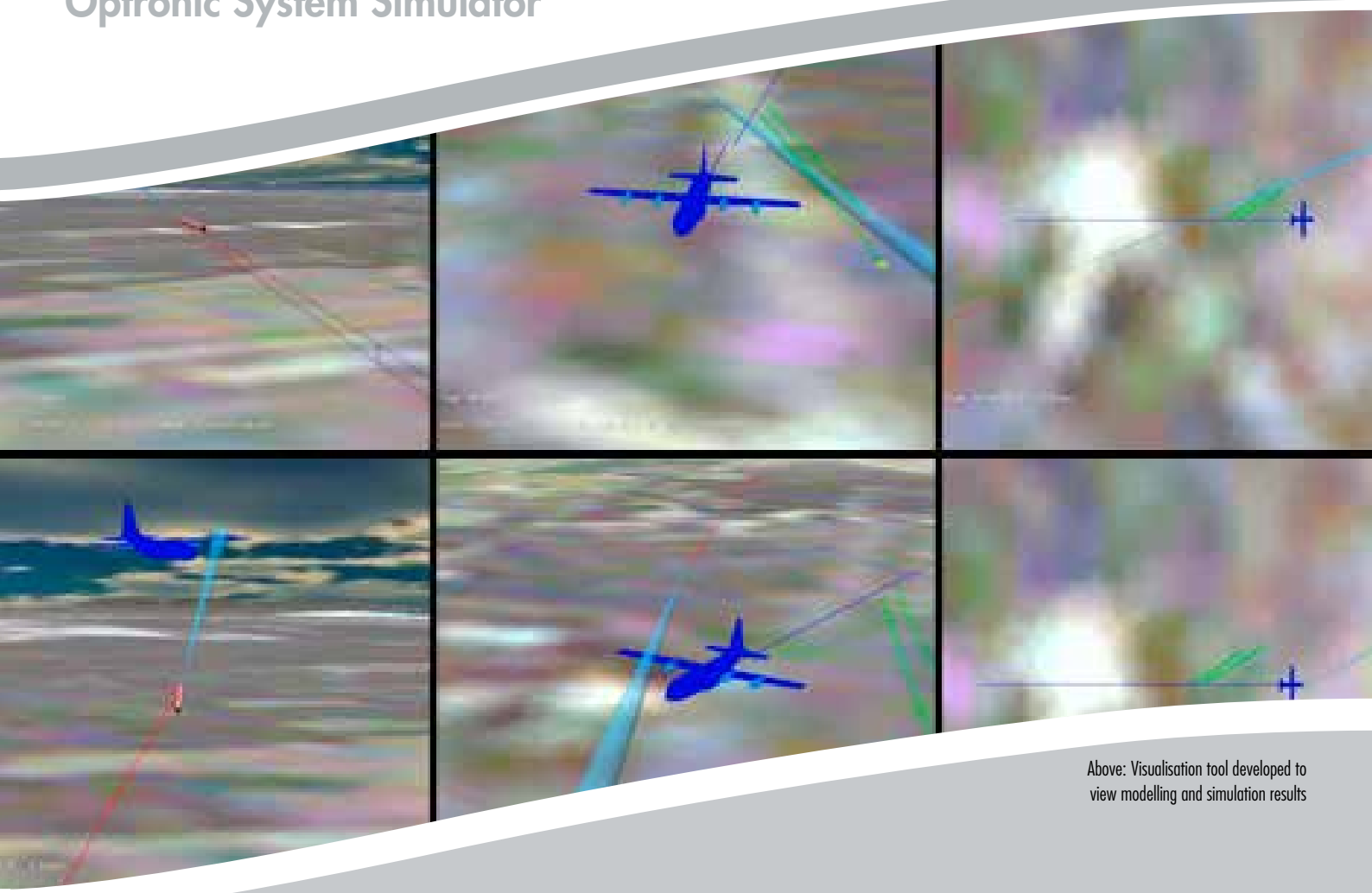
Focus on CSIR

Services in Optronic Sensor Systems

Optronic System Simulator



Above: Visualisation tool developed to view modelling and simulation results

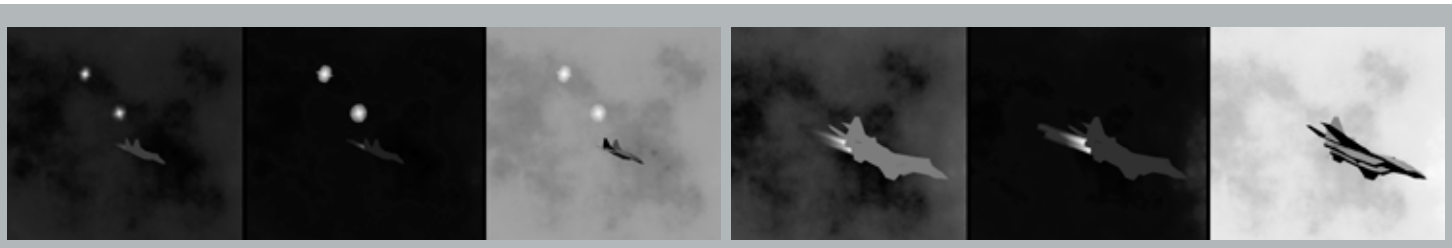
Simulation is increasingly being used to support military system development throughout the entire product life cycle, from concept analysis, development, and doctrine development.

The advent of imaging weapon systems presented the need for simulation that provides accurate image rendering in the optical spectral ranges. Physics-based infrared scene simulators are used in the development, evaluation and optimisation of electro-optical systems, such as infrared missile seekers, thermal imagers, and aircraft self-protection countermeasures.

The development of sophisticated electro-optical equipment requires radiometrically calibrated infrared imaging scene simulators in order to support the evaluation and optimisation of system performance under diverse environmental conditions.

The CSIR's Optronic System Simulator (OSSIM) is an engineering development tool developed to meet this need. It comprises a complete system, including 0.4–14 µm rendering of reflected sunlight and thermal self-emittance signatures, of static and moving (and flying) objects in a complex world scene. The system employs a core library with interfaces, to enable the developer to add specialist models for the required application.

The simulation creates a virtual three-dimensional (3D) world containing all the elements of a real-world scenario. Static or dynamic moving objects, various background scenarios, and realistic modelling of atmospheric conditions are included in the simulation. A high premium is placed on accuracy at a



A wireframe model of a helicopter (left) that would used to develop a radiometric model to be used in the modelling and simulation environment (centre and right).

detailed level in areas of radiometry, atmospheric modelling, object kinematics and signal processing. The simulation provides a rendering engine that calculates infrared and visual images exactly the same as would be measured in the corresponding hardware system.

Physics-true radiometry is achieved by the rendering of reflected sunlight and thermal self-emittance signatures; thereby ensuring accuracy over the full spectral band. Accurate atmospheric modelling in OSSIM requires that MODTRAN (the US Air Force Geophysics Laboratory atmospheric radiative transfer code used to calculate atmospheric properties) be present. Very sophisticated movement kinematics and aerodynamics, such as missile flight, are easily implemented in the kinematics and control system library. The simulation structure allows the end-user to easily integrate his signal or image processing algorithms into the simulation environment.

OSSIM is used in the development of:

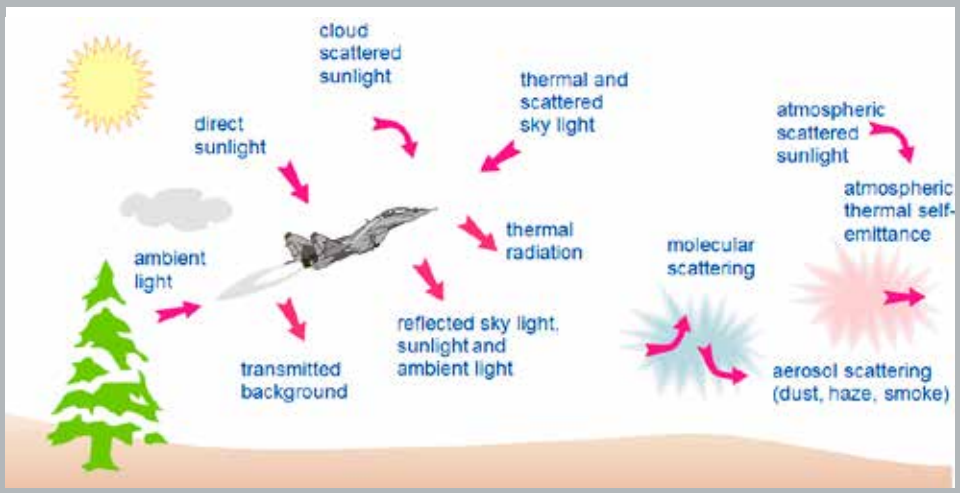
- Electro-optical sensors
- Development of image processing algorithms (target recognition and tracking)
- Infrared signature studies
- Missile countermeasure systems
- System performance evaluation
- Flight-test-preparation performance evaluations.

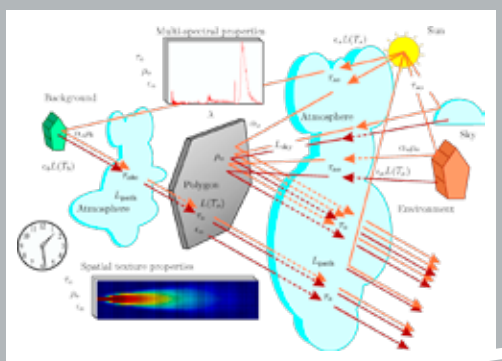
Using suitably qualified models, OSSIM supports formal system validation and qualification, in conjunction with hardware-based qualification.

The simulator is written in C++ and runs on Windows and Linux systems. It is not encumbered with licence restrictions, except for the optional use of MODTRAN. For visualising the results graphically users may use Python, GnuPlot, Matlab or any other plot graphs tool, but these are not compulsory and OSSIM can operate without these.

OSSIM is a second-generation simulation based on its predecessor, SIMIS (Simulator for Imaging Systems). With a 20 year development legacy, the total investment in the development of the two simulators is estimated at more than 50 man-years. Its library provides deeper support infrastructure that enables engineers to focus on developing optronics systems, rather than the physics of radiometry. The library and several applications are actively supported and constantly expanded to meet new user requirements.

Current applications are mainly in the defence domain, but OSSIM can also be applied in the development of civilian electro-optical imager-based products. The CSIR and Denel Dynamics utilise OSSIM intensively and licenced use of the simulator can be arranged for clients.





Radiometric elements in a scene that are all taken into account in typical OSSIM analyses

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