RESEARCH AREAS

- Aircraft self-protection
  - Infrared measurements (Aircraft)
  - Infrared measurements (Countermeasures)
  - Modelling
  - Simulation
  - Threat characterisation
  - Countermeasure effectiveness
- Surveillance applications
  - Image enhancement
  - Target detection, tracking, recognition and classification
- Opto-mechatronics
- Remote space and UAV sensor design
- Satellite calibration and validation
- Atmospheric measurements and characterisation

The research themes are supported by specialist facilities, including:

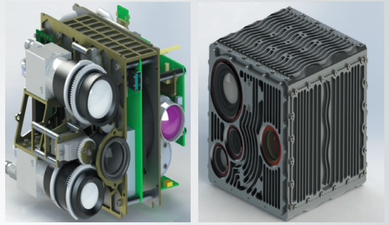
- Optical test and evaluation laboratories
- An infrared mobile laboratory
- A spectrophotometry laboratory
- A countermeasures evaluation laboratory
- A laser laboratory

CSIR OSS capabilities include:

- Mechanical and electronic engineering:
  - Opto-mechatronics
  - Control systems
  - Fine mechanical design
  - Embedded hardware and software design
- Physics:
  - Optics
  - Radiometry
  - Infrared measurements
  - Atmospheric studies
- Computer science:
  - Image processing
  - Machine learning
  - Front-end design
- Project management
- Systems engineering
- Configuration management
- Quality management

Specialised imaging systems

The CSIR develops and integrates high-performance optical components and imaging sensors with image processing algorithms, mechatronics and computer control to realise long-range surveillance sensors with exceptional performance. These sensors typically operate in the visible and near-infrared spectral bands at light conditions down to a quarter moon and, in some cases, even complete darkness, using covert illumination.



Multispectral sensors for UAVs

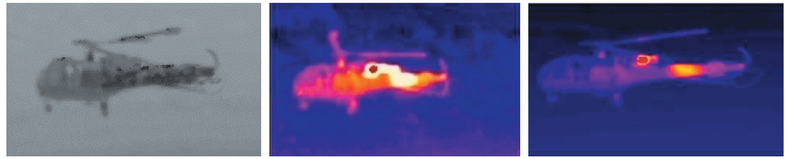
Rino: Long-range and Tyto: Medium-range day-night wide area surveillance systems

Imaging Infrared measurement

Infrared measurements are essential in the development of accurate models for use in simulations. Simulation-based research and experimental development and testing play a critical role in validating equipment, before prototyping, saving researchers time, effort and costs.

The CSIR uses imaging radiometers, as well as an imaging Fourier Transform Infrared Spectroscopy spectrometer, which collects spectral data, to characterise objects spectrally, spatially and temporally. Measurements, using the imaging radiometers, are executed in the short, medium and long-wave infrared bands.

The long, medium and short-wave radiometers used during field deployments



Images of a helicopter captured using these radiometers

Aircraft vulnerability simulations

These aircraft vulnerability plots are developed by performing simulated missile launches at different ranges and angles (with each disc representing a particular velocity and altitude). The colours depict the distance that a missile would pass by the aircraft if launched from that particular point. The worst case for the aircraft would be a miss distance of zero metres. A number of plots would be generated for clients, combining the different variables to produce the scenarios envisaged.

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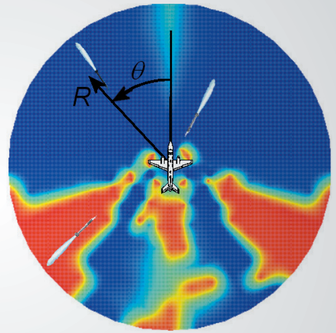
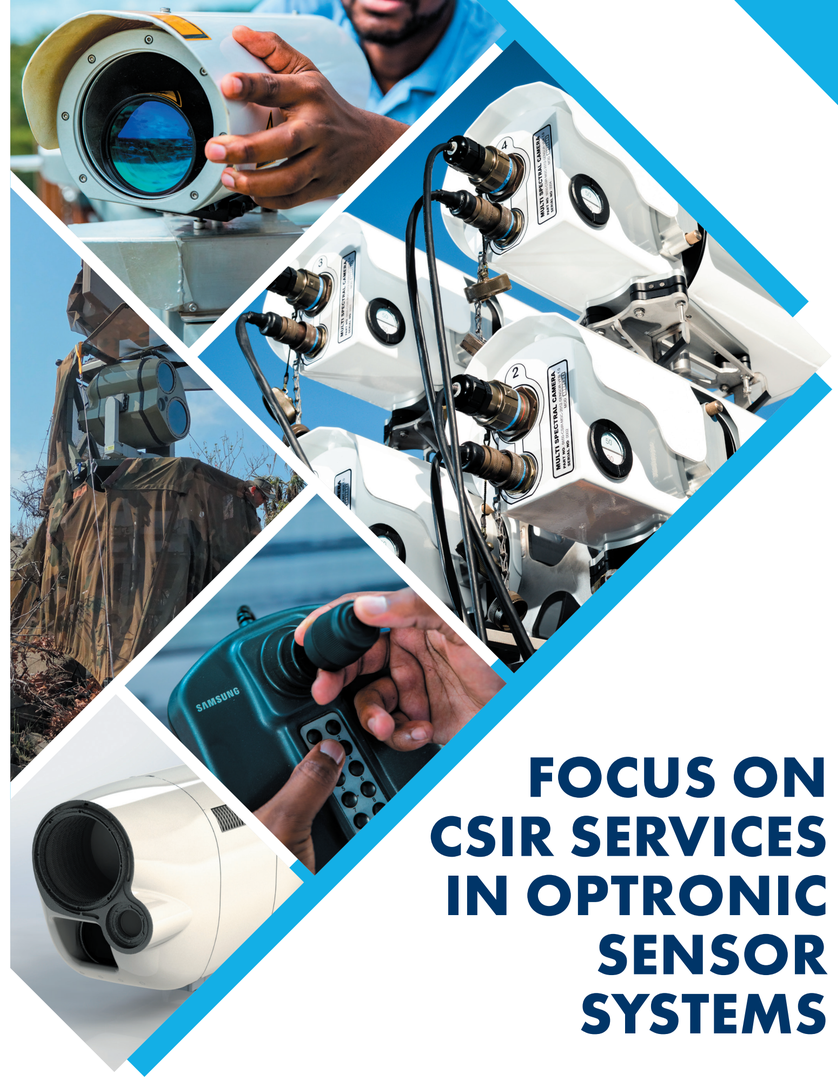


Aircraft vulnerability simulations



FOCUS ON CSIR SERVICES IN OPTRONIC SENSOR SYSTEMS

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

CSIR
Touching lives through innovation

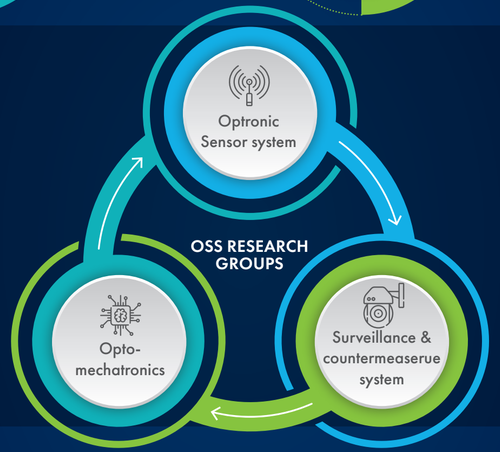
The Optronic Sensor Systems (OSS) impact area at the CSIR focuses on developing novel electro-optic sensors/ imagers and image processing techniques. OSS undertakes the modelling, simulation, engineering, testing and evaluation of advanced electro-optical sensor systems and develops day, night and multispectral surveillance systems. The impact area further specialises in the design, characterisation and evaluation of electronic warfare countermeasures. Its research and development is output-driven and results in the demonstration of prototypes for operations in the maritime, air, land and space domains.

VISION

We accelerate the transition to safer communities, through custom video actionable intelligence.

MISSION

To provide custom video actionable intelligence solutions that address defence and civil security applications, in collaboration with partners.

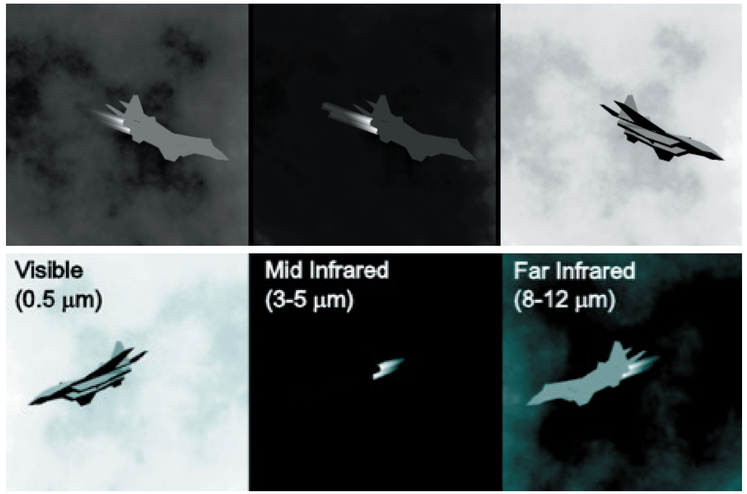


TECHNOLOGY FOCUS AREAS

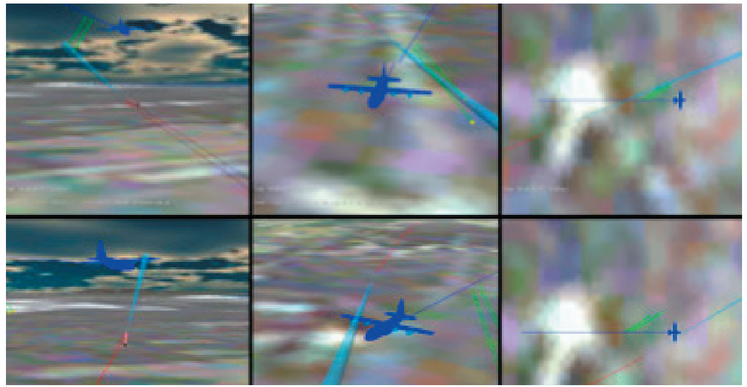
- Video surveillance intelligence object/ action detection, tracking, recognition and classification
- Long-range camera development for border safeguarding
- Platform protection: Infrared electronic warfare capability for the protection of air platforms
- Space remote sensing Specialised payloads for space and unmanned aerial vehicle (UAV) platforms

Modelling and simulation

Optronic sensor systems researchers have moved from hardware-based experimental development to modelling and simulation-based experiment development, saving time, effort and cost. The modelling and simulation approach provides earlier understanding and validation and the opportunity for refinement and improvement. This approach is particularly relevant for the development and evaluation of complex systems, such as aircraft self-protection countermeasures against missile attacks. The use of simulation also extends the evaluation to beyond that which is feasible with hardware-only evaluations.



Output from the Optronic System Simulator

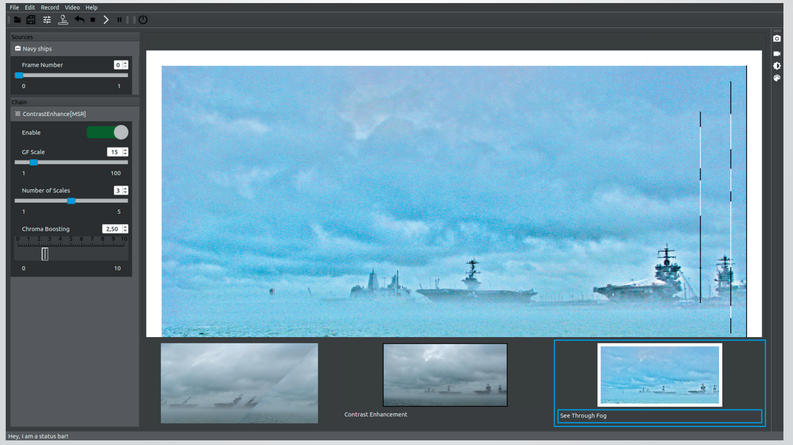


Visualisation tool developed to view modelling and simulation results

Image enhancement

Video frames and images can be distorted by several factors, such as atmospheric turbulence, for example, mist or rain, and platform motion, for example, when an optronic system is mounted on a ship in stormy weather. Several algorithms have been developed by the CSIR's optronic sensor systems experts for tone mapping, low-light image enhancement, image de-warping, image stabilisation, motion de-blur and super-resolution. Real-time implementation is achieved by using multiple central processing units and/or graphic processing units. This capability is particularly useful when looking at real-time video during surveillance missions.

Image processing techniques allow user to see through the fog



Processed image for viewer to see through the fog