

3rd Generation Photon Counter の検討 3rd Generation Photon Counter

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Outlook

ライダー用高速・高分解のphoton counterを開発したい。
高速...数百~1MHzのパルス送信光に追従する繰り返し周波数
高分解...0.15mをすでに達成。さらなる高分解を目指す。

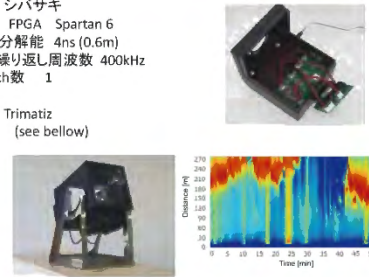
The diagram shows the system flow: 観測信号 (Observation signal) from a PMT (Photomultiplier Tube) goes to a Photon Counter (FPGA), which then outputs 観測データ (Observation data). A graph shows the signal amplitude (V) over time (ms). Another graph shows the signal amplitude (V) over distance (m). A news article snippet from SPIE Newsroom is also included, titled "LED-powered mini-lidar for martian atmospheric dust studies".

3rd Generation Photon Counter

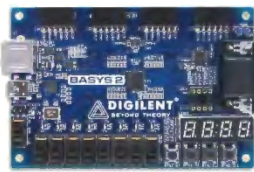
- 高速化は十分 (1MHz = 150mの計測レンジに相当)
- 高分解能化 (1ns 以下、0.1m以下の距離分解能)
- インターフェースを無線化
Bluetooth、無線LANの利用 = システムの遠隔化
- 低消費電力
ボード消費電力 1W以下を目指す。
- 2chの入力、内部外部トリガを踏襲。

Commercialization

- メーカー : シバサキ
: FPGA Spartan 6
: 分解能 4ns (0.6m)
: 繰り返し周波数 400kHz
: ch数 1
- メーカー : Trimatiz
(see below)



Prototype

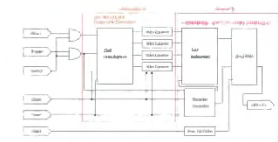


Digilent BASYS 2 (Commercialized products)	
FPGA device	Spartan 3E
System clock	300MHz
EN width	20ns (t=0.0ms)
Number of BRs	31
Maximum counts	65536
Input channel	1
Repetition frequency	50MHz
Interface	-

Architecture

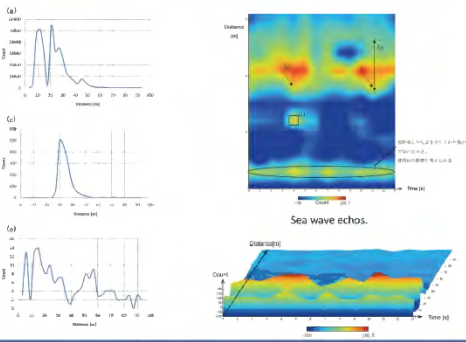


Fundamental architecture of photon counter.



Concrete sketch of signal process on FPGA device.

Results

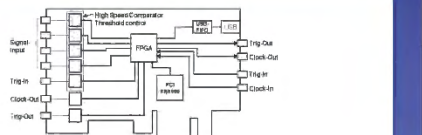


1st Generation



Trimble Photon Tracker I	
FPGA device	Spartan 6
System clock	500 MHz
BN width	5m (=1.75m)
Number of BNs	32,767
Maximum counts	32,767
Input channel	1
Repetition frequency	>300 MHz
Interface	PCI Express

Architecture



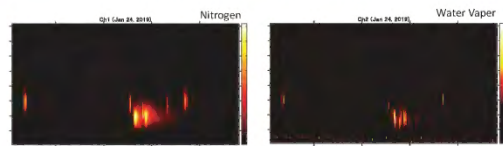
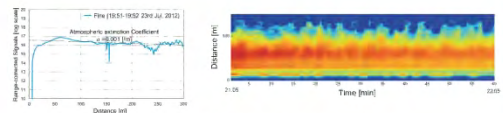
FPGA photon counter board.

Table 1. Main characteristics of Trimble product and comparison table with products from other providers.

Characteristics	Trimble	Makro A	Makro B	Makro C	Makro D
BN width	5m (1.75m or 3m) (30m/30m included)	3.2m (0.8m or 1.6m)	30m	1m	0.5m or 0.2m
Number of BNs	32,767	32,767	4096	16,384	32,768
Maximum	32,767	32,767			
Input channel	1 (1/4/8/12)*	1	1	1	1
Repetition/Freq	300 MHz				
Type	Board	standalone	stand	standalone	board

* Up to 8/12 channels due to the possibility of synchronization between two or three boards.

Results



2st Generation



Trimble Photon Tracker II	
FPGA device	Spartan 6
System clock	500 MHz
BN width	1m (=0.15m)
Number of BNs	32,767
Maximum counts	32,767
Input channel	2
Repetition frequency	>300 MHz
Interface	USB

Architecture



Results

