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TECHNOLOGY OFFER

Improved operation of silicon photomultipliers in sensory systems

Institute Jozef Stefan, Slovenia, and a Slovenian SME jointly developed a sensory system based on silicon photomultipliers (SiPM) useful in research and industrial measurement systems based on SiPM. The system improves the operation of SiPM by reducing the systematic error caused by sensor saturation. License agreement and/or technical cooperation are offered to companies interested in development of new products, or improving existing products with built-in precise SiPM-based sensory systems.

Key words: Optics, Remote sensing technology, Medical Technology / Biomedical Engineering

Typical sensory systems based on SiPM are usually composed of SiPM sensors connected to a multichannel analyser that collects, and enables further analysis of, the signal from these sensors. Since the SiPM sensors consist of thousands of microcells, the statistics of the binomial saturation allows for a modest relative uncertainty in the number of temporarily inhibited microcells.

The device developed by the Slovenian researchers represents a sensory system consisting of SiPM sensors connected to a multichannel analyser through a fast analogue-digital converter and correction processor. The analogue-digital converter converts the electrical signal to digital signal (a series of numbers), which is further processed in the correction processor. This processor generates another series of numbers, corrected to such values that would have been obtained from the sensor, if there was no binomial saturation. Thus, proportional representation of the actual light incident on the sensor is reflected. The corrected signal is then further processed in a multichannel analyser that prepares a list with records of impulse amplitudes.

The correction processor of the device compensates the binomial saturation in such a way that in each suitably chosen short time interval the processor executes the following: (1) prepares an estimate on the number of microcells that are still inhibited, on the basis of known sensor properties, and based on estimation of the number of previously inhibited microcells prepared during previous time intervals; (2) prepares an estimate on the current sensor sensitivity, which is proportional to the number of currently active microcells. From these data, an estimate on the actual light input to the sensor is prepared, by taking into account the reduced sensor sensitivity due to the number of inhibited microcells.

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The device is directly useful in further processing in research and industrial measurement systems, in medical diagnostic devices and cameras, security systems and all other systems, which have built-in silicon photomultipliers (e.g. in the fields of hazard and threat detection, bio-photonics, high energy physics, LiDAR surveying technology, and so on).

Since the technology aims to reach its full potential in an industrial setting wherever precise sensory SiPM is needed, industrial partners are sought. The technology is in the field of finer mechanics; therefore, technical cooperation is sought in order to facilitate continuous development rather than just routine production. License agreements and / or agreements for technical cooperation will enable the researchers to maintain their focus on the research behind the technology whereas up-scaling to industrial level will be carried out in the industrial partner's setting.

Advantages:

The technical solution reduces the systematic measurement error in determining the intensity of brightness of frequent flashes of light and improves the operation of sensory systems, which have built-in silicon photomultipliers, such as research and industrial measurement systems, medical diagnostic devices and cameras, security systems etc.

The technology was developed in a close collaboration between a Slovenian institute and a Slovenian SME and the knowledge behind the presented device relates to both: the assembly of the device and its operation as well as the algorithms based on correction tables were prepared by a systematic search of parametric space of amplitudes and timestamps.
The researchers are nuclear physicists with competences in spectroscopic measurements of photons by high resolution detectors and active members of global nuclear laboratory scientific networks participating in the planning, execution and analysis of coincidence experiments with polarised electron beams and polarised targets, whereas the Slovenian SME is a top global semiconductor company known for its processor expertise, software and system-wide view competences.

STAGE OF DEVELOPMENT

Prototype available for demonstration

INTELLECTUAL PROPERTY

Patent(s) applied for but not yet granted

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