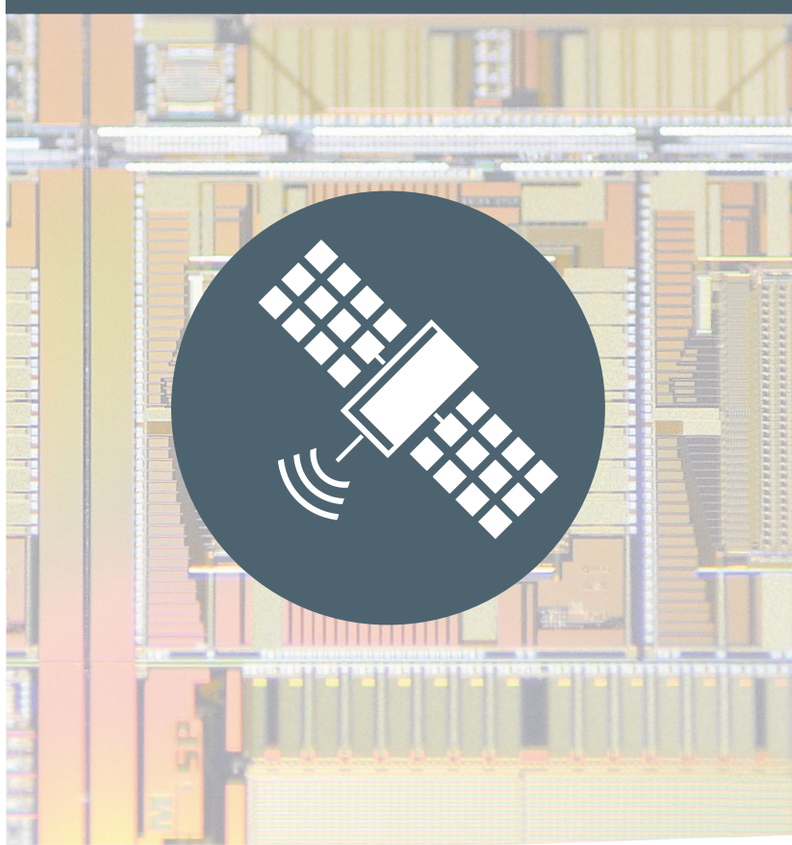
Fraunhofer IMS

FRAUNHOFER INSTITUTE FOR MICROELECTRONIC CIRCUITS AND SYSTEMS

BUSINESS UNIT SPACE AND SECURITY



Fraunhofer IMS

The Fraunhofer Institute for Microelectronic Circuits and Systems IMS in Duisburg is a globally recognized application-oriented research institution for the development of marketable technologies and processes in the fields of microelectronics and sensor technology. Especially in the key areas of »Health, Industry, Mobility, Space and Security«, scientists have been working intensively and interdisciplinarily on the development of future-relevant solutions for industry and society - for over 30 years.

Glossary

MEMS	micro-electro-mechanical systems
BSI SPAD	backside illuminated single photon avalanche diode
CMOS CCD	complementary metal–oxide–semiconductor chargecoupled device
IRFPA	infrared focal plane array
AIfES	artificial intelligence for embedded systems
FNN	feedforward neural network
LiDAR	light detection and ranging
ROIC	readout integrated circuit
TDI	time delay and integration
MWIR	mid wave infrared
LWIR	long wave infrared

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Introduction to the business unit

The business unit Space and Security of Fraunhofer IMS offers the whole variety of services ranging from development to pilot production of customer-specific and innovative MEMS sensors with focus on optical sensors. Latest state-of-the-art technologies including BSI SPAD arrays, CMOS CCD detectors and uncooled IRFPAs enable Fraunhofer IMS to provide flexible, future-proof and reliable customer applications for observation and surveillance of critical infrastructures on earth as well as in and from space.

For use in such sensible application scenarios as space, security and defense we offer the integration of trustworthy and secure electronics parallel to the actual MEMS sensors. Regarding this specific use case, Fraunhofer IMS relies on its self-developed efficient microcontroller core based on the open standard instruction set architecture RISC-V but being additionally extended with hardware acceleration for applications using artificial intelligence. AIfES is a platform-independent machine learning library in the programming language C, allowing for an implementation of a fully configurable FNN.

Space

As one of various applications in space, we utilize BSI SPAD arrays as highly sensitive detectors in LiDAR sensors for a three-dimensional detection of the environment. Within the ROIC of the BSI SPAD arrays, digital time stamps are generated reproducing the time of flight of a laser pulse sent out by the LiDAR sensor. Because of the compact and digital design of the ROIC itself, BSI SPAD arrays with high integration density can be realized by means of a modern wafer to wafer bonding process for usage in LiDAR systems with high optical resolution for various applications in space. In addition, LiDAR allows for a wider implementation of robotic systems for detection of the environment under harsh conditions, such as in space.

For earth observation from orbit, the business unit Space and Security of Fraunhofer IMS offers state of the art optical sensors such as CMOS CCD detectors for operation in TDI mode. Here, we focus on the development of detectors for high resolution, multispectral, optical focal planes of future satellites for earth observation. Those satellites are used amongst others for scanning of urban regions in the context of city planning as well as for supportive reaction to natural disasters or other crises with the provision of high-resolution images of selected regions of interest.

Security and Defense

The IRFPA technology allows for passive observation, detection and surveillance of people or objects by means of uncooled IR imaging methods. Passive relates to the fact that no active illumination of the scenery is required since, according to Planck's law, people or objects emit IR radiation themselves. Depending on individual, customer-specific demands, either MWIR ranging from 3 µm to 5 µm or LWIR ranging from 8 µm to 14 µm can be chosen as the wavelength range of choice of the IRFPA for various applications in security and defense.

MWIR sensitive IRFPA sensors are suitable for detection and surveillance of so-called hot sources. The latter appear in sensing of gases by means of imaging methods or in firefighting.The latter appear in sensing of gases by means of imaging methods or in firefighting. The IRFPA technology provides not only a visualization of the fire source itself with high contrast as compared to the visible light spectrum, but also a spectral detection of hazardous gases. In contrast, IRFPA sensors optimized for LWIR are highly sensitive to human IR radiation and are mainly used for a reliable detection and surveillance of people under weak visibility conditions, such as at night, in fog, smog or smoke. The latter is relevant for customer applications with police or military background and also for use in civil security, such as for mountain and sea rescue or traffic safety.