Institut "Jožef Stefan", Ljubljana, Slovenija

center za prenos tehnologij in inovacij
na Institutu "Jožef Stefan"

Licensing opportunity

Improved operation of silicon photomultipliers in sensory systems

Field of use

Research and industrial measurement systems, medical diagnostic devices and cameras, security systems, 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 etc.).

Current state of technology
Stage of Development: Prototype available for demonstration

Patent status
Secret Know-how

Publication
Secret Know-how

Developed by
Jožef Stefan Institute

Reference
SiPM

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Background

A Slovenian research institute 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.

Description of the Invention

A Slovenian research institute and a Slovenian SME have developed a sensory system based on silicon photomultipliers (SiPM) capable of eliminating the systematic error due to the sensor saturation from the output signal.

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 relatively 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.

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.

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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.

Main Advantages

In the regime of piled-up pulses of light the SiPMs may be subjected to conditions where:
a) A significant proportion of SiPM microcells have been excited by light within a short period of time. Consequently the overall light sensitivity of a SiPM sensor for further incident light is significantly reduced, which is known as "binomial saturation" resulting in non-linear response of the system and its reduced dynamic range;

b) High occurrence rate of the measured light flashes causes overlapping of flashes over time. Consequently the gain of the sensor depends not only on the brightness of the pulse being measured, but also on the temporal dynamics and amplitudes of the most recent preceding pulses.

Binomial saturation and overlapping of flashes over time are compensated by introducing the correctional processor unit into the sensory system device. The analogous signal from SiPM is converted to digital and corrected based on pre-prepared estimation for temporary detector sensitivity.

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.

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