



Simulation framework for research of "intelligent" reconnaissance systems

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MSSLab – MultiSensor Simulation Lab

Sensors:

- IR
- Visual
- Radar
- Ladar

Weather:

- Fair weather
- Cloudy
- Rain
- Fog

Environments:

- Kvarn
- Norrköping
- Middle East
- Baltic Sea

Objects:

- People
- Vehicles
- Helicopter
- UAV

Sensor platforms:

- UAV
- Aircraft
- Missiles
- Vehicles

Signal processing:

- Detection
- Tracking
- Sensor Management
- Recognition



The diagram illustrates the MSSLab architecture. A central blue oval labeled 'MSSLab' is the core. It is surrounded by six rectangular boxes, each representing a different component. Arrows point from each of these boxes towards the central oval. The boxes are: 'Sensors' (top-left), 'Weather' (top-middle), 'Environments' (top-right), 'Objects' (far-right), 'Signal processing' (bottom-right), and 'Sensor platforms' (bottom-left). Below the central oval, a large blue bar contains the text 'Assessment of existing and future sensor systems'. In the bottom right corner, there is a logo for 'FOI' (Forsvarets forskningsinstitutet).

MSSLab

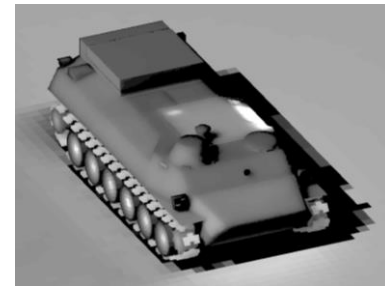
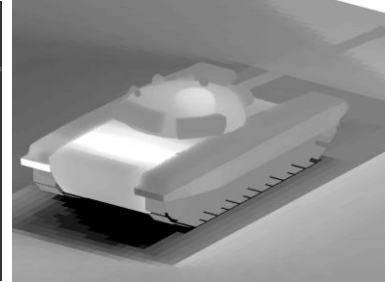
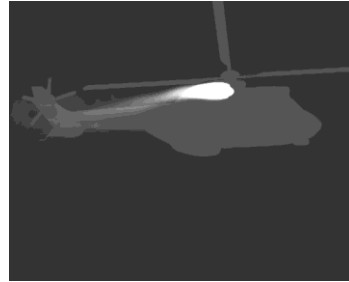
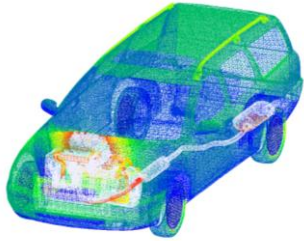
Assessment of existing and future sensor systems

Examples of ground vehicles in MSSLab



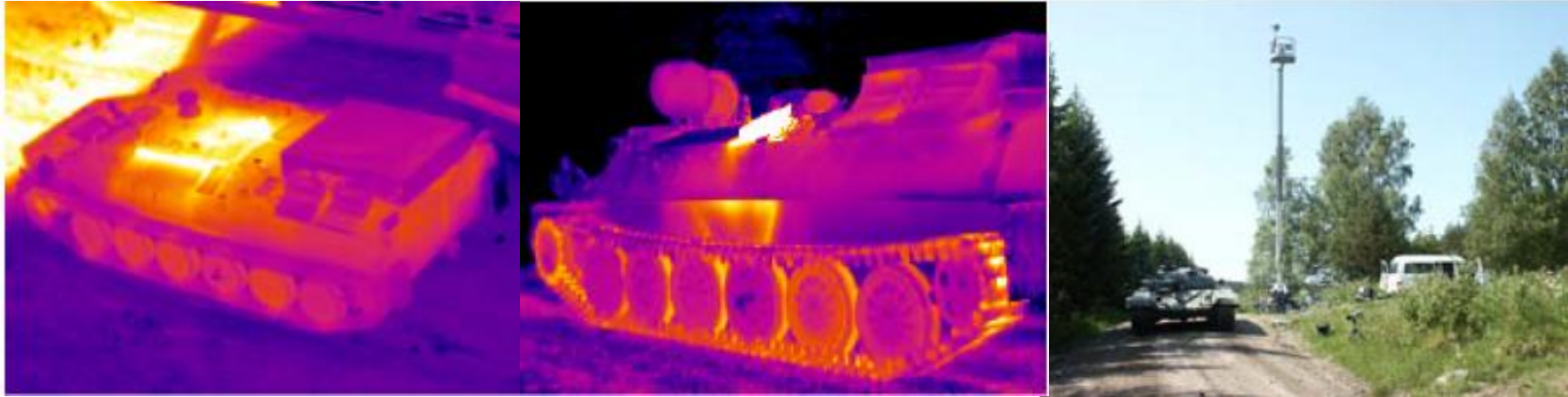
Ural 4320, MT-LB, BMP-3, BTR-80, SA-19 and T-72

Calculation of infrared signatures using TAIThermIR



Input: Weather files, material data, reflectance, operating profiles (positions and velocities), land gradient etc.

Signature measurements



- Vehicles: T-72 and MT-LB
- Measured with different sensors: video, infrared and thermocouple

Animation of characters and crowds

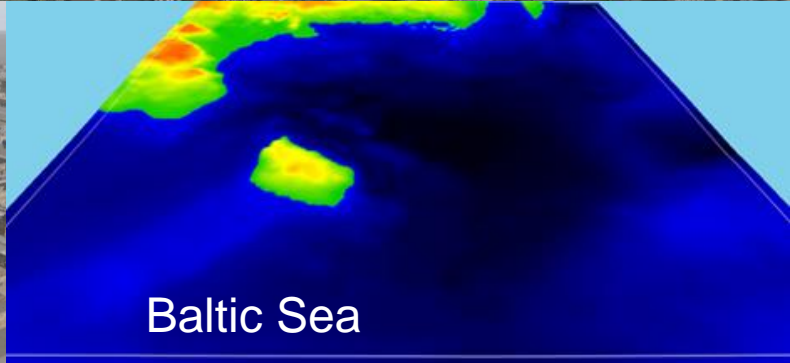


HLAS Character Animation Characters with props

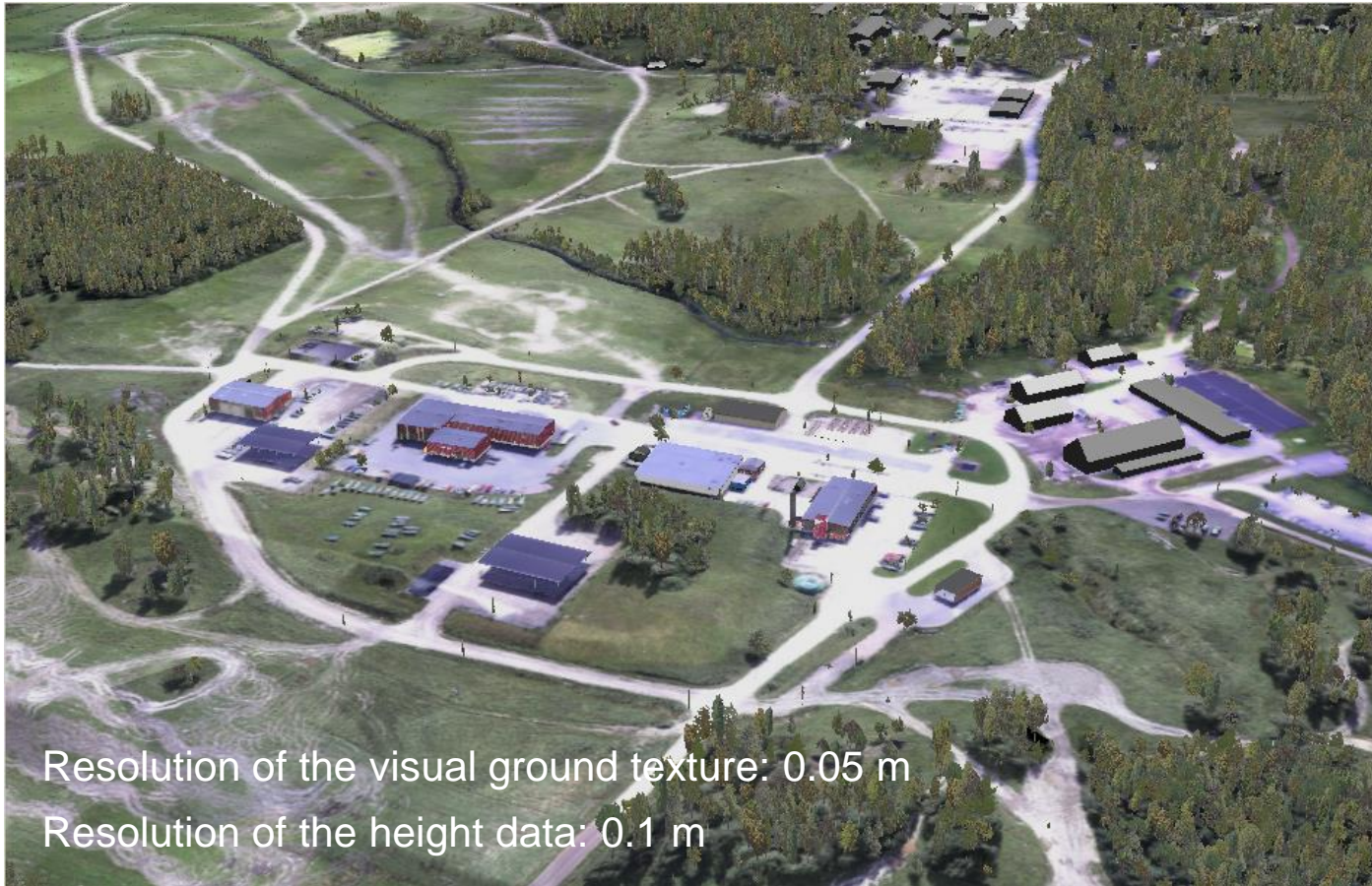


- AI and crowd simulation with several high level behaviors. Anti collision and navigation mesh.
- Animation of characters with smooth transitions and body part specific behaviors.

Terrain models



Kvarn (Rural model)



Resolution of the visual ground texture: 0.05 m

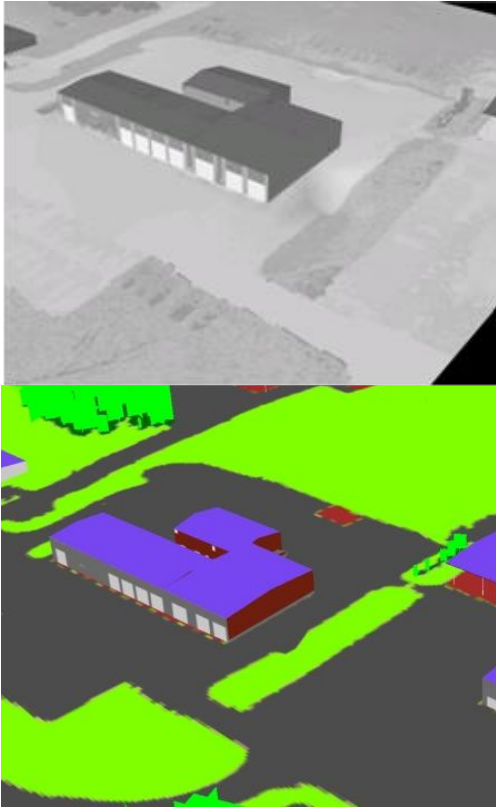
Resolution of the height data: 0.1 m

Norrköping (Urban model)



Resolution of ground texture: 0.2 m

Calculations of visual and IR scenes with SE-WORKBENCH-EO



SE-WORKBENCH-EO:

- Wavelength range: UV, visual and IR.
- Physical-based models for scattering, transmission, reflectance and absorption.
- Thermodynamic models used to calculate the physical surface temperature.
- Can use signature calculations from TAIthermIR.
- Using MODTRAN as atmospheric model.

Verification of sensor simulations with existing sensor data



SE-Workbench with TAIThermIR models



Simulation of IR data with BMP-3 and T-72

Test with a shape detection algorithm



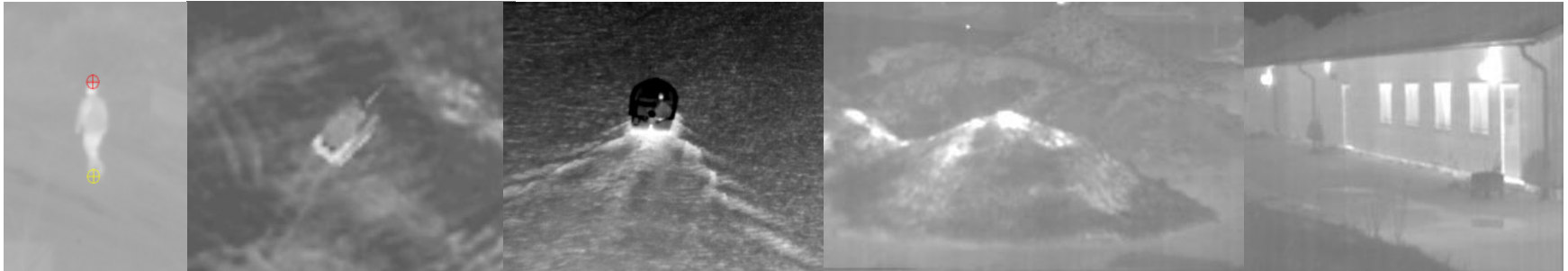
Real sensor data



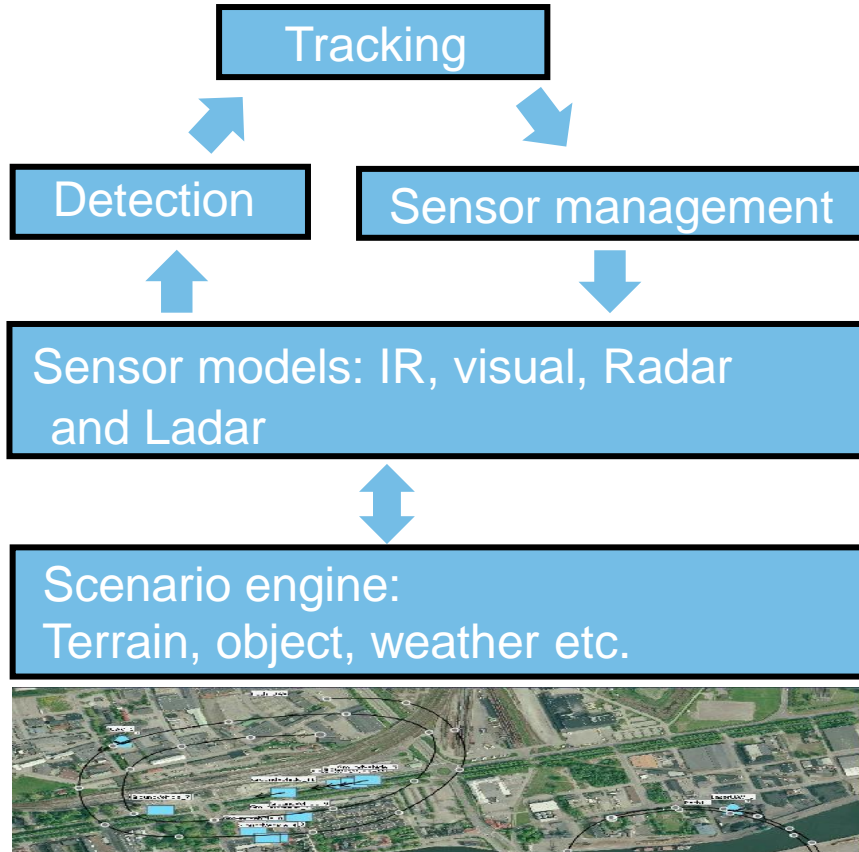
Simulated sensor data

Shape detection algorithm

- runs in real time
- works on different sensor data: visual, IR etc.
- the detection algorithm have been trained to find various objects in an image, such as people, ground vehicles etc.
- works in various environments, weather conditions and time periods



Integration of simulation models in MSSLab

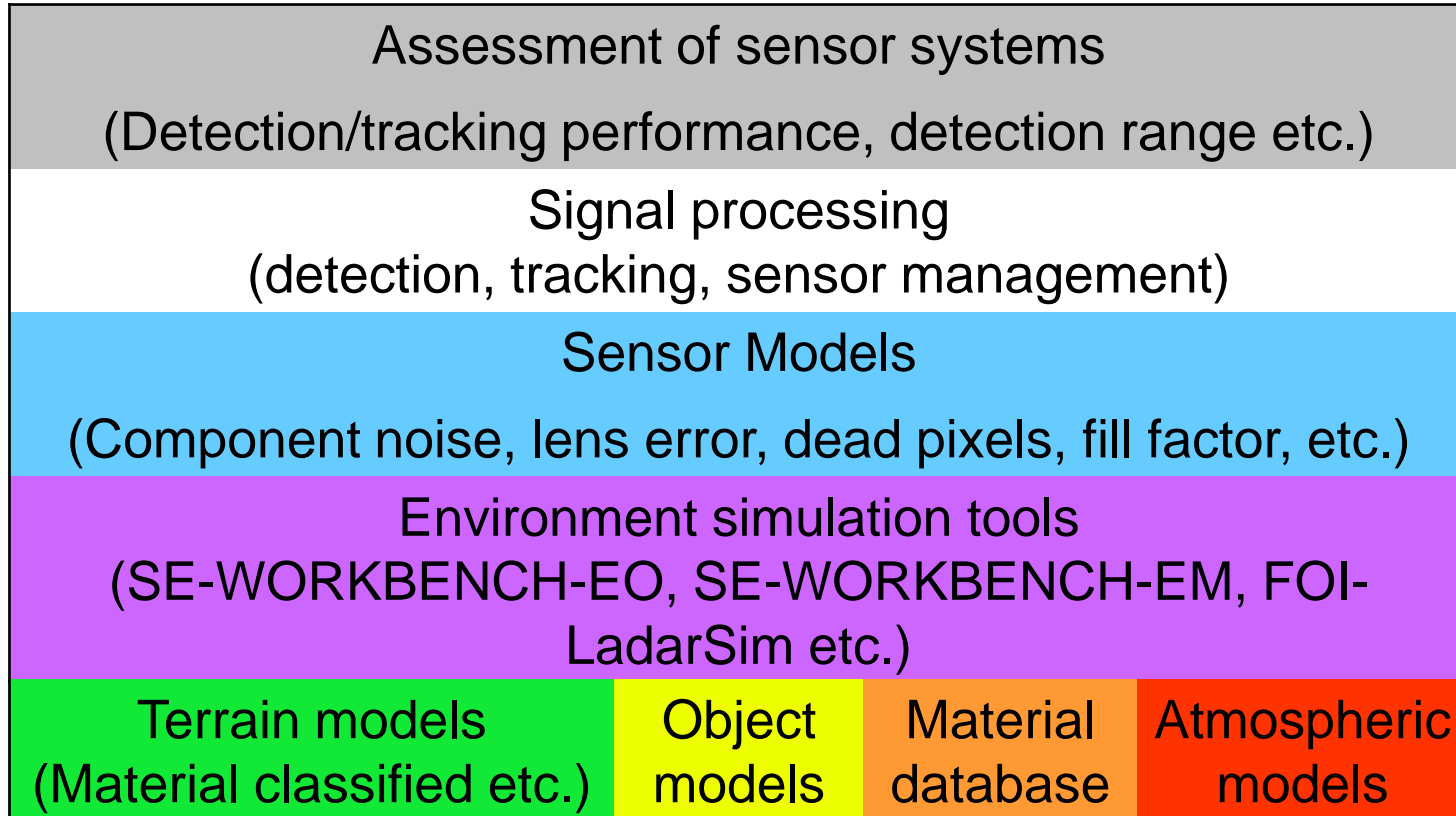


- We use HLA 1516-2010.
- MSSLab is designed to be modular. It is easy to add new federates to the simulation.
- Different federates can use different programming language: Java, Matlab and C++.

Sensor management



Simulation models in MSSLab



Summary & Future

- MSSLab can be used to simulate "intelligent" reconnaissance systems in various environment, weather conditions and time periods.
- Verification of IR simulations show that the terrain models have too few details, such as stones and bare rocks.
- I am interested to find ways to cooperate.



Thank you for your
attention!

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