Focus on CSIR

Services in Optronic Sensor Systems
Image Processing and Computer Vision

World-class tools, sophisticated techniques and knowledge workers with decades of experience positions the CSIR to adequately satisfy the requirements of the customer with regard to surveillance systems.

A strong capability in various fields of image processing allows the CSIR to support several applications in surveillance. Some of these include:

- Maritime object detection and tracking
- 360 degree image stitching
- Atmospheric turbulence mitigation in images
- Detection of moving targets from aerial platforms
- Distributed surveillance

Image processing and computer vision is a broad research area that involves specialists from various fields of expertise. These include:

Photogrammetry

The relationship between the image and the world around it can be determined using photogrammetry - the science behind taking measurements from photographs. Modern maps are typically created using photogrammetry and photographs. With this capability, a normal optical camera is turned into a precision measurement instrument, which can be used to create images for real-time stitching, helmet tracker-based navigation and targeting, see-through armour and image fusion.

Computational photography

The CSIR looks at combining non-traditional camera designs (including coded apertures and plenoptic focal plane arrays) with computer processing. This allows for advanced image processing that includes digital refocus, perspective shifts on images and foliage penetration.

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Low contrast image enhancement

Low light contrast enhancement

Classification

Photogrammetrically stitched panoramas.

Image enhancement

Video frames can be distorted by several factors such as atmospheric turbulence (mist or rain), and platform motion (when an optronic system is mounted on a ship in stormy weather). Several algorithms were developed by the CSIR's optronic experts for tone mapping, low-light image enhancement, atmospheric turbulence mitigation, image stabilisation, motion de-blur and super resolution.

Real-time implementation is achieved using multiple central processing units (CPU) and/or graphics processing units (GPU). This capability is particularly useful when looking at real-time video during surveillance missions.

Pattern classification and machine learning

The CSIR's Optronic Sensor Systems group has conducted research into microdot processing, optical character recognition (OCR), object detection and target classification. These rely on state of the art methods, such as deep learning and convolutional neural networks. These networks are computing systems made up of a number of highly interconnected processing elements that process information through their dynamic state response to external inputs. The systems are able to, for example, differentiate between types of animals and different makes of vehicles in cluttered environments

Object tracking

Tracking algorithms developed by the CSIR use techniques such as particle filters to estimate a target's state.

Coarse to fine image matching strategies are used to align video frames. For particular applications, computer vision models have been developed for robust tracking. Object trackers consist of target detection and segmentation modules for automatic operation in real-time. Image segmentation refers to the extraction of pixels of objects of interest from video.

Augmented reality

Augmented reality is a 'real-world' view of an environment with computer-generated sensory input. Graphics combined with see-through or transparent head mounted displays can be used to relay tactical information and training simulations, or increasing one's situation awareness, for example.

Wide area surveillance

The Wide Area Surveillance System (WASS) provides instantaneous wide area situational awareness. With a panorama of 360° and a high-resolution digital video at 20 frames per second, the sensor initially began operations in the visual band. Ruggedised modules have been tested in the maritime domain for the detection of small craft in support of anti-piracy operations. Multi-spectral versions of the system employ thermal cameras and active cooling. Calibration of the cameras is done using the CSIR's patented Automatic Photogrammetric Camera Calibration System (APCCS).

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