GEO Intelligence 2022

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Dr. Ambedkar International Centre, New Delhi

THEME: GEOSPATIAL STRATEGY FOR DEFENCE AND SECURITY

Terrain Analysis & Visualisation
GIS Enabled Approach

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Terrain Analysis

Terrain Analysis & Visualisation in Geospatially Enabled Environment.

Definitions:

1. Military terrain analysis is 'the collection, analysis, evaluation, and interpretation of geographic information on the natural and man-made features of the terrain, combined with other relevant factors, to predict the effect of the terrain on military operations.' (DoD, 2010).

2. The two reasons to do terrain analysis? explore data and see relationships, and then communicate results to others? can be considered part of telling a story or analysis.

3. Terrain analysis employs elevation data, usually in conjunction with other geospatial information, to describe the landscape, for basic visualization, modeling, or to support decision making. The primary product will almost always be a map.

4. Terrain analysis is the same as any other study in geography, or indeed any intellectual endeavor, and differs only in the questions asked and the data employed.

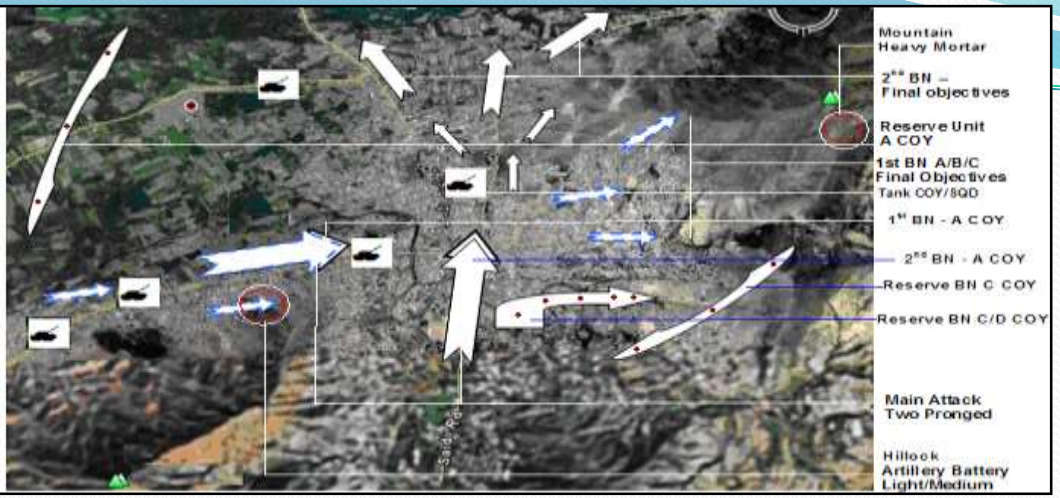


IMAGE 1 simulation (source Google Earth) - AVENUES OF APPROACH - TWO DIRECTIONS © Author 2009

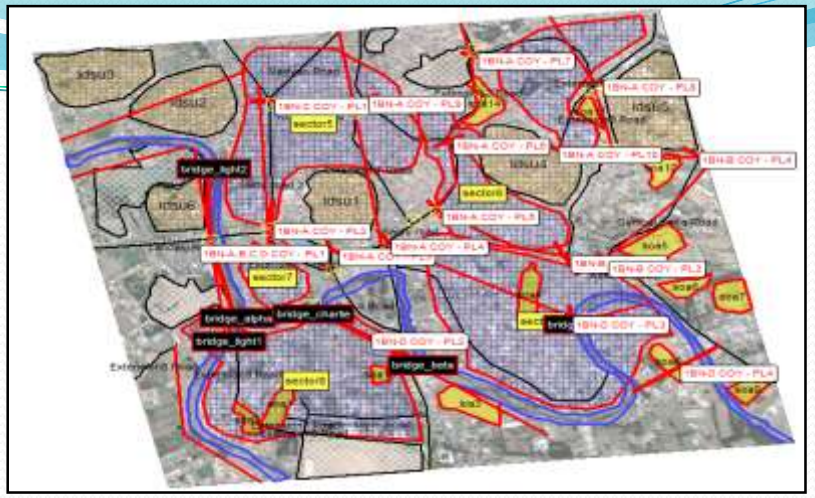


IMAGE 2 simulation (source Google Earth) – FORWARD MOVEMENT WEST-EAST DIRECTION © Author 2009

Combining information about terrain features with knowledge about enemy assets can lead to inferences about : *offensive role, delaying role, defensive role.*

-possible avenues of approach,
-areas that provide cover and concealment,
-locations that are vulnerable to enemy observations,
-the intent of the enemy forces

KOCOA Approach

Area 1 – The objective
Area 2 – Possible Fire Support / Observation post (OP) locations
Area 3 – Eastern Ave of Approach
Area 4 – Western Ave of Approach
Area 5 – Complex Terrain, possible OPLs / Ave of approach
Area 6 – Concealed Approaches

VISUALISATION

Visualisation

Terrain as a Force Multiplier - through visualisation.

(a) Display of Map with Military Grid. Ability to seamlessly use geodata available from military mapping agencies and display map with military grid.

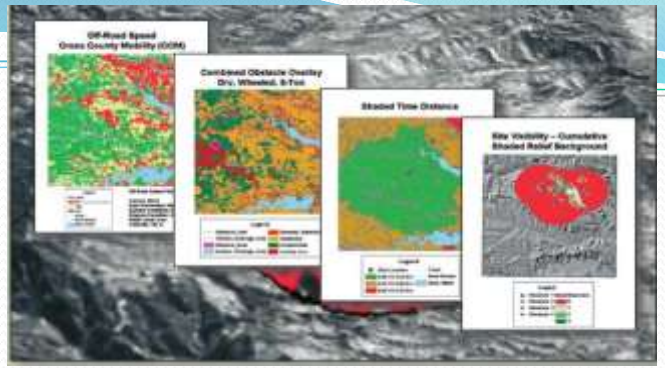
(b) Preparations of Overlays. Overlay capabilities that include insertion/deletion of specific topographical features, terrain attributes, tactical overlays.

(c) Analyze the Terrain. Use terrain analysis tools to determine optimum sites for bridging, crossing of obstacles system, landing sites etc.

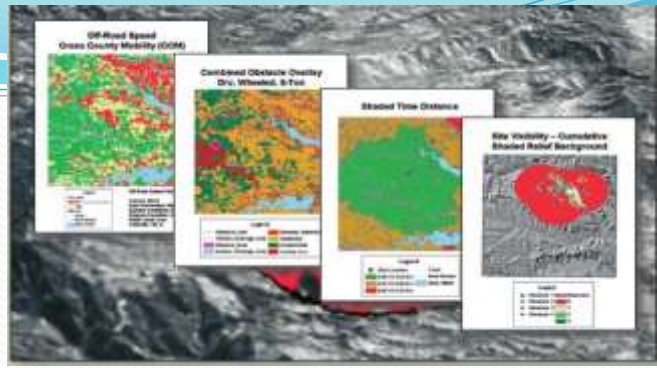
(d) Dissemination. Inbuilt export functions for sending the overlays instantly to other formations/units over low bandwidth WAN/LAN communication.

(e) Three Dimensional Visualization of Battlefield. Three dimensional view, fly-through, visibility analysis, terrain profiles, going maps etc.

1. Terrain Visualization

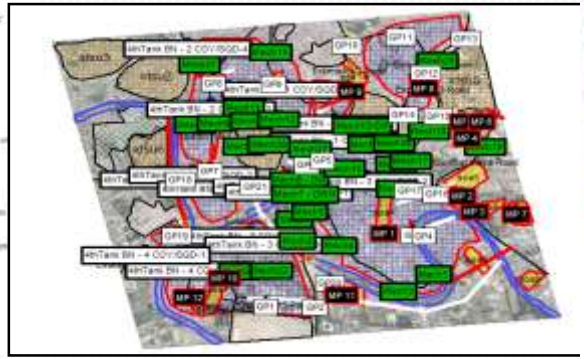


2. Obstacles



3. Terrain Mobility

4. Terrain association



5. Terrain intelligence

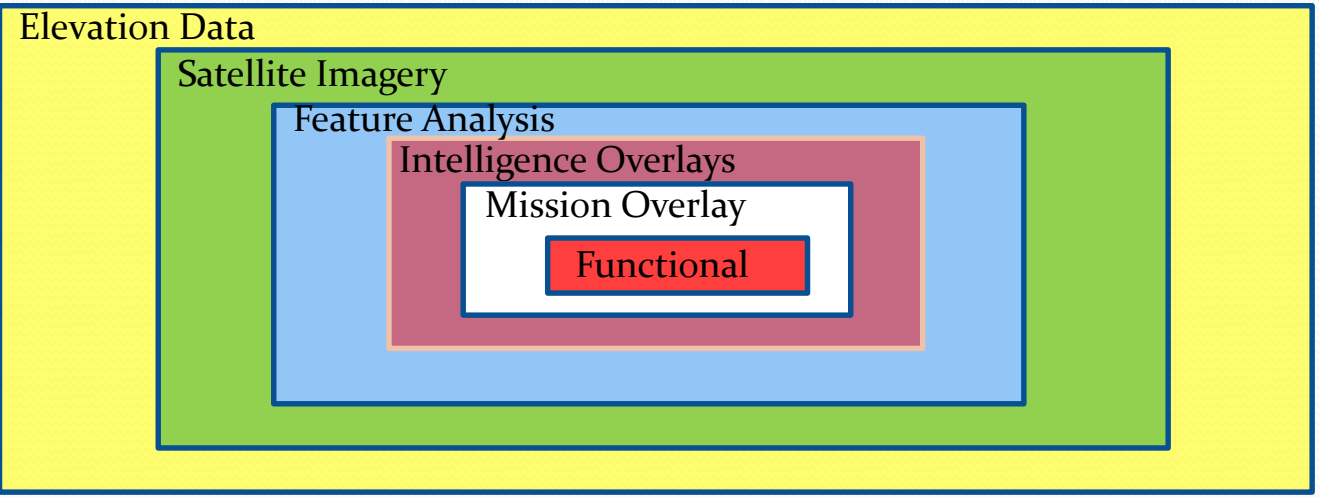
6. Terrain Study

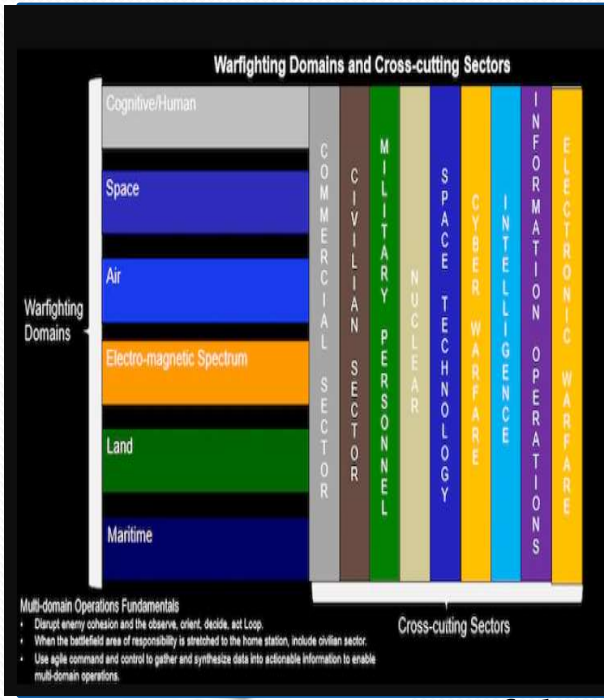
Source: 1,2,3. ESRI, 4,5,6 Author

Military Environment: Multi-Dimensional

Automated 3D map generation are an in built feature of modern terrain analysis products and solutions. Current and future developments are incorporating AI induced solutions to provide for intelligent terrain based solution for military decision making process for prompting best course of action ~ COA.

Common Operational Picture ~ COP





Terrain analysis, weather analysis, analysis of other battlespace characteristics and the analysis of the combined battlespace effects.

Multi-domain operations (MDO) –

Integrated military capabilities

MDO fuses innovative technology to compensate for vulnerabilities and weaknesses in certain areas whilst leveraging strengths in others.

MDOs are conceptually distinct from joint operations.

They emerged as a response to the Anti-Access model of warfare, information warfare and to contest the electromagnetic spectrum (EMS).

MDO are increasingly important as the space and cyberspace domains evolve beyond their original functions as mere enablers of the traditional domains.

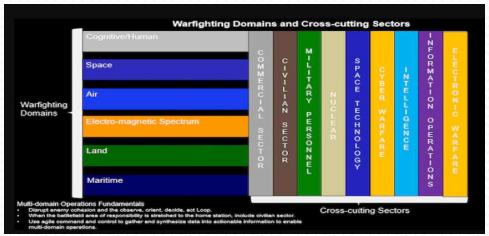
India's threat vectors emanate from its neighbors, and they have adopted hybrid and asymmetric warfare techniques. We also need to add concept of Unrestricted Warfare;

These cross-sectors include the commercial sector, civilian sector, military sector, space technologies, cyber, nuclear, intelligence, information operations, and electronic warfare.

HPC

MDO

HPC



Special plans according to the local terrain

hazard

position

mobility

resource

ground conditions

Infiltrate enemy anti-access and area denial (A2/AD) systems (layered and integrated long-range precision-strike systems,

Disrupt anti-access and area denial systems to enable operational and tactical maneuver.

Exploit the resulting freedom of maneuver to achieve operational and strategic objectives by defeating enemy forces in all domains

Re-compete—consolidate gains across domains.

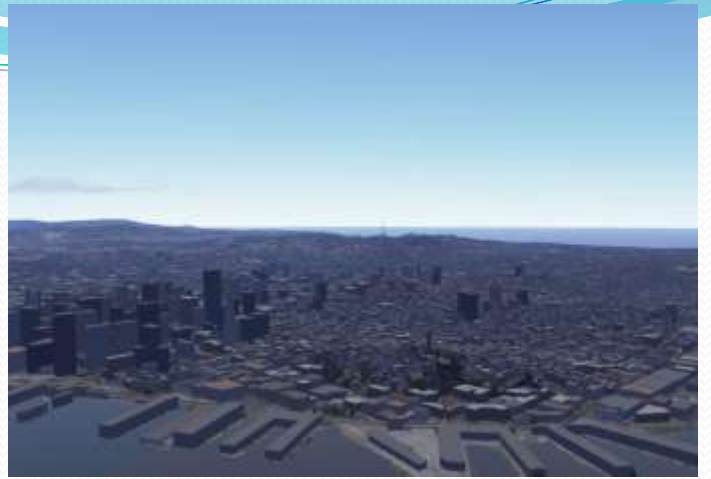
IPB

COP

War-gaming and Simulation

3D Visual

Automated 3D Generation - Visualisation



1. Aerial imagery is an asset in defence matters.

2. Conversion of 2D to 3D

3. New emerging methods

4. Photogrammetry Conversion

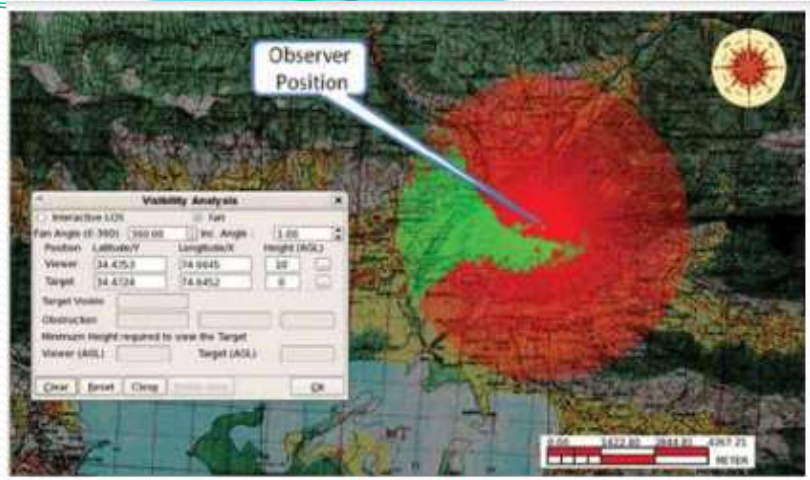
5. Dual purpose – Multi Utility

Source : Army's Geospatial Research Laboratory in Virginia, Techcrunch 2019.

Geospatial Integration

Geospatial Integration

1. The GIS expertise.
2. Seamless visualization.
3. Measurements
4. Simulation of 3D perspective.
5. Creation and manipulation of operation Overlay.
6. Spatio-temporal query
7. Large scale visualization of multi-sensor data.
8. Support for various military maps in use by the armed forces

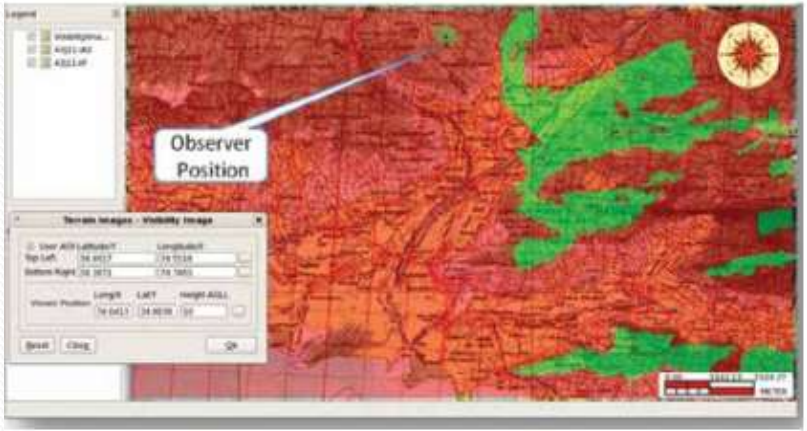


Visibility Profile

Functional Block Diagram of INDIGIS

Basic Features and Capabilities of INDIGIS

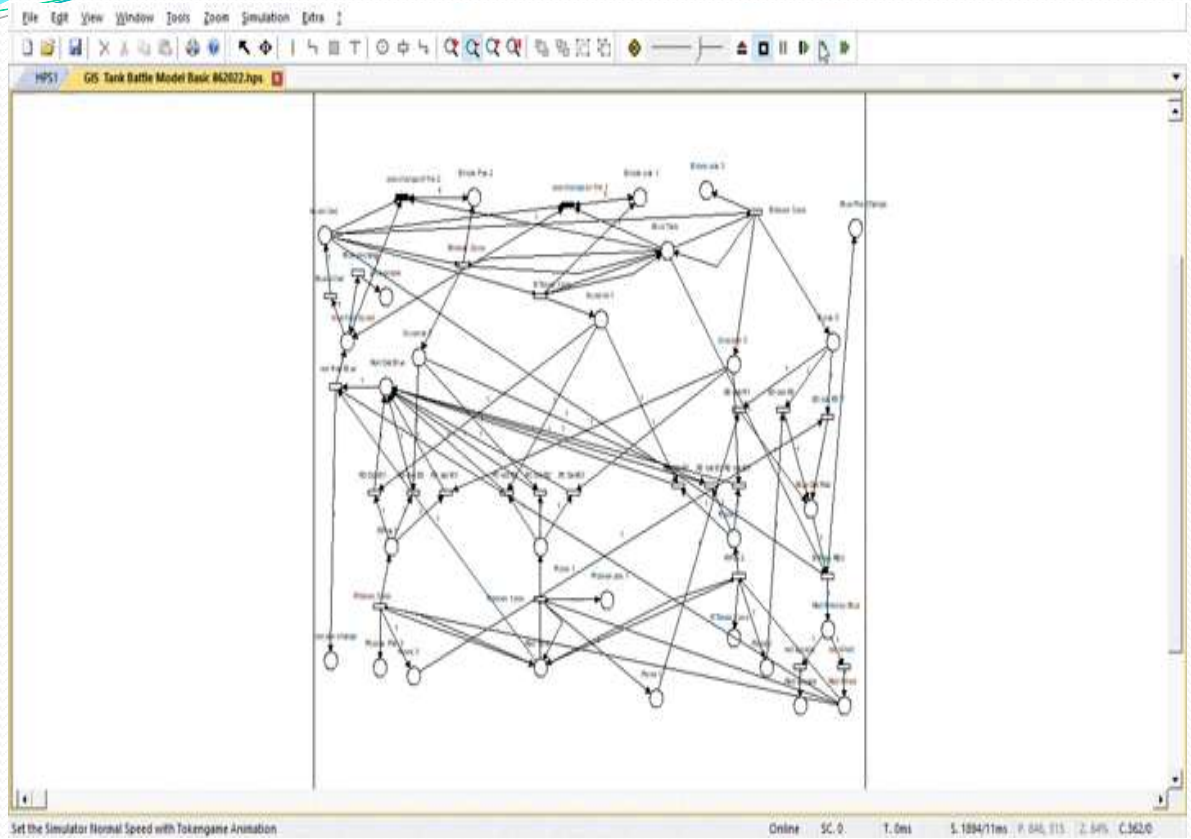
Source: Technology Focus - CAIR INDIGIS



Visibility Image

The Petri Net (Graph) Model

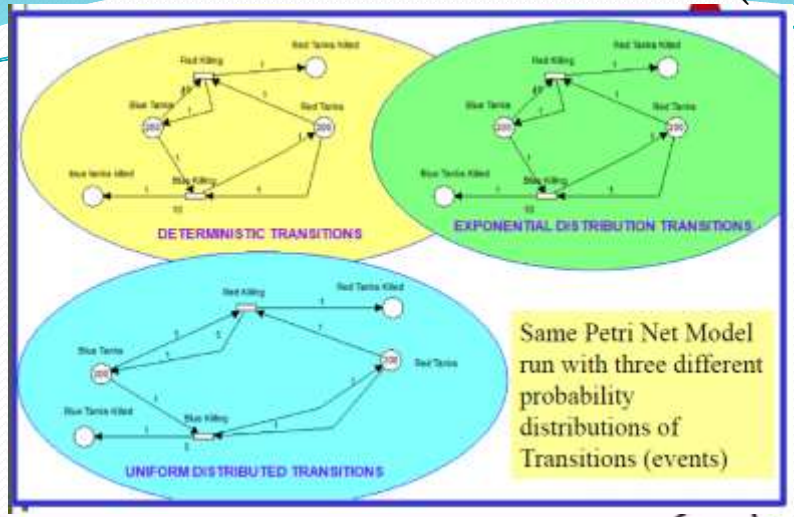
Definition: PN are graph models for system description using notions of conditions and events.

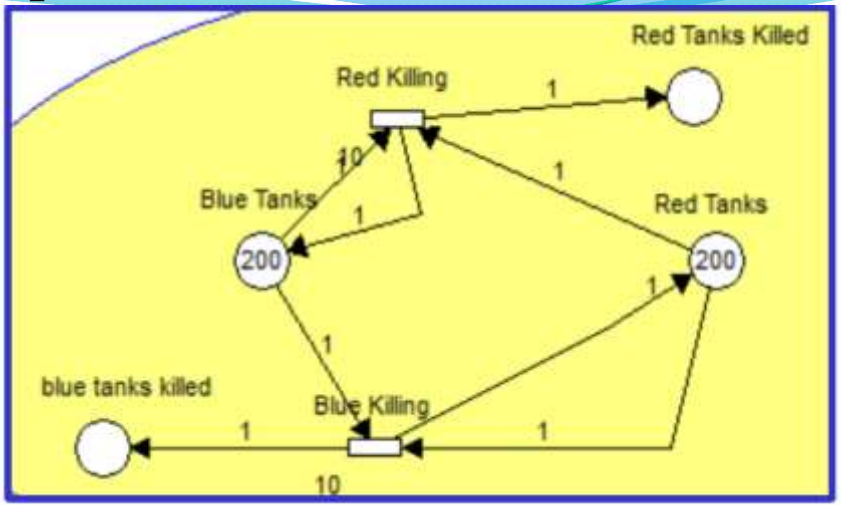


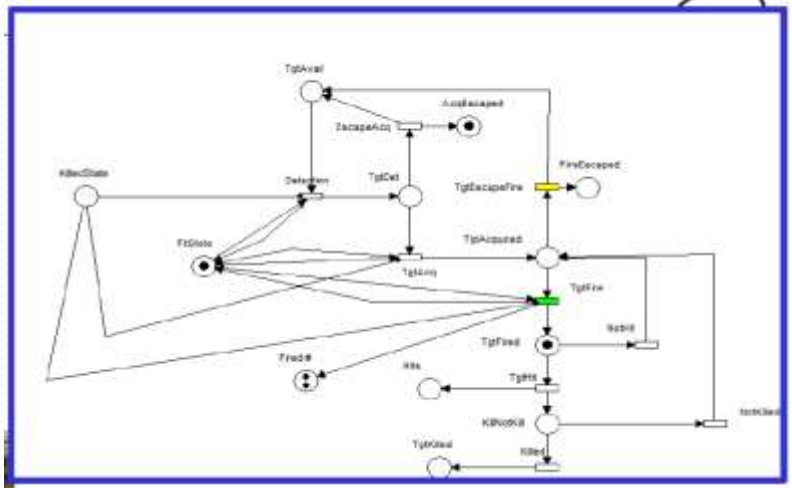
Blue Vs Red Team Exercise

1. Multi - Parameter.
2. Non-deterministic.
3. Asynchronous & Concurrent
4. Feedback Chain linking
5. Dynamic events
6. Discrete Events

The Petri Net (Graph) Model







Ability to support analysis of many properties and problems associated with concurrent systems

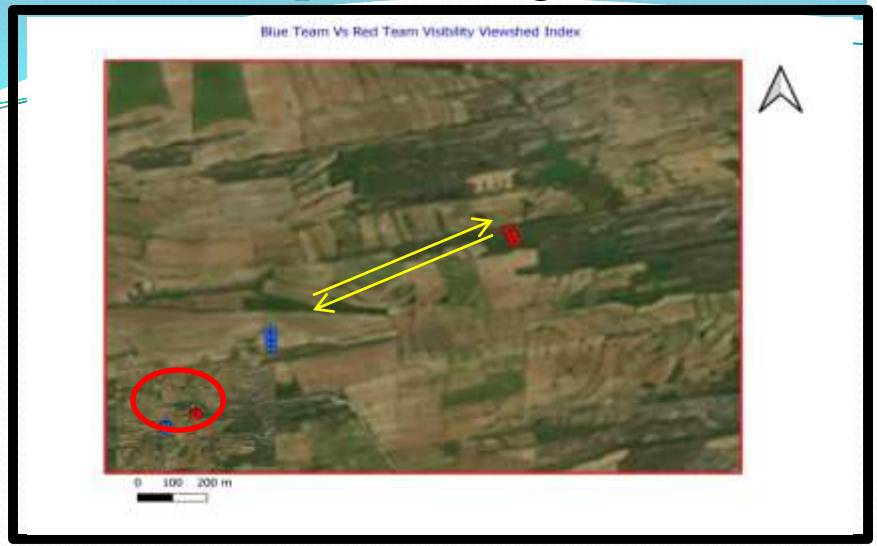
- Reachability
- Boundedness
- Safeness
- Liveness
- Persistence
- Coverability
- Reversability

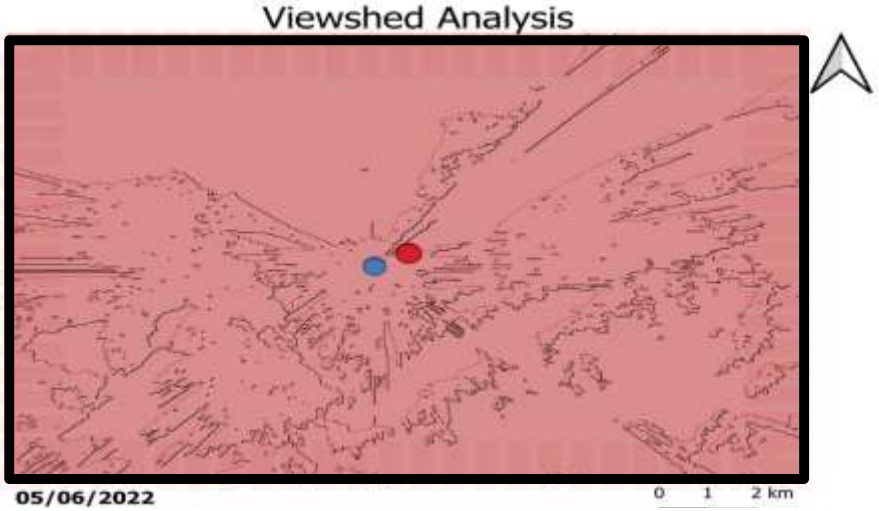
Analysis Methods

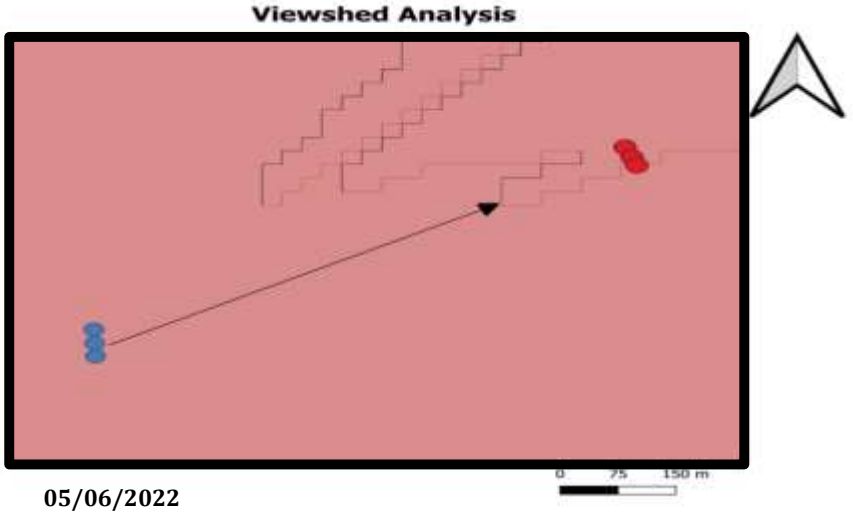
- CoverabilityTree
- Matrix State Equations
- Reduction or Decomposit techniques

System Simulation

Geospatial Integration







Visibility of Red team positions from Blue team positions

	R1	R2	R3
B1	0	0	0
B2	0	0	0
B3	1	1	1

Visibility of Blue Team positions from Red Team positions

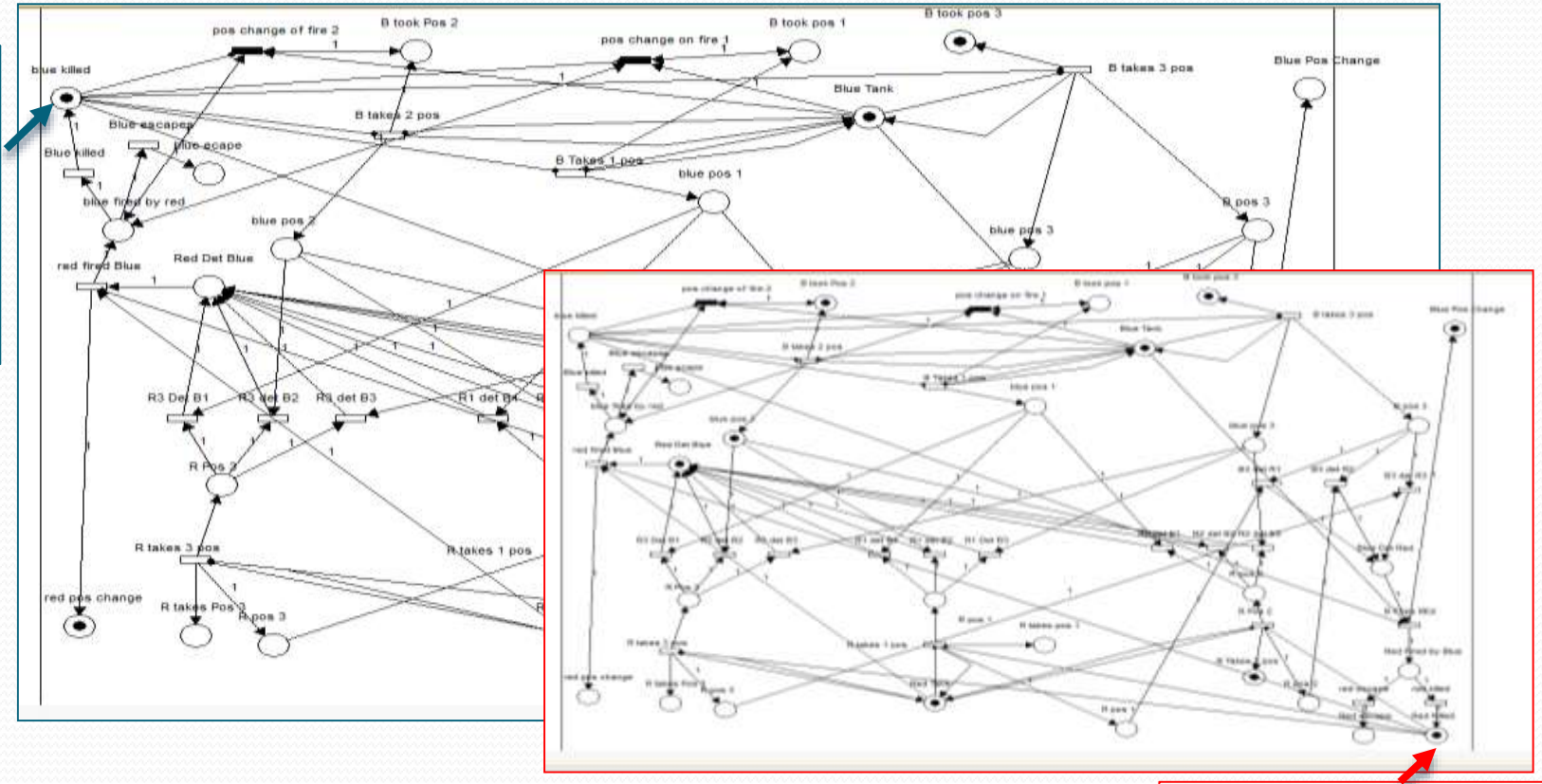
	B1	B2	B3
R1	1	1	1
R2	1	1	1
R3	1	1	1

The Petri Net (Graph) MODEL

Blue Vs Red Team Exercise

BLUE tank killed

RED took pos. 2



RED tank killed
Blue took pos. 3

THANK YOU

JAI HIND