The Global Defence and Security Experts

Automated Situation Assessment in Maritime Combat Systems

Presentation for 12th International Command and Control Research and Technology Symposium

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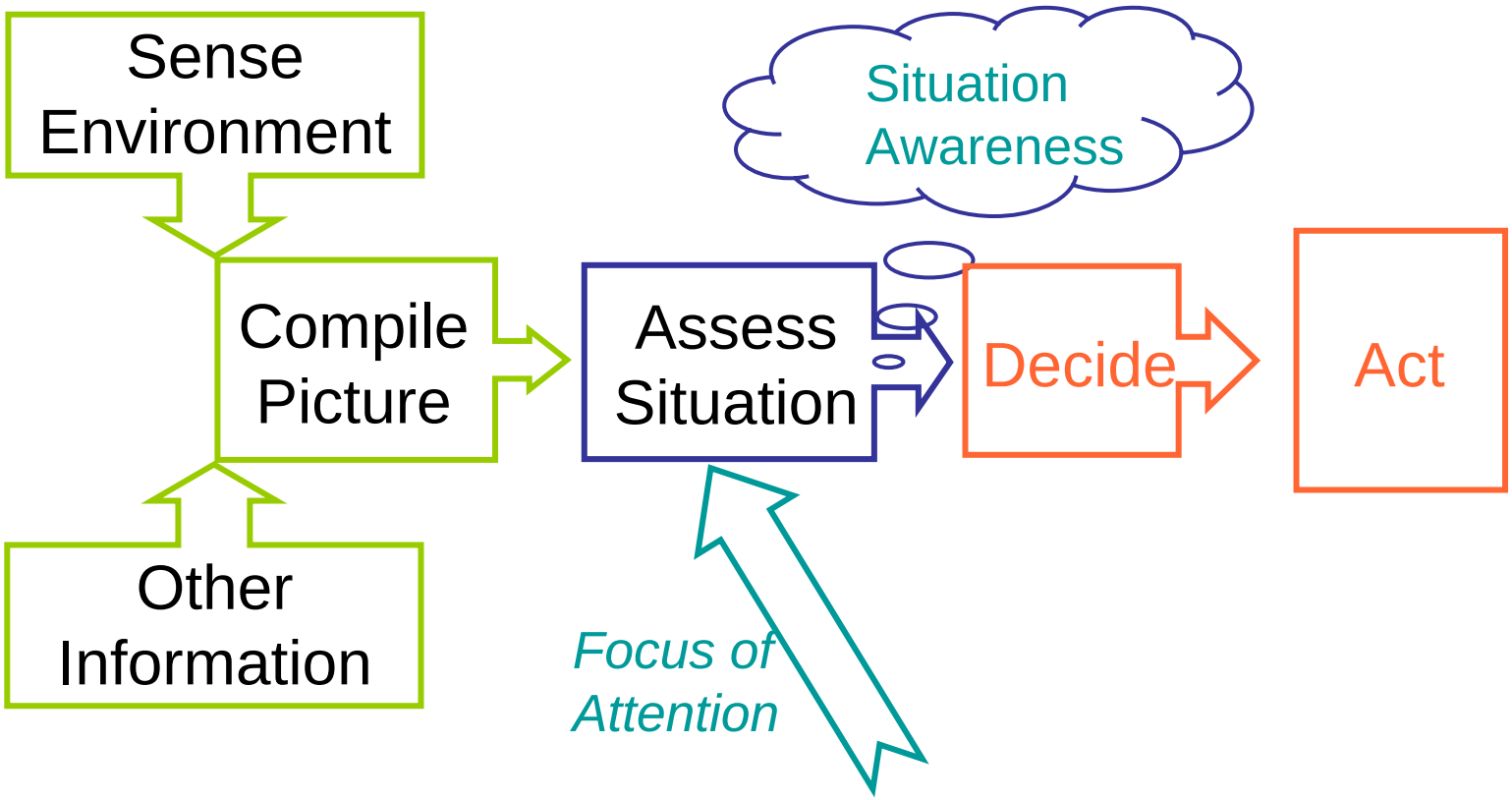
June 2007

01 Maritime CMS process



01 Situation Assessment

- Sensor and data fusion technology can deliver a picture with hundreds of contacts
  - where should operator attention be focussed?
- Command's effectiveness is limited by 'human' ability to:
  - manage and interpret large and increasing volumes of data
  - focus on many concurrent events
  - input assessments for network distribution
- …but human knowledge gained from experience is the key to situation assessment
  - Can that knowledge be captured in a machine to provide automated assistance?

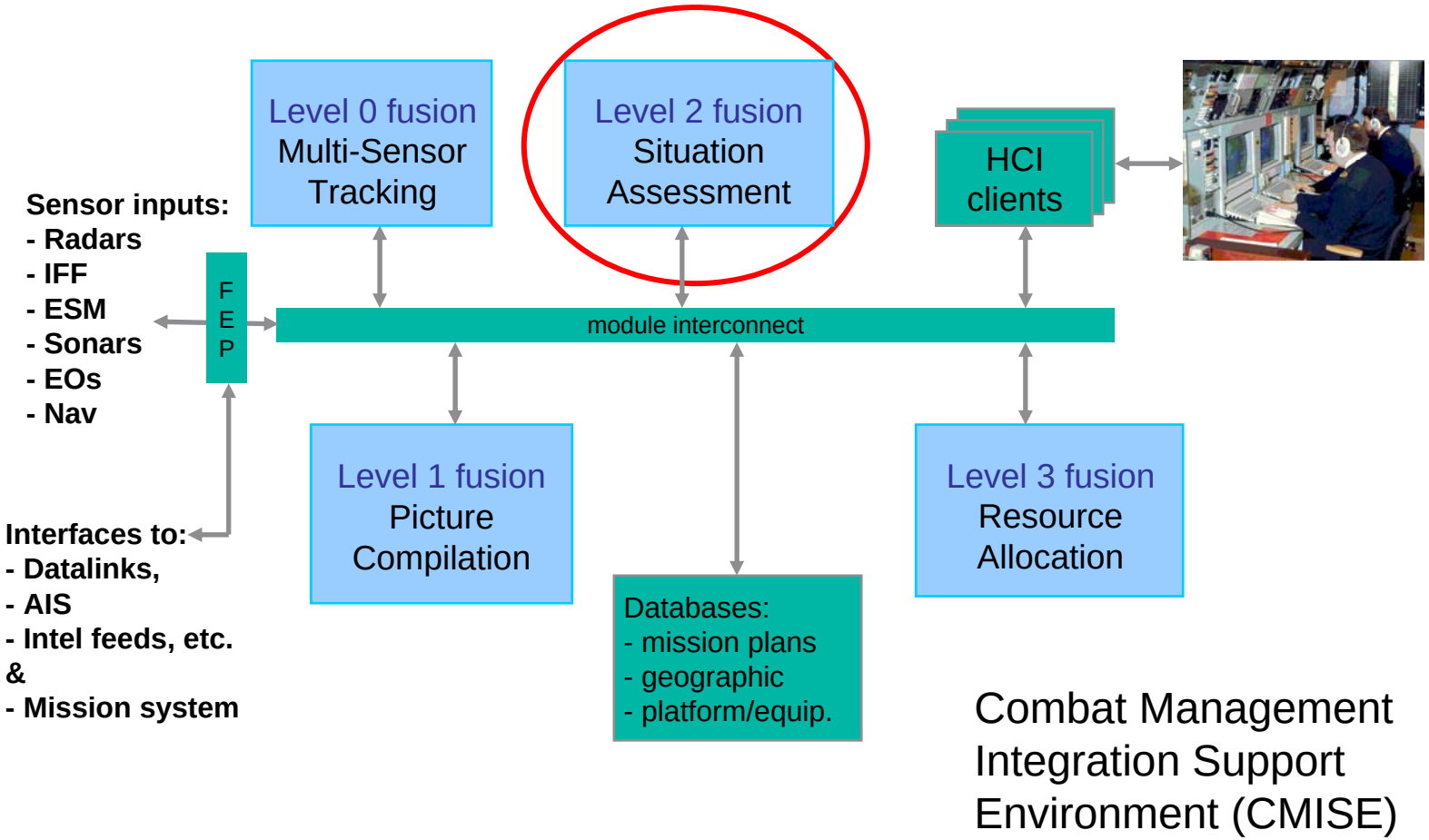
The Hypothesis

Automated situation assessment enhances C2 through rapid systematic reasoning and relentless exploitation of all accessible information; making results available across the network.

01 QinetiQ research: Technical approaches

- Early attempts to capture situation assessment knowledge resulted in fixed rule sets for specific cases
- Latest research (completed 2006) has explored two more powerful strategies:
- (1) Pattern matching based on user programmable patterns
  - Allows full user control of the automated assessment function
  - Enables patterns devised from off-line data analysis to be entered into the operational system
  - Generic pattern libraries ease the task of setting up
- (2) Machine learning strategies
  - Data Mining techniques: Cluster Analysis, Inductive Logic Programming, Sequence Analysis
  - Potentially can discover previously unknown patterns of behaviour or ways of recognising such patterns

01 Implementation of user programmable patterns



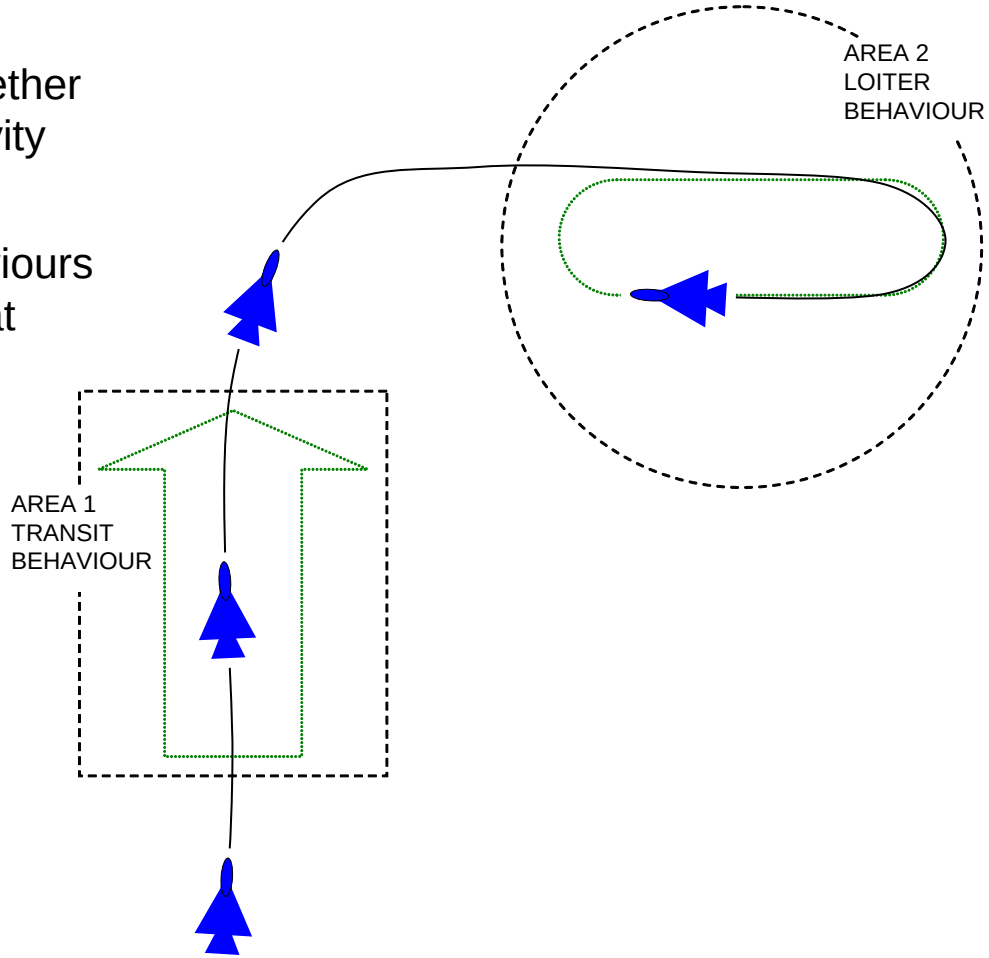
Combat Management Integration Support Environment (CMISE)

02 Automated Situation Assessment:

– Pattern Definition

02 What is a Pattern?

- A pattern comprises one or more behaviour/area combinations, together with related identification and activity information.
- A combination of areas and behaviours may be used to identify the combat aircraft in this example
- The aircraft is expected to follow a particular route and then follow a racetrack
- This can be represented as a single pattern containing two sequenced behaviours
  - A transit across area 1
  - A loiter across area 2



02 Relationship between patterns, areas and behaviours

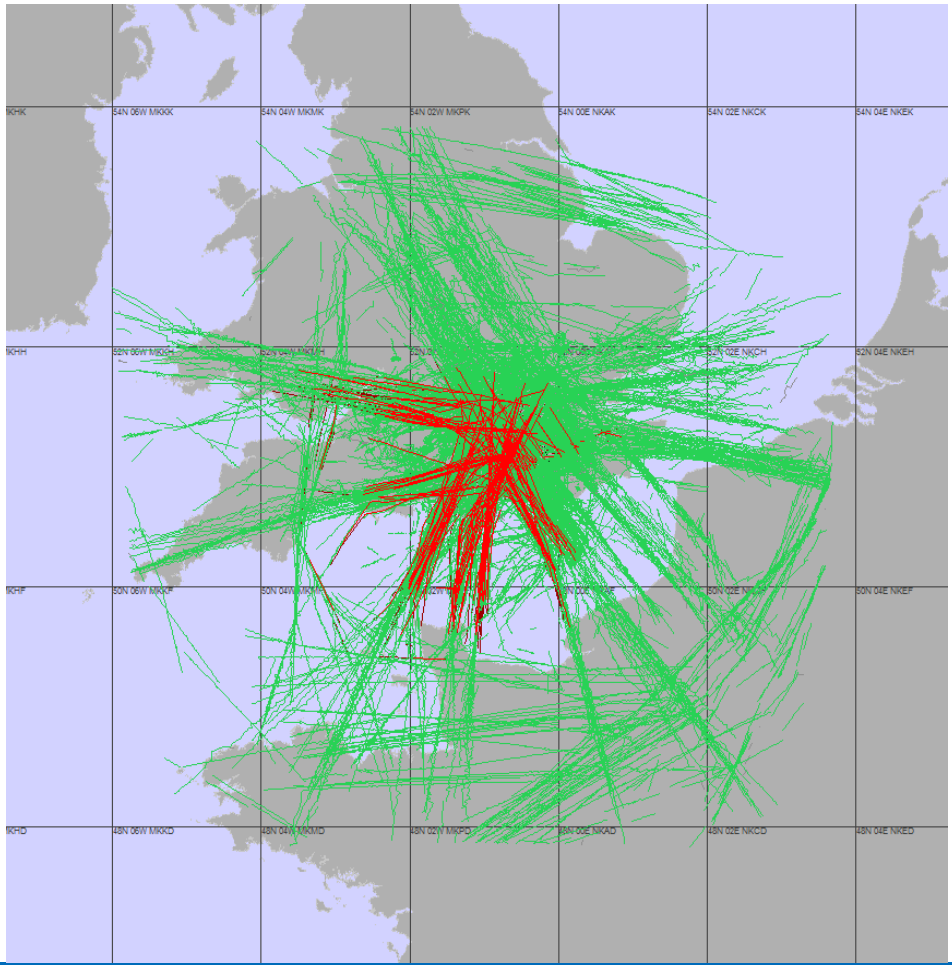
- Pattern attributes include:
  - Platform identity (type, class or name)
  - Standard Identity
  - Platform Activity
  - Whether the pattern is of particular interest
  - Whether an alert is required on match/break
- Behaviour types include:
  - Loiter
  - Transit
  - Takeoff
  - Approaching/leaving
  - Pop up
  - Straight and level
- Each behaviour type has its own set of attributes
- Area types include:
  - Corridor
  - Polygon
  - Circle
  - Sector
- Each area type has its own set of attributes

02 Example sources of pattern data

- Geographic
  - DAFIF data provide airports and air lanes
  - charts provide traffic separation zones and deep water channels
- Timed
  - Ferry time tables
- Intelligence
  - Air and surface plan data
  - Areas of suspected hostile activity
- Patterns learnt during previous operations
- Patterns learnt in theatre

03 Automated Situation Assessment:

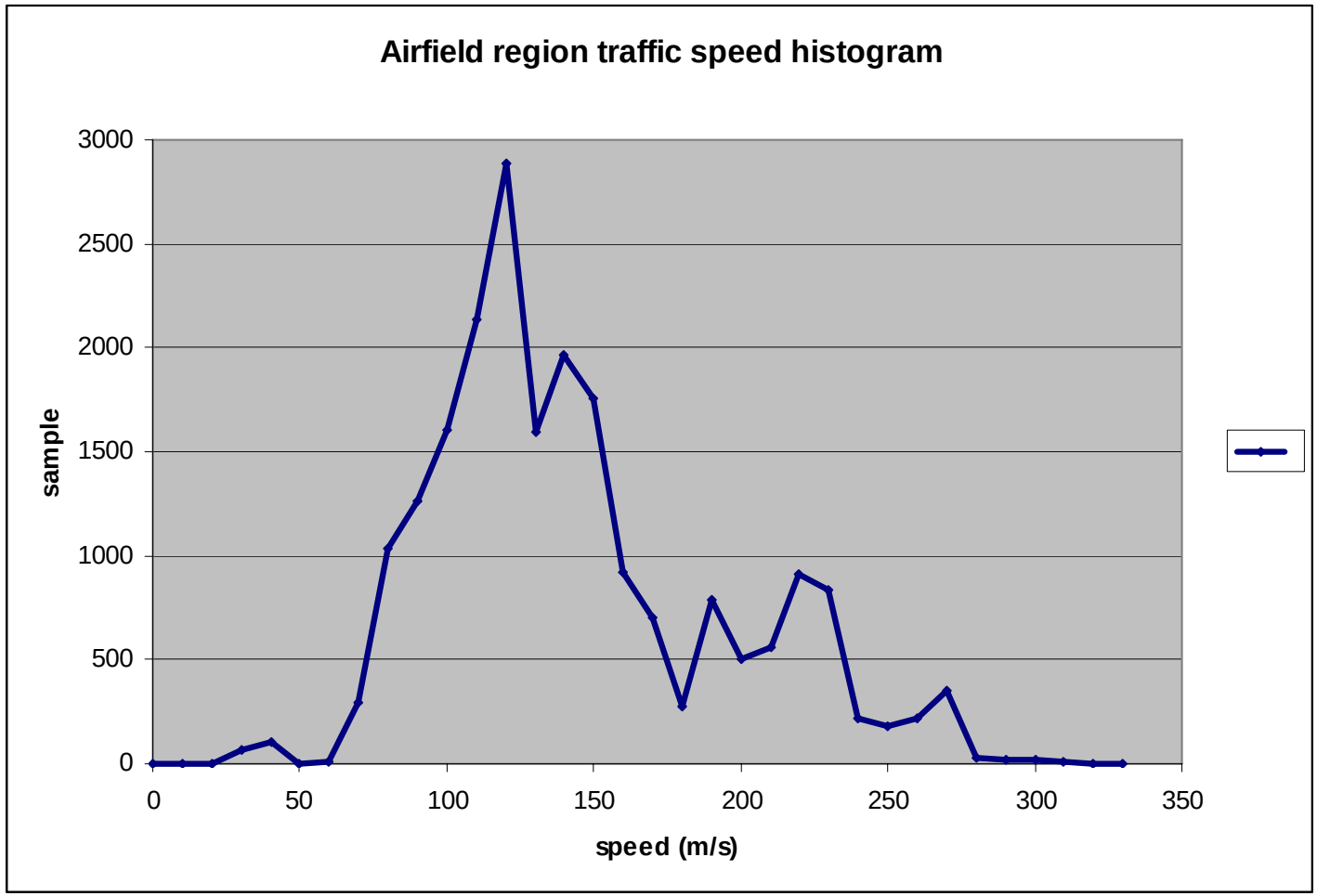
– Trials with live data



03 Trials example 1: Airfield monitoring and ID by origin

- Concept:
  - Monitors airfields and tags all aircraft taking-off with origin; generates alerts as required
- Evaluation:
  - Determine feasibility and performance
  - Requires sufficiently large set of examples
  - Civil airport (LGW) chosen:
    - Close enough for reasonable surveillance from available radar
    - Busy enough to provide many examples

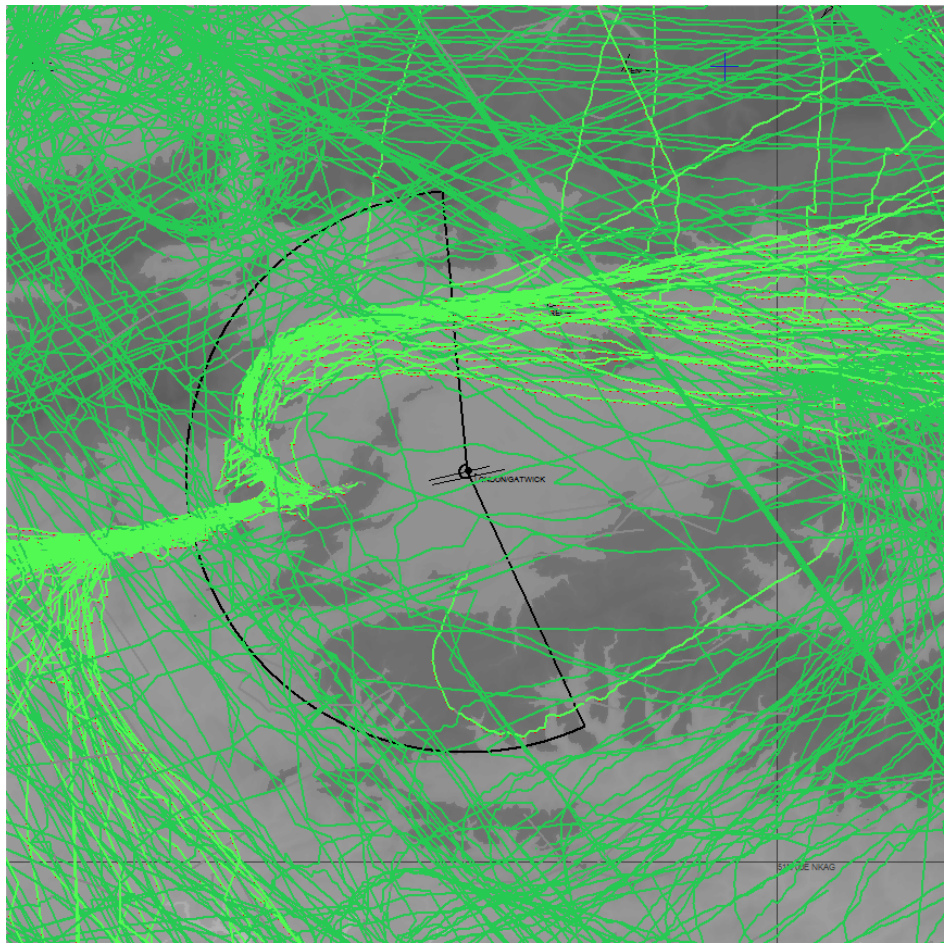
03 Airfield traffic speed characteristics



03 Pattern and behaviour set-up

- Sector from end of runway
- ‘Pop-up’ behaviour
- Min and max speed criteria

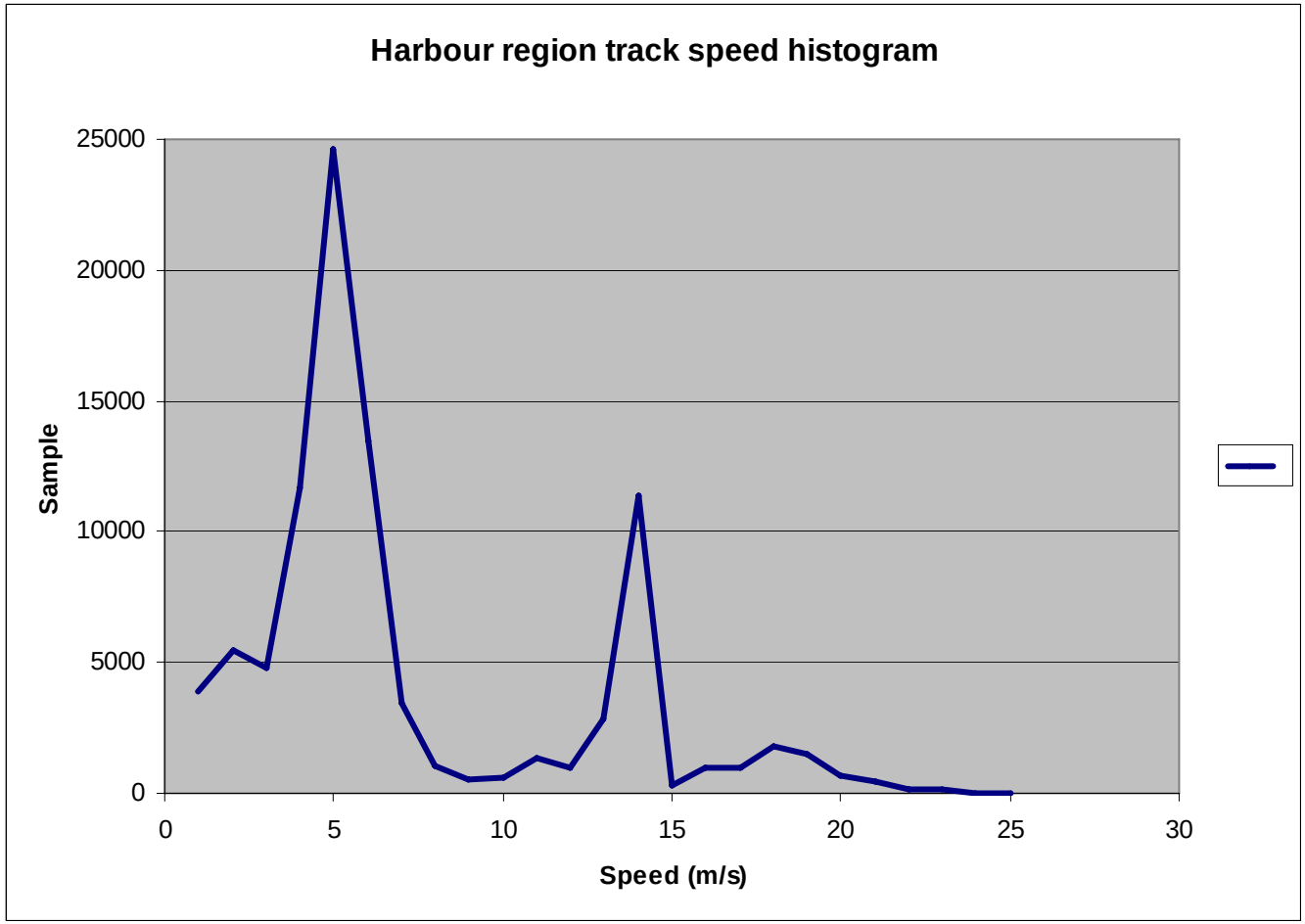
- Results:
  - 95% of take-offs detected
  - No false alarms



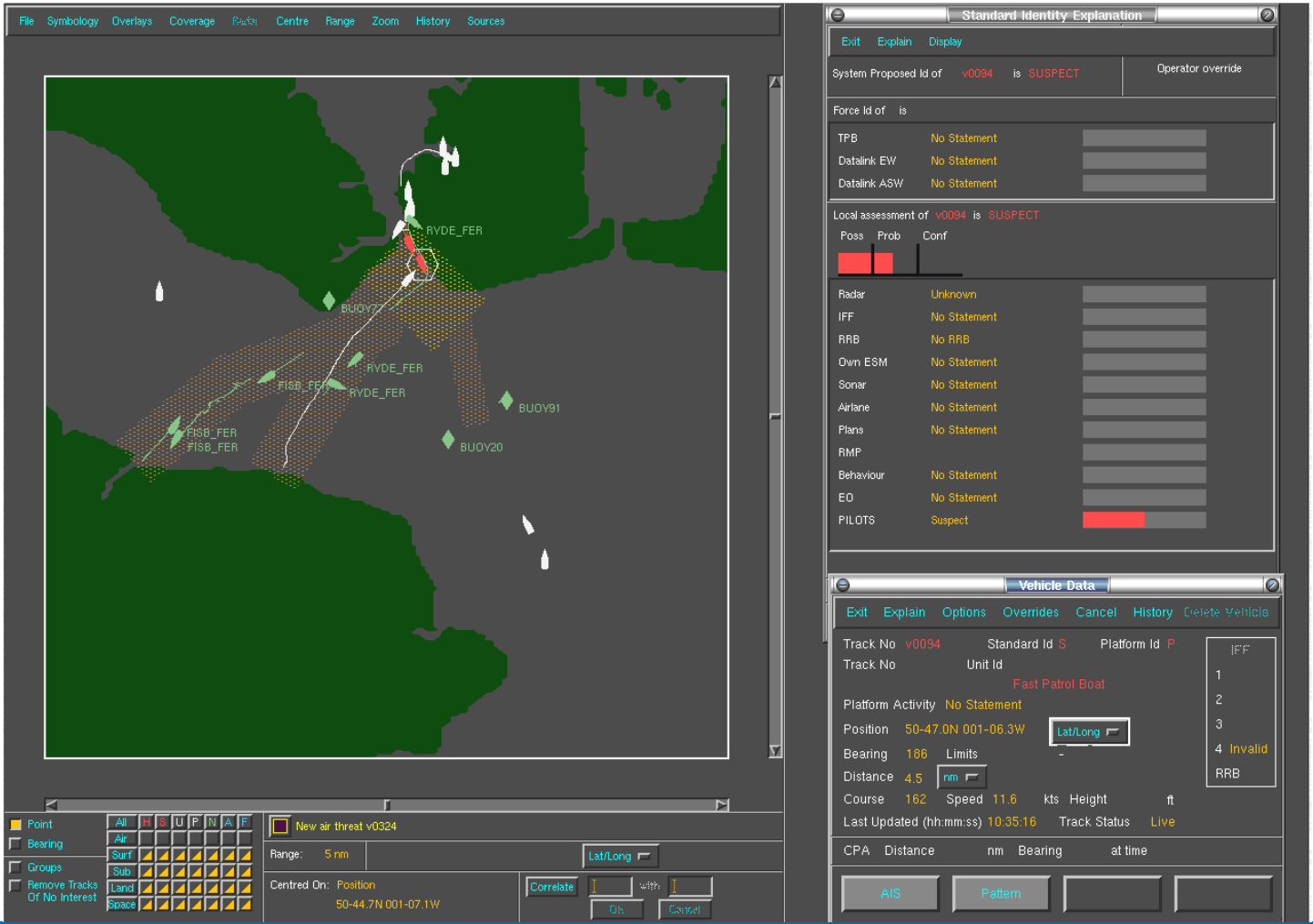
03 Trials example 2: Harbour and surface traffic monitoring; ID by route and behaviour

- Concept:
  - Monitors harbours and tags all vessels leaving with origin;
  - Monitors traffic behaviour and identifies benign vessel movements;
  - Highlights vessels not conforming to expected routes and behaviours

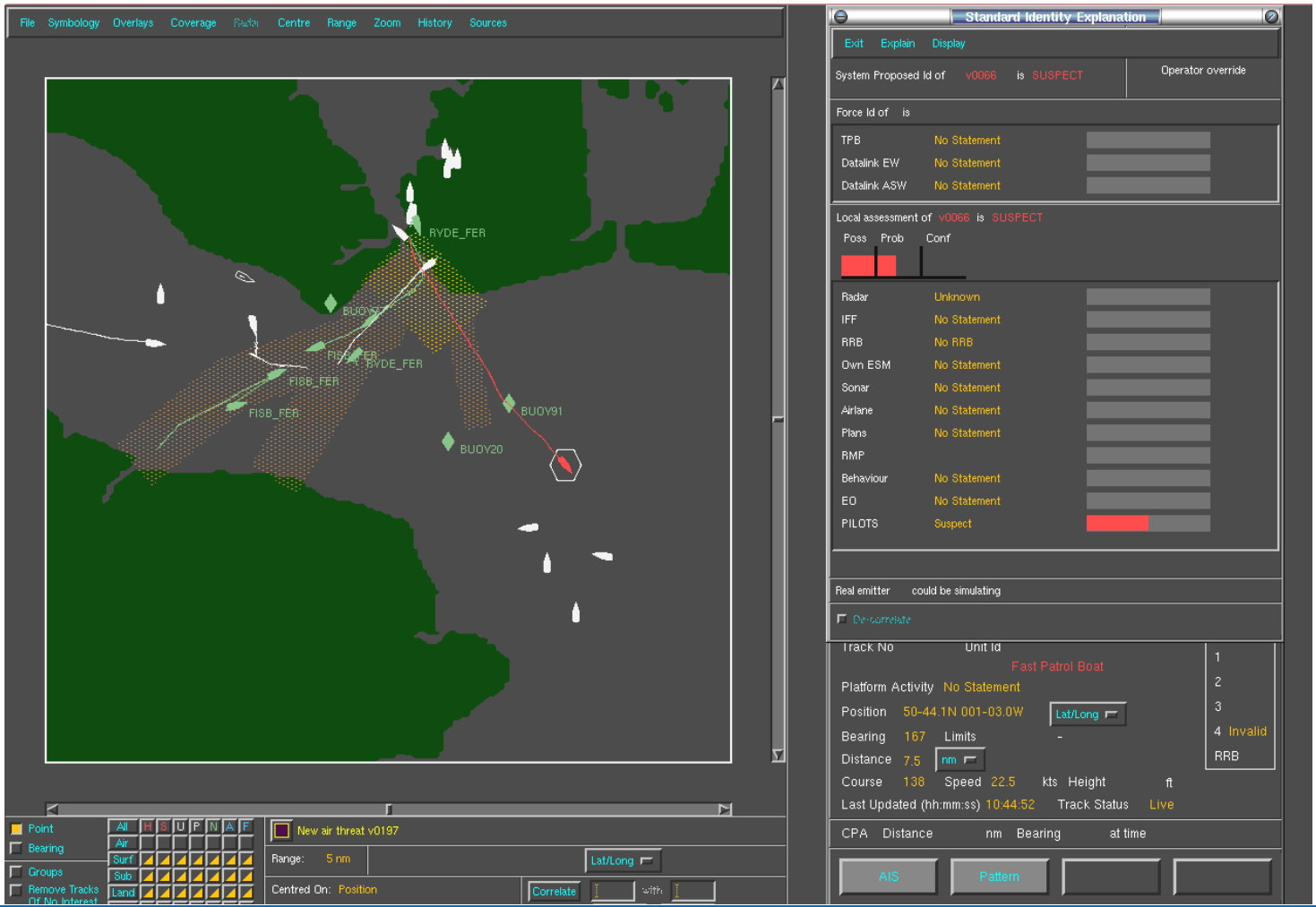
03 Harbour traffic speed profile



03 Two vessels highlighted leaving harbour



03 Vessel not conforming to patterns remains highlighted



04 Summary

- Automated Situation Assessment has been demonstrated using a user-programmable pattern matching approach.
- Potential benefits include:
  - Reduced operator workload
  - Alerts to focus attention on contacts of interest
  - More effective use of resources – particularly air assets
  - Improved situation awareness
  - Applicable across land, sea and air environments
- Next steps:
  - Sea trial (September 2007)
  - Research into machine learning for pattern discovery

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