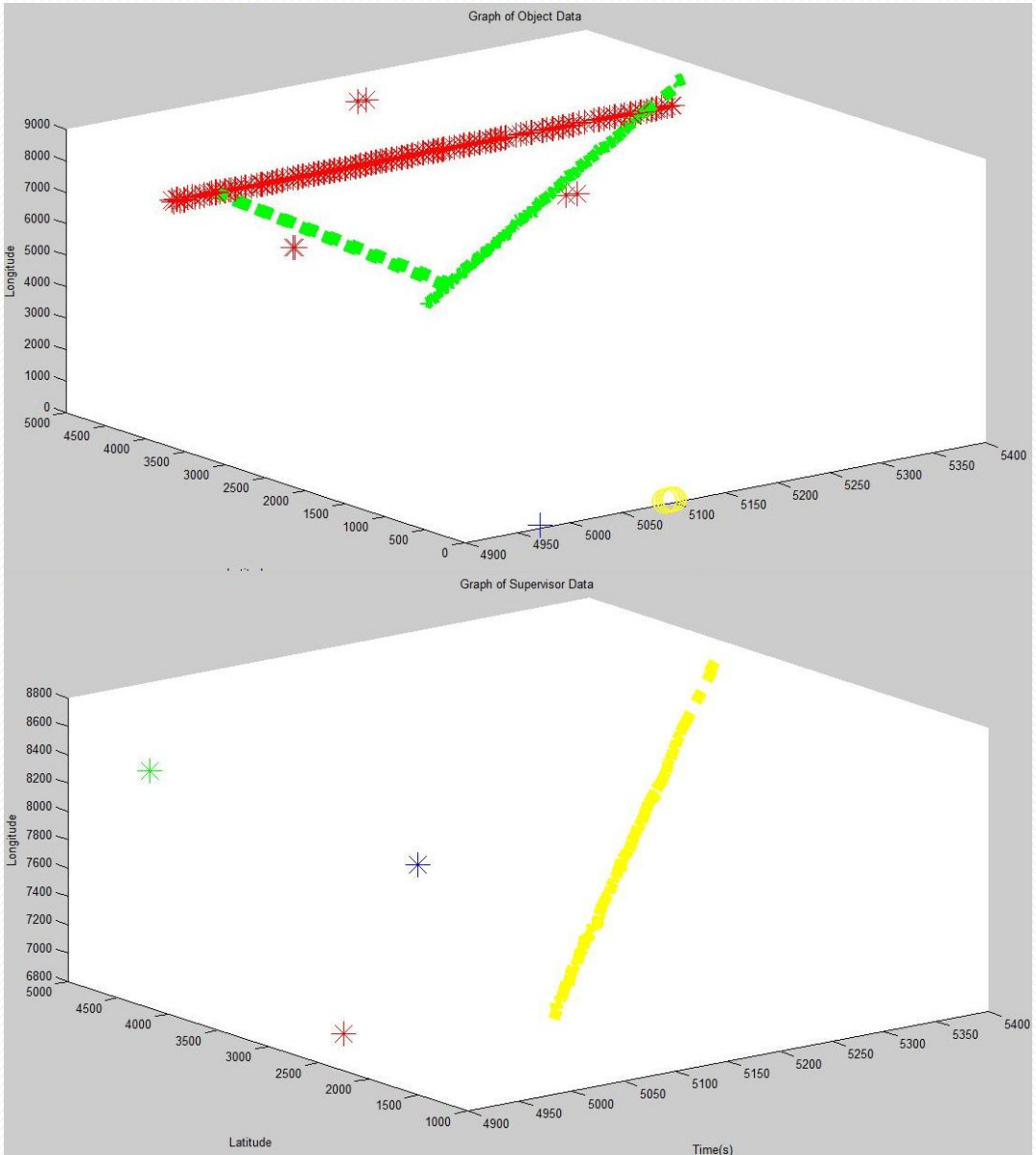
Integration of Both Concepts

- How can target clustering and MHT be combined?
- Currently MHT has only be used for one field of view
- WASMs interact with each other to add pieces to the puzzle
- Each WASM has its own field of view
- So far only the Object State(Information on the Target),Supervisor State(Answer Key) Data have been utilized
- Will try to find a way to utilize the Weapon State Data(Information about the WASM)

Breaking Down the Data

Objective Data Sample

Supervisor Data Sample



Questions and Suggestions