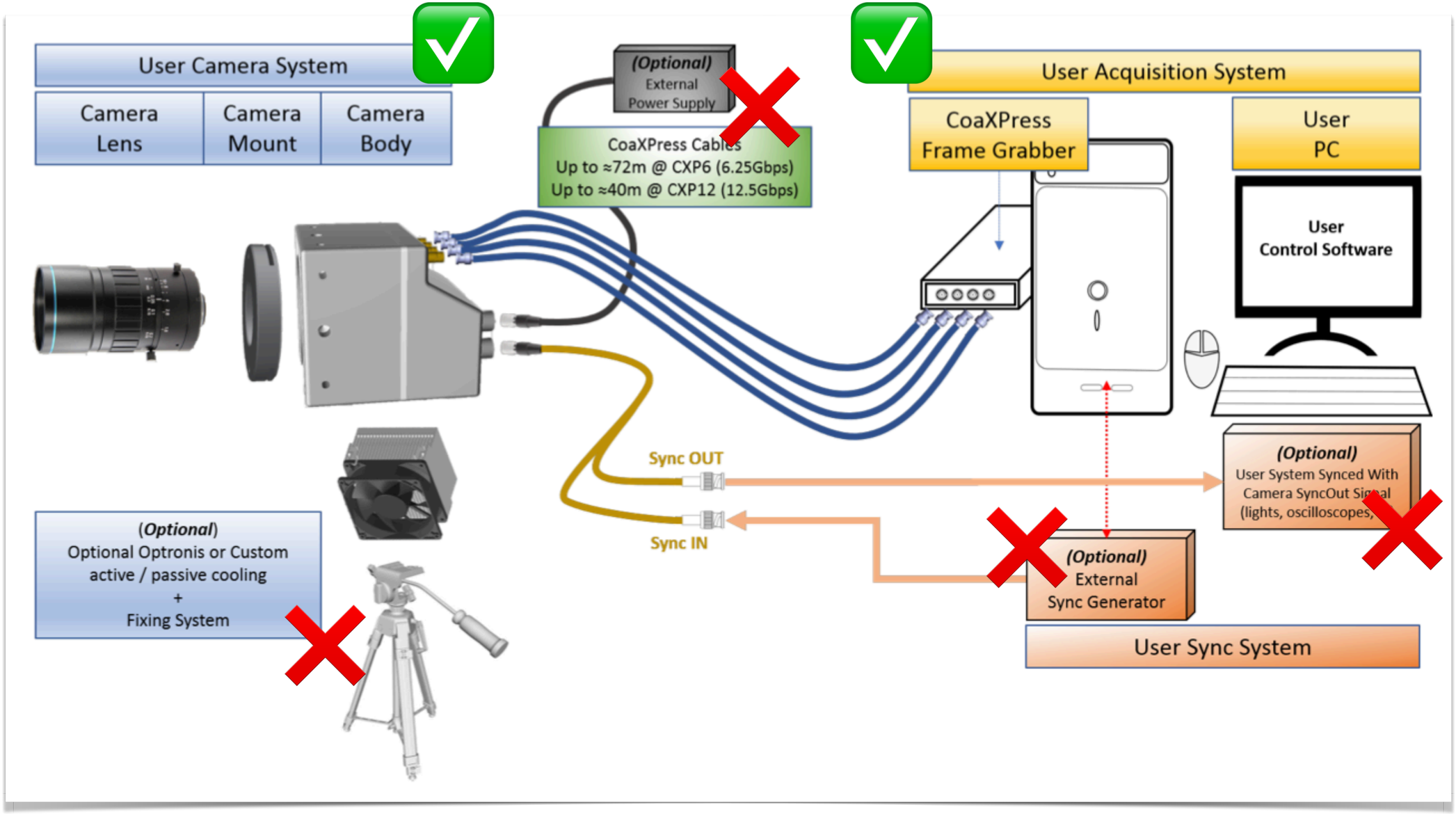
Studio del noise per la camera Cyclone-2-2000M

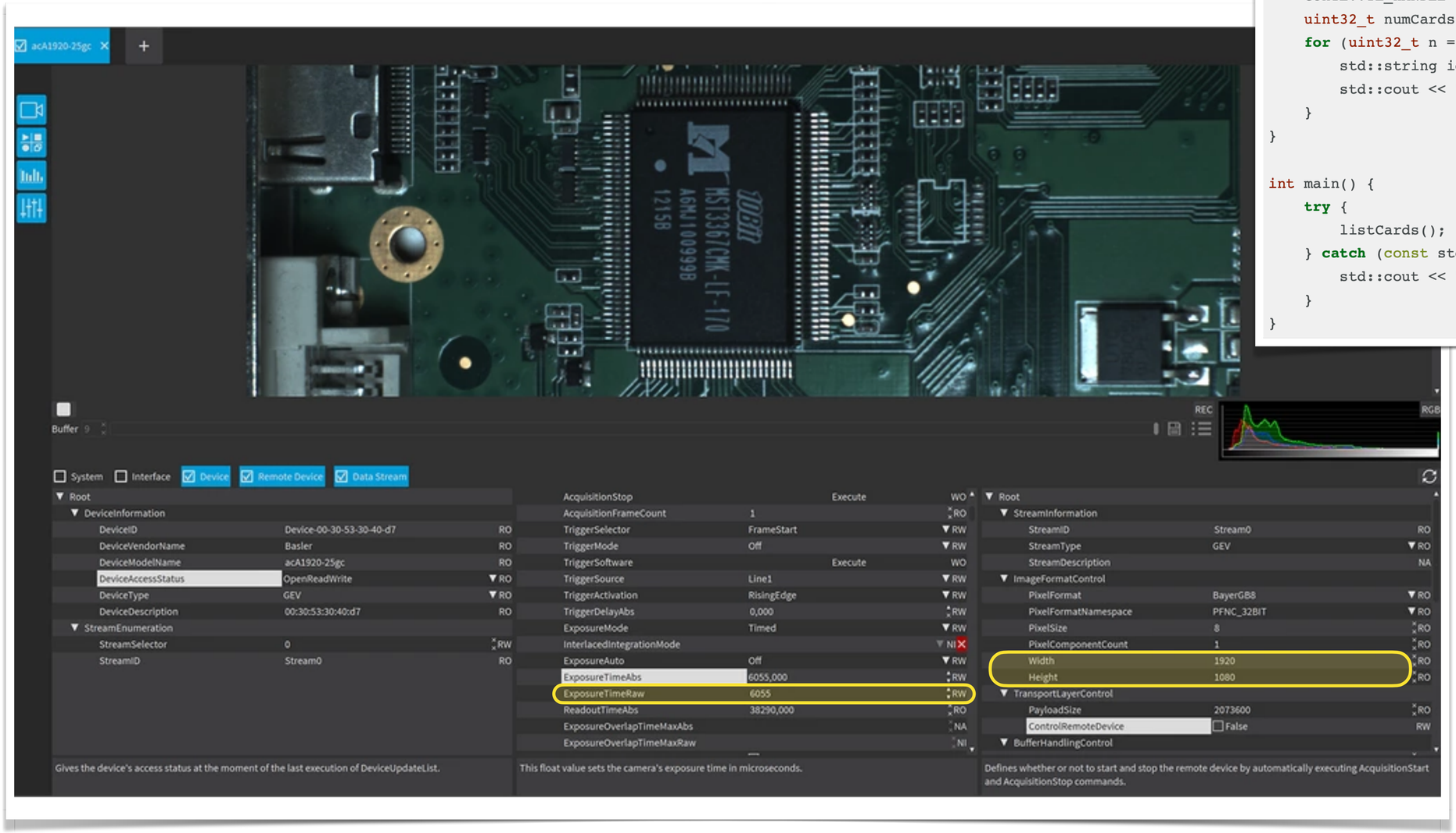
Samuele Lanzi

12/02/2025

Setup


User Camera System
Camera Lens
Camera Mount
Camera Body
(Optional) External Power Supply
CoaXPress Cables
Up to ≈72m @ CXP6 (6.25Gbps)
Up to ≈40m @ CXP12 (12.5Gbps)
User Acquisition System
CoaXPress Frame Grabber
User PC
User Control Software
Sync OUT
Sync IN
(Optional) User System Synced With Camera SyncOut Signal (lights, oscilloscopes,
(Optional) External Sync Generator
User Sync System
(Optional) Optional Optronis or Custom active / passive cooling + Fixing System

eGrabber Studio




```
#include <iostream>
#include <EGenTL.h>

void listCards() {
    Euresys::EGenTL gentl;
    GenTL::TL_HANDLE tl = gentl.tlOpen();
    uint32_t numCards = gentl.tlGetNumInterfaces(tl);
    for (uint32_t n = 0; n < numCards; ++n) {
        std::string id = gentl.tlGetInterfaceID(tl, n);
        std::cout << "[" << n << "] " << id << std::endl;
    }
}

int main() {
    try {
        listCards();
    } catch (const std::exception &e) {
        std::cout << "error: " << e.what() << std::endl;
    }
}
```

Specifiche

PERFORMANCE (EXAMPLES, 8 BIT)

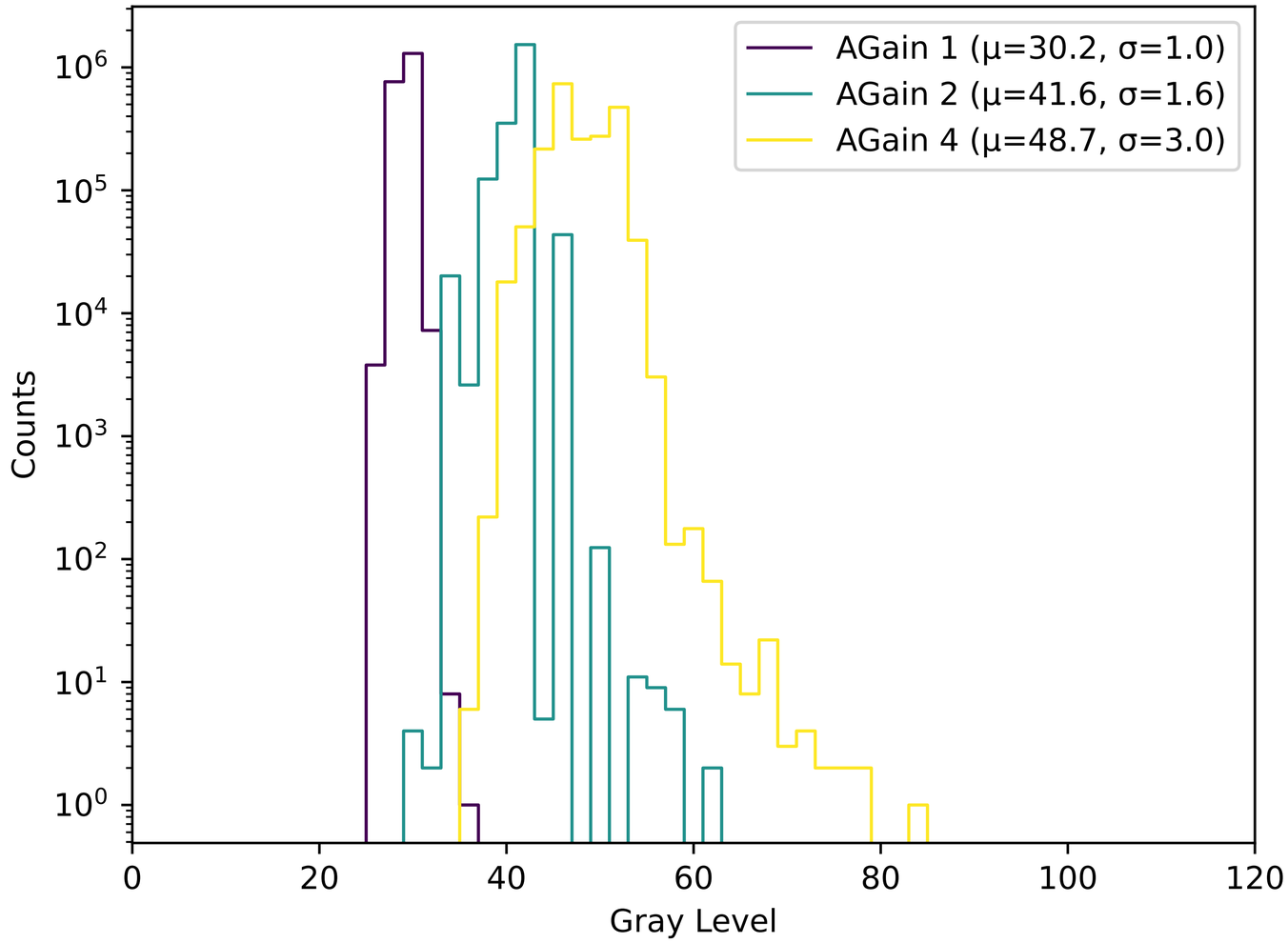
Resolution (HxV)	Frame rate	Resolution (HxV)	Frame rate
1 920 x 1 080	2 166 fps	1 920 x 960	2 435 fps
1 280 x 960	2 587 fps	1 920 x 480	4 840 fps
640 x 480	5 143 fps	1 920 x 120	18 667 fps
512 x 384	6 409 fps	1 920 x 32	61 842 fps
256 x 8	177 935 fps	1 920 x 8	167 504 fps

EMVA1288 measurements (v3.1 typ. preliminary)	
Dynamic range	TBD dB
Saturation capacity	15 000 e^-
Temporal dark noise	10 e^-
System gain	15 e^-/DN
Signal-to-Noise Ratio	50 dB

SPECIFICATIONS

Sensor type	LUX19HS, Global Shutter
Resolution	1 920 pixel x 1 080 pixel
Frame rate (full resolution)	20 .. 2 166 fps
Exposure time	4 µs .. 1 / frame rate
Active area / Diagonal	19.20 mm x 10.80 mm / 22.03 mm
Pixel distance	10.0 µm x 10.0 µm
A/D conversion	8/10 Bit
Sensitivity (sensor)	20 V/lux·s @ 550 nm
Quantum efficiency (sensor)	>45 % @ 550 nm
Synchronization	internal, external, CoaXPress
Synchronization signals	Synch IN and Synch OUT, TTL level, electrically isolated
Interface	CoaXPress 2.0 (4 ch., CXP-12) Micro-BNC (HD-BNC) connectors
Power	12 W, PoCXP, ext.
Temperature Ranges	
- operation, amb., no cooling	0 .. +30°C / 32 .. 86°F
- operation, amb., with CY-HIS	0 .. +40°C / 32 .. 104°F
- operation, amb., with CY-FAN	0 .. +55°C / 32 .. 131°F
- operation, case temperature	0 .. +70°C / 32 .. 158°F

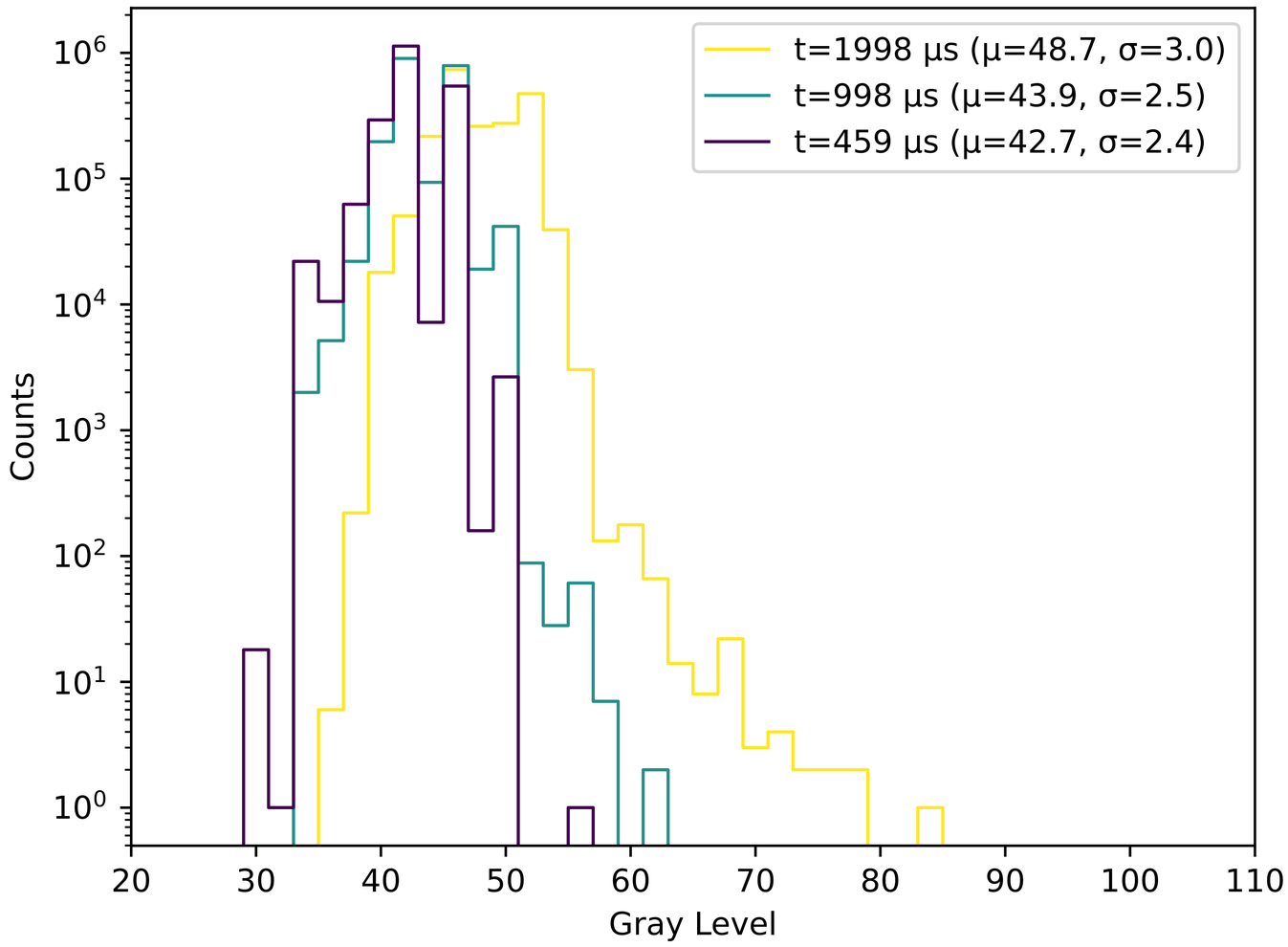
Analisi preliminare - Gray level vs gain



Camera a frame-rate fisso e variando il gain nei suoi possibili valori

Media e deviazione standard crescono all'aumentare del gain

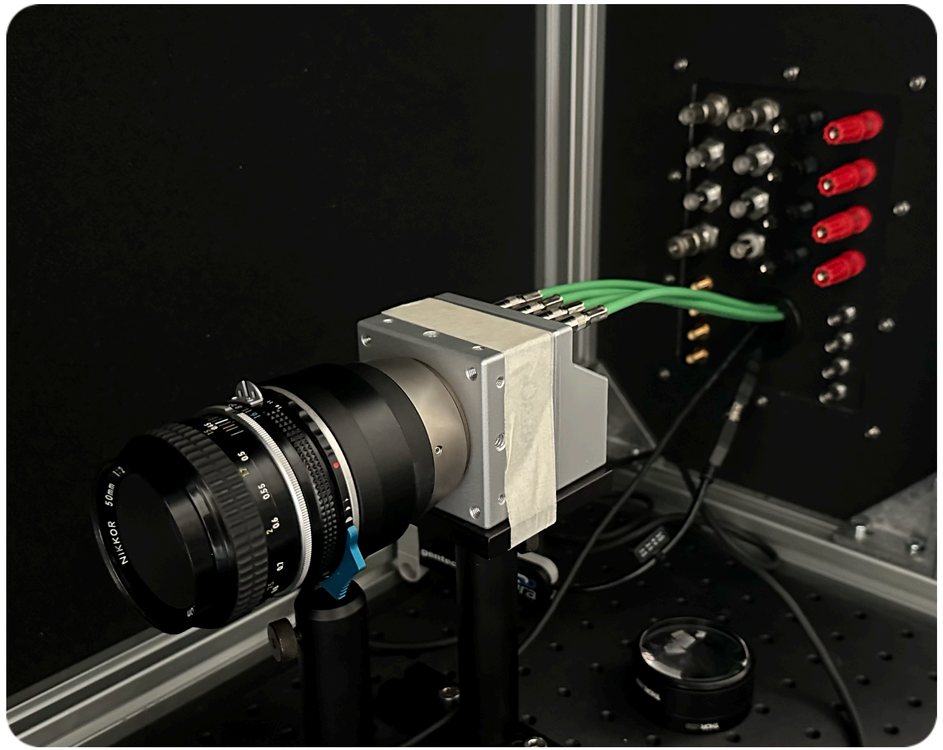
Analisi preliminare - Gray level vs esposizione



Camera a gain massimo variando il tempo di esposizione

Media e deviazione standard crescono all'aumentare del tempo di esposizione

Camera bias



1. Camera tappata
2. Frame rate 2166 Hz
3. 100 frame
4. Stack delle immagini
5. GL medio dello stack

	Mean Bias (GL)	Std (GL)
AGain 1	30,716	0,009
AGain 2	39,824	0,015
AGain 4	42,708	0,017

Camera gain

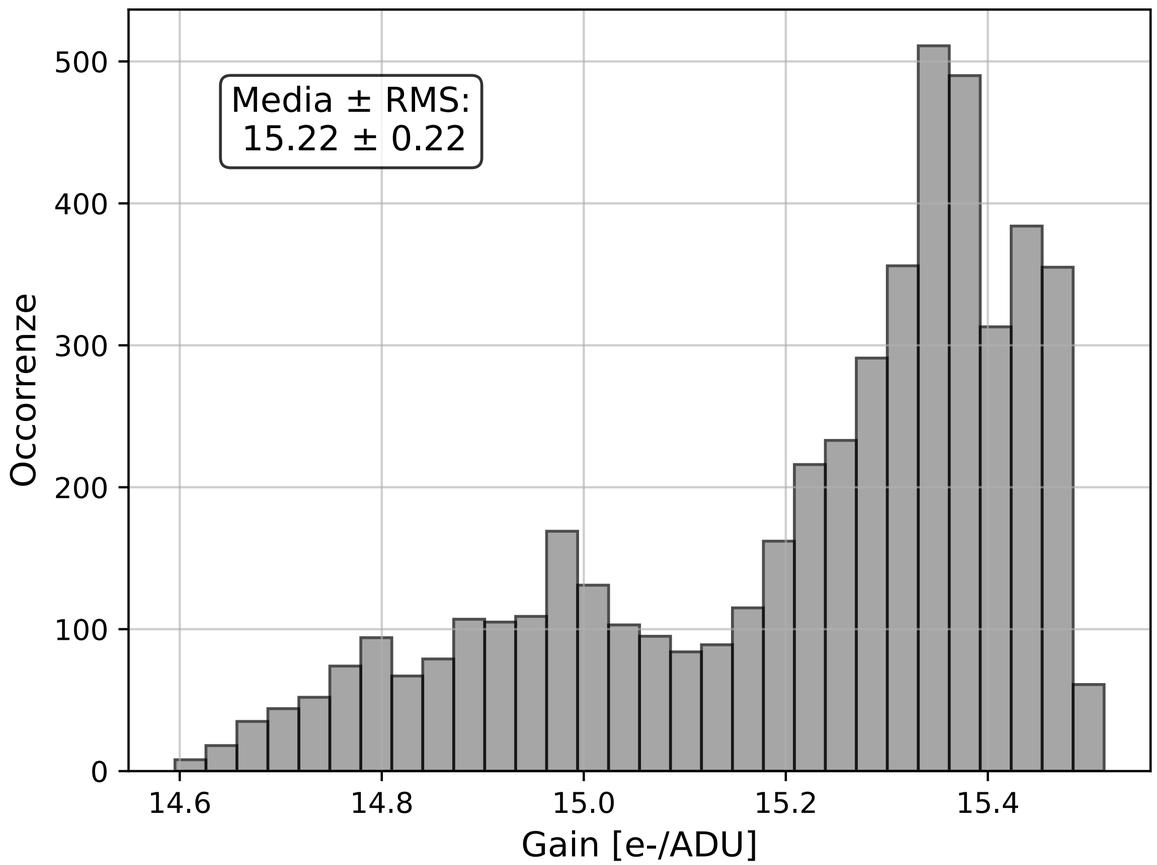
1. 100 frame bias
2. 2 light frame ad esposizione 5 ms
3. Media tra le medie dei light frame $\mu_{1,2}$
4. Differenza tra i light frame
5. Calcolo deviazione standard della differenza σ_{diff}
6. Calcolo della varianza

$$V = \sigma_{diff}^2/2$$

7. Calcolo il gain

$$G = (\mu_{1,2} - \text{bias})/V$$

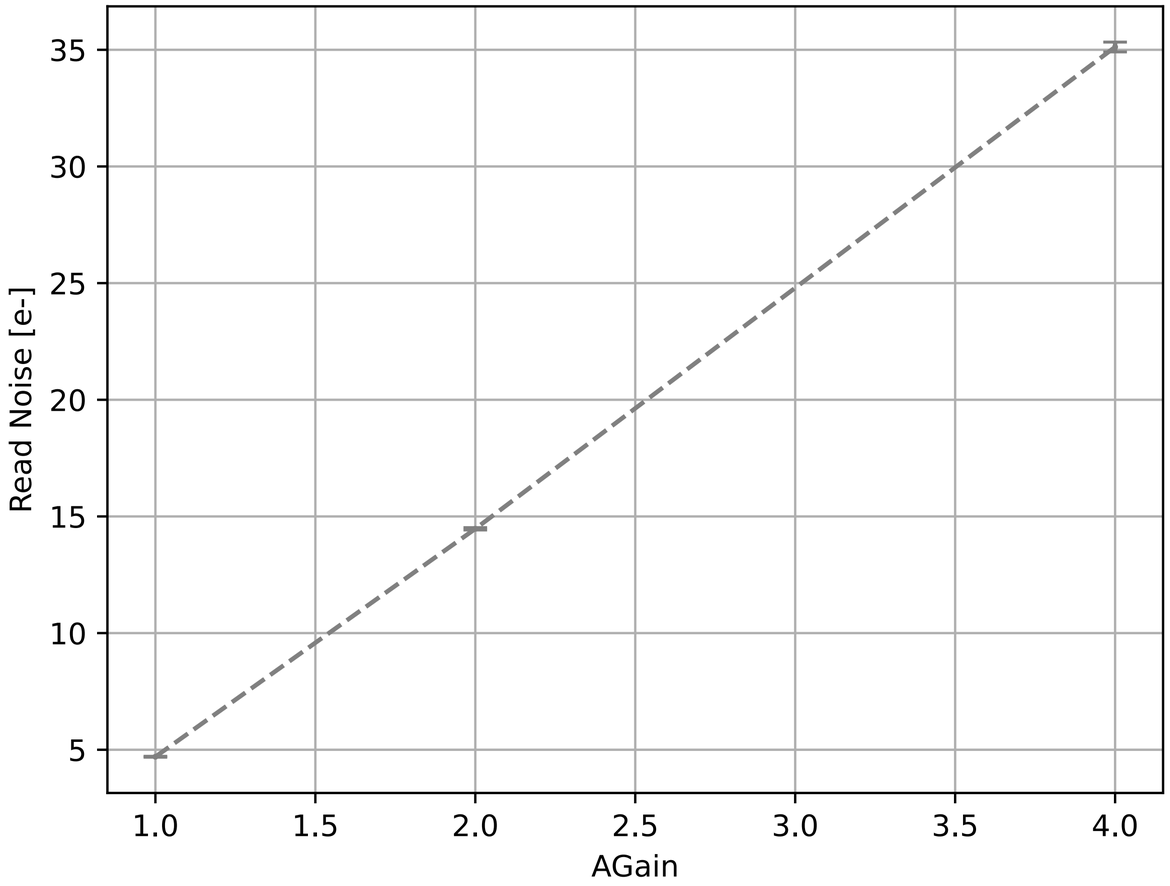
Cambiando ad ogni iterazione le coppie di immagini



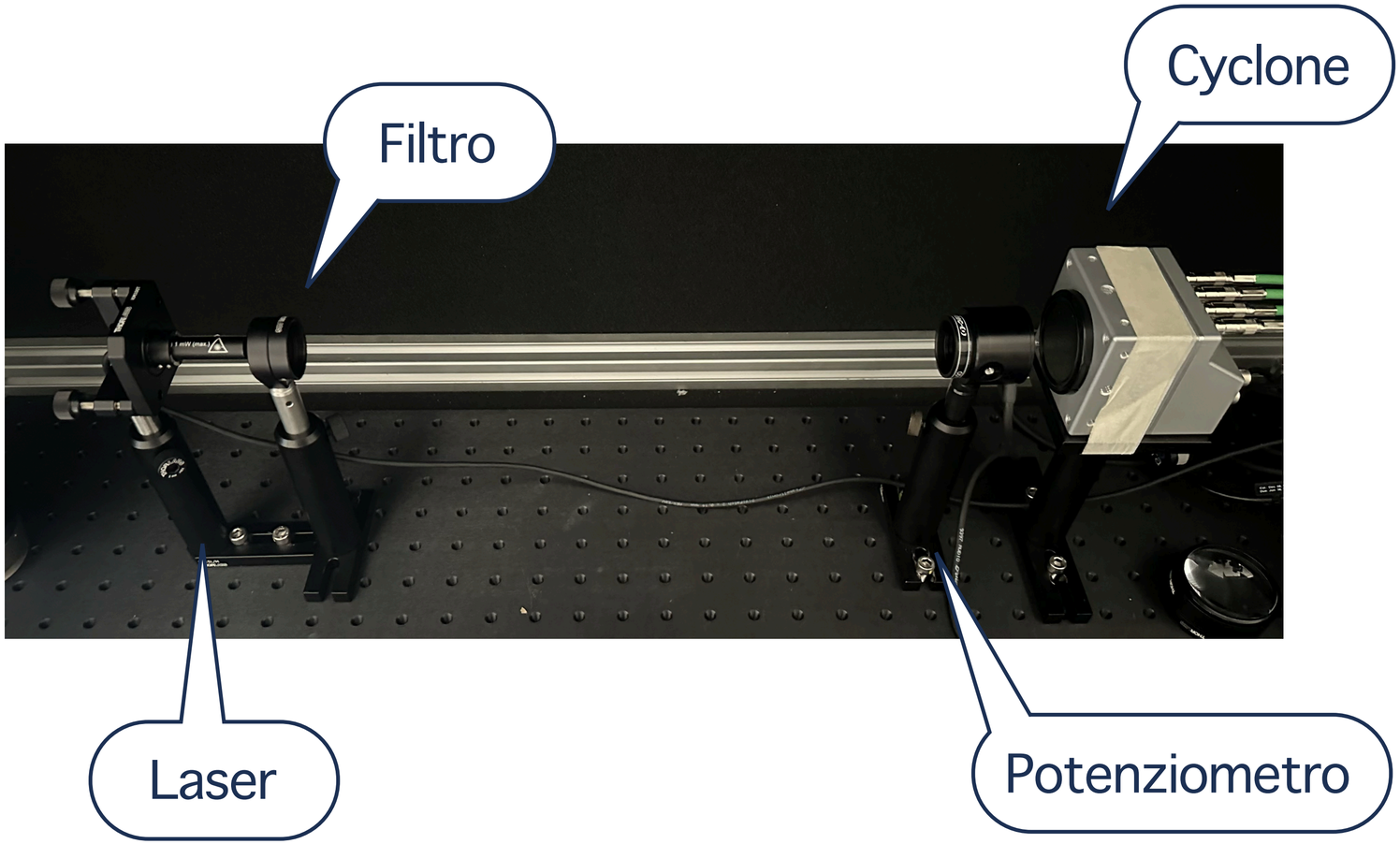
Camera read noise

1. 2 bias
2. Differenza tra i due bias
3. Calcolo deviazione standard della differenza σ_{diff}
4. Calcolo del read noise

$$RN = (\sigma_{diff} G)/\sqrt{2}$$



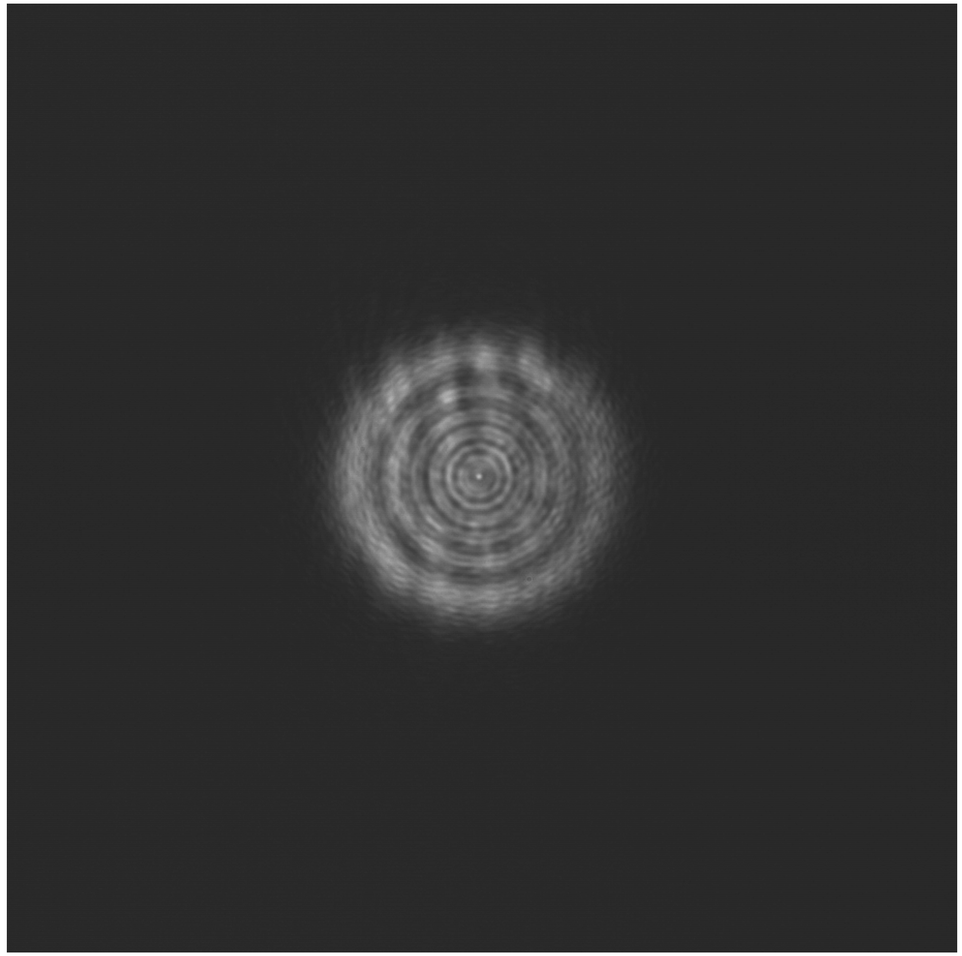
Laser spot

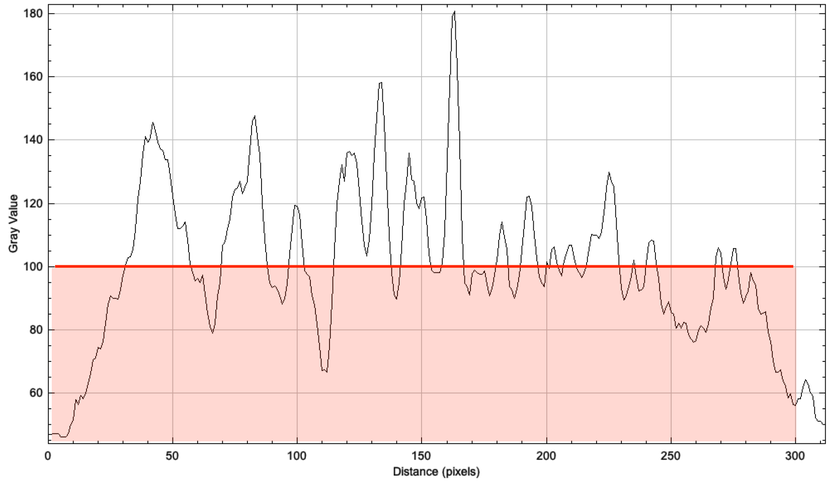


	Potenza
No filtro	106 uW
NE05A-A	32,7 uW
NE10A-A	11,3 uW
NE30A	43,6 nW

0.04 % della potenza iniziale

Laser spot





$(\text{Signal}_{GL} - \text{bias})G \sim 2$ Me-

Da conti fatti sulla potenza del laser dovrebbero arrivare ~ 10 Mγ

Conclusioni

1. La camera **Cyclone** è stata installata con successo.
2. È una camera ad alta velocità, in grado di acquisire immagini fino a **2166 Hz** alla massima risoluzione.
3. Sono state condotte analisi per caratterizzare il sensore, quantificando:
   - **Bias**,
   - **Gain**,
   - **Read noise**.
4. È stata effettuata una prima stima del numero di **elettroni generati sul sensore** dall'illuminazione di uno **spot laser**.
5. Il passo successivo è il calcolo dell'**efficienza quantica (Quantum Efficiency, QE)** del sensore.