

# 360° CAMERA SYSTEM



KONGSBERG



## 360° Camera System

The Electro-Optical Sensor Suite (EOSS) from KONGSBERG, consists of a rotating platform housing a visual and infrared 360° camera and a pan-tilt platform housing a visual zoom camera, a fixed lens IR camera, a laser range finder and signal lamp.

The 360° Camera System is based on a rotating platform incorporating two cameras. One line scan camera for visual light, VIS 360°, and optionally one line scan camera for Long Wave Infrared Light, IR 360°.

This camera system is particularly designed to an Out-The-Window view in a remote center or virtual tower center, so to:

- Provide the operator with vision acuity as equal to the Out-The-Window (OTW) as possible, both with respect to optical resolution, light sensitivity, color reproduction, scale and orientation.
- Reduce the required data bandwidth as much as possible between aerodrome and control center without compromising the vision acuity.
- Provide the user with a module based system for easy maintenance and shortest possible downtime during replacement and service.
- To avoid impaired visibility due to rain and snow all windows are equipped with wipers. Heated windows will improve the efficiency of the wipers and avoid problems with ice and snow. The rotational speed of the 360° Camera System will in itself prevent snow, rain, salt, sand and other debris from sticking to the windows.

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- Visual acuity 1.0 - same resolution as the human eye with a 20/20 vision
- All weather protection
- Day camera and IR camera integrated and fused into one image
  - 360 and 60 degrees field of view seamless presentation - no stitching



## Functional Description

Both cameras, VIS 360° and IR 360°, use Time Delayed Integration (TDI) technique to improve light sensitivity. The platform will rotate at 5Hz and provide 5 high resolution 360° degree images per second. The captured image is projected on a native cylindrical format.

This solution has a number of inherent advantages such that discontinuities and non-uniformities in the horizontal plane are non-existent. Changing sunlight levels or even direct sunlight will not restrict view. For Remote Tower operations the relatively low transmission bandwidth is another inherent advantage. The 5 Hz update rate on 60 kHz flicker-free screens highlights the Operators attention to moving objects as planes, cars, animals and clouds. The 5 frames per second update rate is more than adequate to obtain similar Operator's situational awareness as with an Out-The-Window view.

The rotating platform has absolute control on the azimuth angle with a resolution much better than the pixel resolution, and there is no optical distortion in azimuth. This solution gives a very accurate and reproducible angle positioning to an observed object. The 360° Camera System will be aligned with respect to north with accuracy better than  $\pm 1$  mrad.

This sensor combined with the offered display solution, will give the operator a real angle perception between objects as they will appear with exactly same separation as in Out-The-Window View of a classic tower. The same as ICAO's required 20:20 visual acuity.

Both VIS 360° and IR 360° are physically positioned on a rotating table. This is a high performance direct drive servo motor with long life time.

The power, control signals and video is transferred to the rotating table by an inductive-optical slip ring. This ensures that there is no mechanical contact except from the ball bearing. This type of slip rings is provided by several suppliers and is widely used due to long life time and high data bandwidth.

## IR 360°

The IR 360° horizontal field of view is 360° and the vertical field of view is 17°. An important feature is that the camera internally have a servo controlled mirror as a part of the infra-red lens. The vertical field of view of 17° can then remotely be aligned vertically to any sector of interest, i.e. covering exactly the runway or elevated up against the sky for weather observation. The limitation for the field of view adjustment is -10° to + 50° with reference to the horizontal plane.

The lens has a focus control that automatically will compensate for temperature changes to maintain good focus. This temperature compensation will be controlled internally in the camera and is not visible to the Operator.

