Ground-Based Air Defence systems simulation at the Swedish Defence Research Agency (FOI)

ISMOR 2018-07-18

Tâm Beran


GBAD
GBAD
GBAD
GBAD
GBAD
OPaL
GBAD

Outline

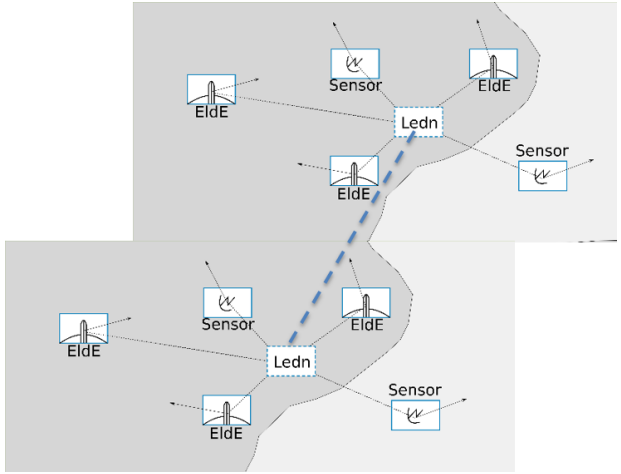
- Purpose
  - The need of a simulation tool for GBAD (***G**round-**B**ased **A**ir **D**efence*)
- OPaL
  - Components and building blocks
  - Assessment and analysis capabilities
- Future studies

Purpose • general

- Assessment of various GBAD systems and configurations for the Swedish Armed Forces
  - Supporting the procurement of mid-range air defence system
- Modelling of:
  - Various GBAD solutions
  - Existing sensor chain
  - Sweden (landscape and impact of vegetation)
  - Swedish tactics

Purpose • Ground-Based Air Defence simulations

- Model GBAD for many-on-many simulations
- Detailed kinetic performance of weapon and behaviour models
- Include limited effects of sensors, limited simulation of electronic warfare
- Network centric GBAD
- Focus on general performances and time dynamic



OPaL • Modelling framework

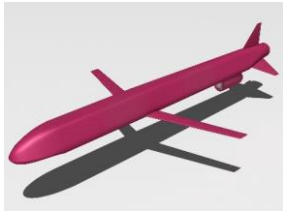
- C++ as programming language
- Simulation framework and model library
  - Modularity
  - Extendibility
- Used at the Swedish Air Force Air Combat Simulation Centre

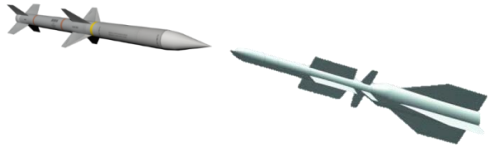
  *FLSC **F**lygvapnets **L**uftstrids**S**imulerings**C**enter*
  - Real-time simulation for training and exercise
  - Computer Generated Forces for tactics training

FOI

OPaL • system models

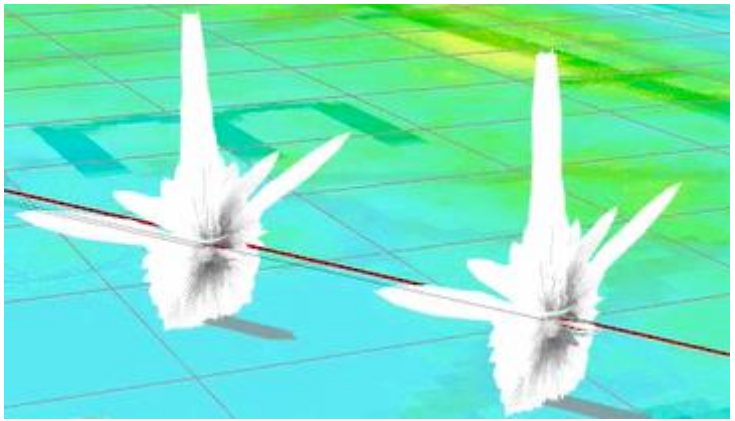
- GBAD systems and threat models
  - GBADOC (***O****perating* ***C****entre*), sensor fusion, fire unit, …
  - Cruise missile, ballistic missile, bomb, aircraft, …
- Interchangeable
  - Unclassified / Classified
  - Low / High fidelity





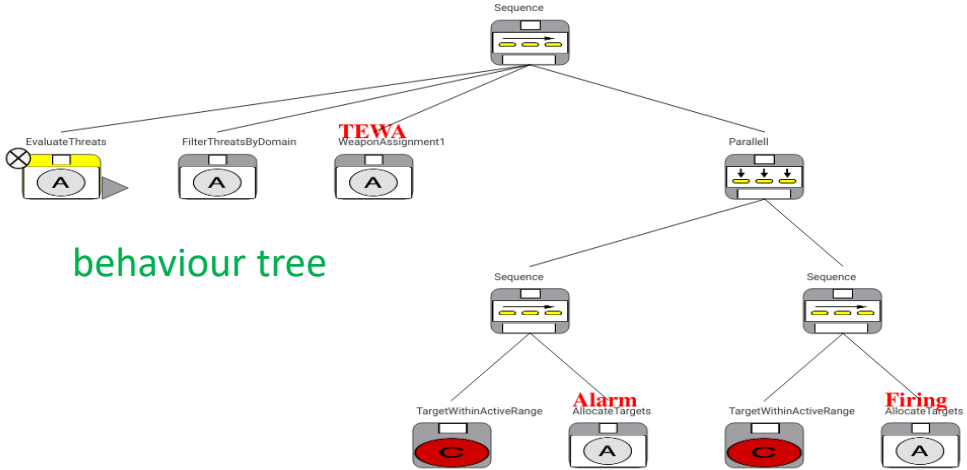
OPaL • signatures

- Geometry and platform, frequency dependent signatures
  - RCS (***R**adar **C**ross **S**ection*)
  - IR



OPaL • behaviour modelling

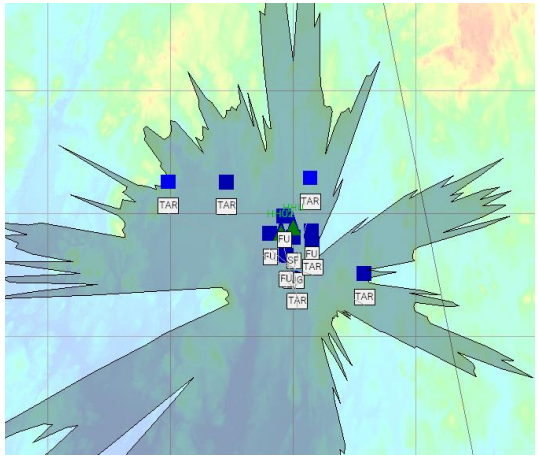
- TEWA - ***T**hreat **E**valuation **W**eapon **A**ssignment*
- Compute optimal response given
  - Weapon (estimated p_{kill})
  - Threat levels
- Different doctrines can be implemented



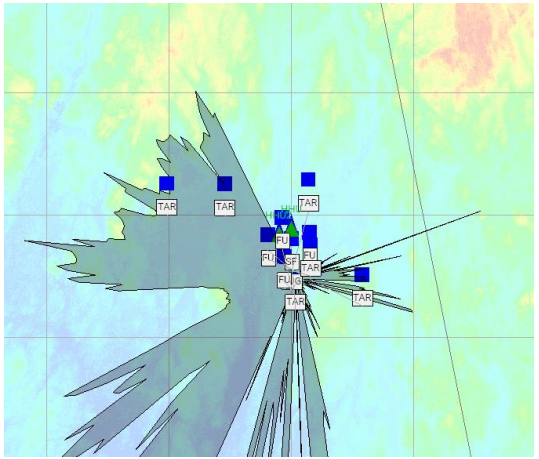
behaviour tree

OPaL • terrain and vegetation modelling

- Affects sensor coverage, Line of Sight
- Different resolutions can be used: 2, 12, 50 m, e.g.



Without vegetation



With vegetation

Framework

System models

Environment

Behaviour

What builds up OPaL?

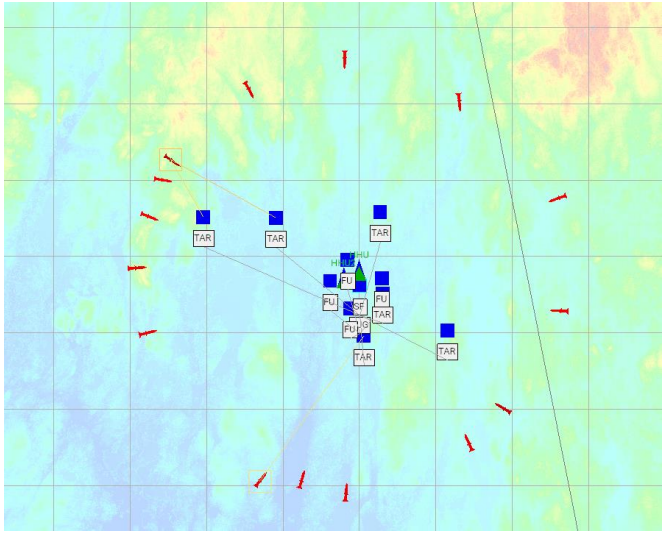
OPaL – ***OP****erativ utvärdering* ***a****v* ***L****uftvärn*

FOI's own simulation tool for assessment of GBAD scenarios.

Movie time!

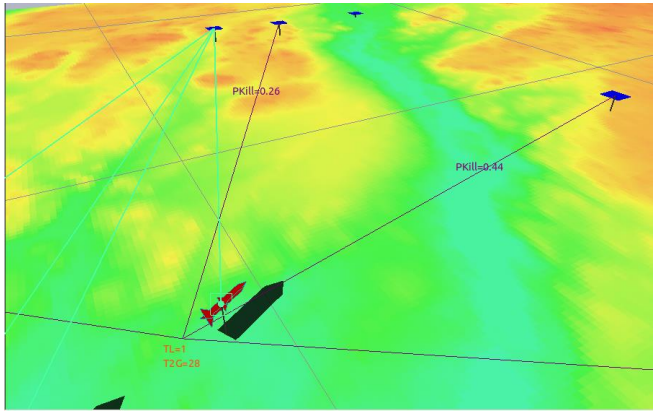
OPaL • assessment capabilities

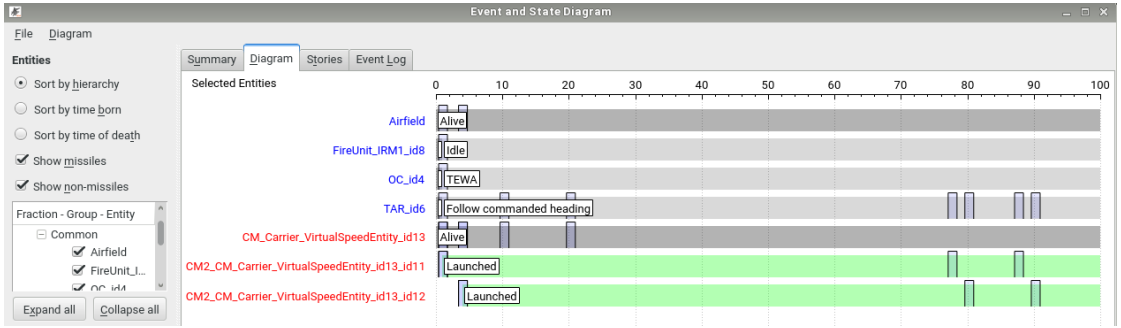
- Large-scale scenarios with many units and platform types can be analysed
- Various tactical behaviours of GBAD can be modelled and assessed
- The combat effect can be analysed with generated statistics of the scenarios



OPaL • analysis tools

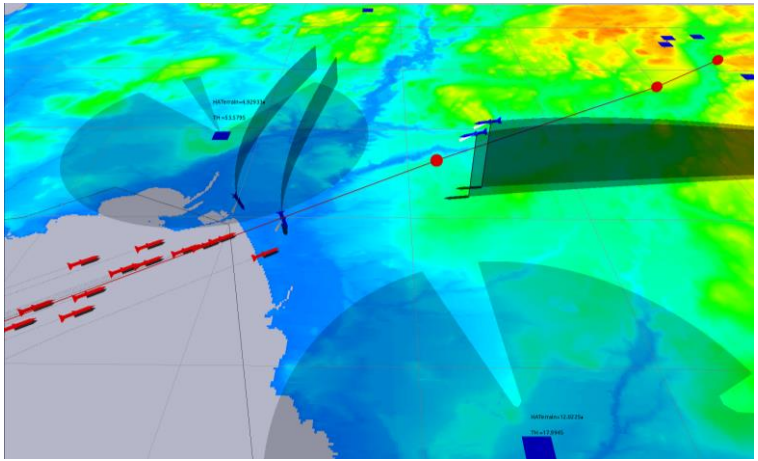
- Visualize scenario and model states in real-time
  - Tracks
  - p_{kill}
  - Threat levels
- Timeline charts

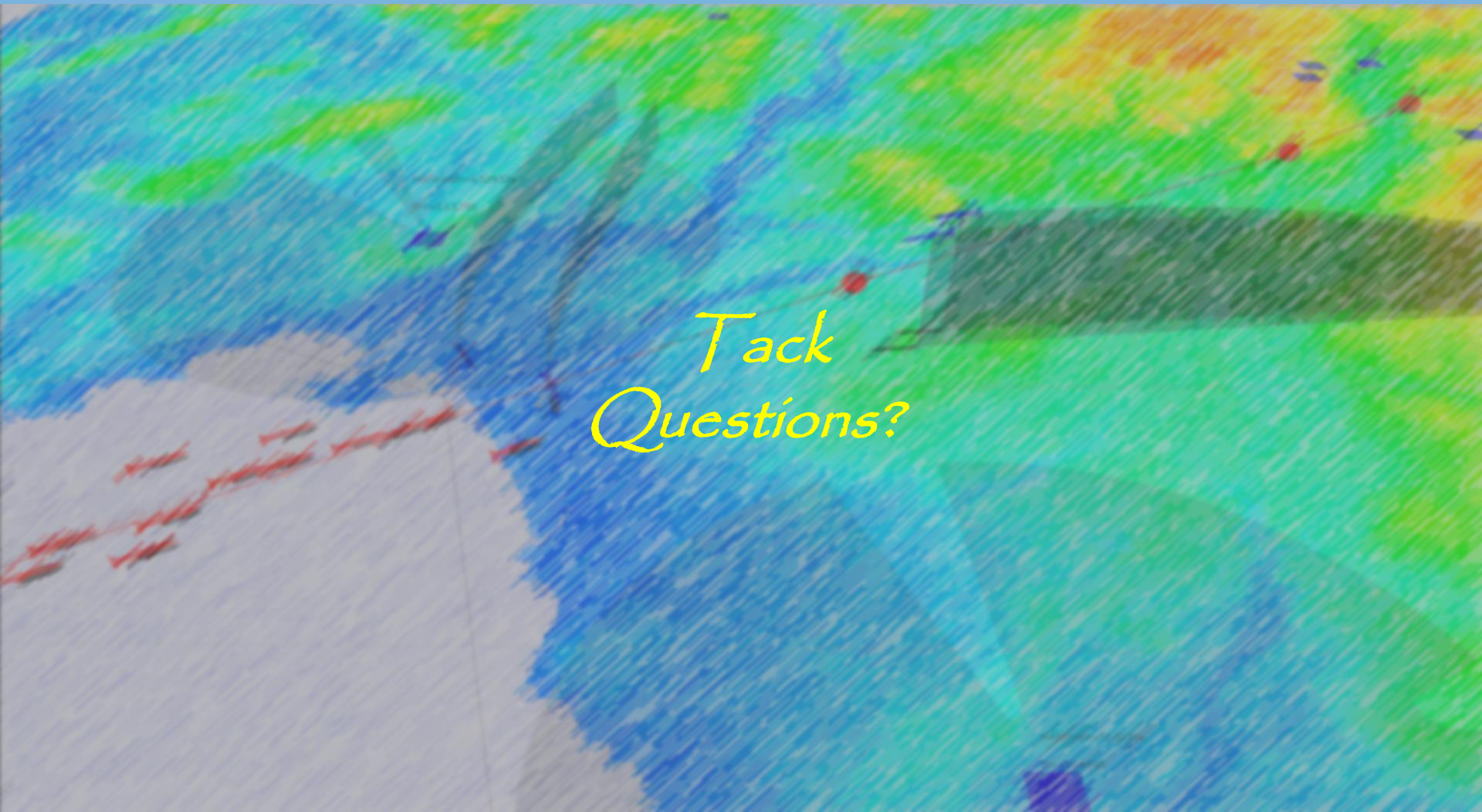




Future studies

- Doctrine analyses
- Integrated Air Missile Defence
  - Sea-based air defence
  - A2AD (***A**nti-**A**ccess **A**rea **D**enial*)
  - UAV
- Visualization
- Batch simulations
- Scenario optimization




Tack
Questions?