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THE ESA METEOSAT THIRD GENERATION LIGHTNING IMAGER PROVIDES KEY DATA FOR
WEATHER NOWCASTING AND SAFETY OF AIR TRAFFIC**Abstract**

In December 2022 Leonardo launched a state-of-the-art Lightning Imager (“LI”) aboard the ESA/EUMETSAT MeteosatThirdGeneration (MTG) satellite. In this paper the design challenges and in-flight performance of LI are described. LI detects lightning during night and day, which is a key feature for weather forecasting and safety of air traffic. LI has been designed to operate at Geostationary Orbit, continuously and simultaneously observing total lightning over the hemisphere centered on Europe, Africa, and portions of Asia and South-America, providing information to the users at extremely high timing of 30sec., at about 5km spatial resolution. These continuous lightning data for the whole hemisphere constitute a new set of info to use in nowcasting, climatology, and atmospheric research. The LI lightning detection working principle consists of triggering events on pixels where and when a sudden increase of energy is measured over the background radiance (i.e. Earth disk) image. In addition to lightning pulses, other sources such as acquisition noise, jitter movements of the instrument line of sight or high-energy particles, induce signal variations that trigger events. A succession of on-board and on-ground filters is therefore needed to discard false events, while keeping the true lightning information, in addition to the Super-High-Sensitivity detector used to image the Earth disk. The LI is composed of one Optical Head and one Electronic Unit.

The Optical Head consists of four identical Optical Channels [OCs], each imaging a different portion of the visible Earth surface, with the four lines of sights tilted 4.75 from the SSP toward North, South, West and East, to achieve the required coverage.

The Electronic Unit includes the Power Units and a Single Board Computer. LI has the first European processing board implementing a “Power PC” technology (PPC7448 with 2300 DMIPS @ 1GHz) to run its Application Software. The LI Detector is a key element of the design, as many of the system requirements are dependent on its characteristics and performance. This detector was developed by ESA in Europe specifically as an enabling technology for the lightning imaging from GEO. It is a backside-illuminated CMOS Active Pixel Sensor, since backside illuminated technology improves the QE and consequently the SNR required by the detection process. The LI Detector has internal column ADCs, allowing digitalization of five rows in parallel, providing the necessary processing capacity to operate at 1KHz frame rate. The digital data is then multiplexed internally to the serial LVDS outputs running at 250Mbps.