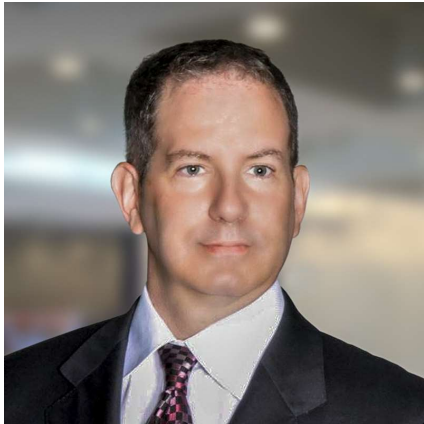




Ready-to-Use Individual High-Performance Modules

Partnering with **Embedded Vision Innovators**

Overview Topics



Mike Faulkner
Sales Manager – The Americas

- ➔ **Who is Photonfocus?**
- ➔ **Trends in machine vision & camera design**
- ➔ **Why do we need spectral bands outside of VISible?**
- ➔ **New interfaces are changing the market**
- ➔ **Camera technologies**
- ➔ **Embedded vision platforms**
- ➔ **Camera trends**

Who is Photonfocus?



Main product lines are

- ➔ Cameras for 2D applications (VIS, UV, SWIR, Hyperspectral)
- ➔ Cameras for 3D applications (VIS, UV)
- ➔ Modular Embedded Systems
- ➔ CMOS sensors

What are we known for?

- ➔ One of the first in the market for CMOS (fast cameras)
- ➔ Designing our own sensors with large full well capacity (@100ke-) vs Sony IMX174 (@32ke-)
- ➔ Being the leader in high dynamic range imaging with our LinLog[®] technology
- ➔ Being the “go-to” camera manufacturer for very difficult applications



Embedded Vision Innovators



Highest Customer Values by Joint Forces of Photonfocus and ISRA VISION

- ➔ 20+ years Vision System Competence
- ➔ Pioneer of Performance Imaging
- ➔ Award Winning Imaging Specialist



- ➔ Enabling Process Optimizing Systems
- ➔ Offering Quality Assurance Gages
- ➔ Managing Big Data Evaluation
- ➔ Suppling Robust, Integrated Sensors

- ➔ ~ 900 Employees, 175 software & 20 hardware engineers
- ➔ Revenues: 154 M€ (2019)
- ➔ More than 30 years experience in machine vision
- ➔ One of the world-leading machine vision innovators



- ➔ Designing Industrial Processes for Industrie 4.0
- ➔ More than 10,000 Installations worldwide
- ➔ Developing Application-Proven Machine Vision Algorithms
- ➔ Trusted Stability and Global Support

Trends in machine vision & camera design we see

Non-Visible

- ➔ Exploring the spectrum: Inspection outside the visible spectrum / human eyesight and RGB camera's capability

Speed

- ➔ New Interfaces and new sensors reach new speed record levels
- ➔ Are line scan cameras becoming obsolete or not?

High-Resolution

- ➔ Large resolution CMOS sensors introduced to the market

3D Preprocessing

- ➔ Future applications in visible and non-visible spectrum, i.e. with UV cameras
- ➔ Intelligent algorithms on-board the camera

Why do we need spectral bands outside of VISible?

- ➔ Our eyes and cameras use the VISible spectrum, we do not see everything
- ➔ Non-VISible camera technology lets us see the invisible
- ➔ **Transparent** materials can be inspected in **UV** because they become non-transparent, e.g. glass
- ➔ **Non-transparent** materials may become transparent in **NIR**, e.g. in pharmaceutical blister packs
- ➔ **Hyperspectral** can help detect characteristic for unique material unlike RGB cameras e.g. for material sorting in distinguishing salt from sugar to foreign material contamination

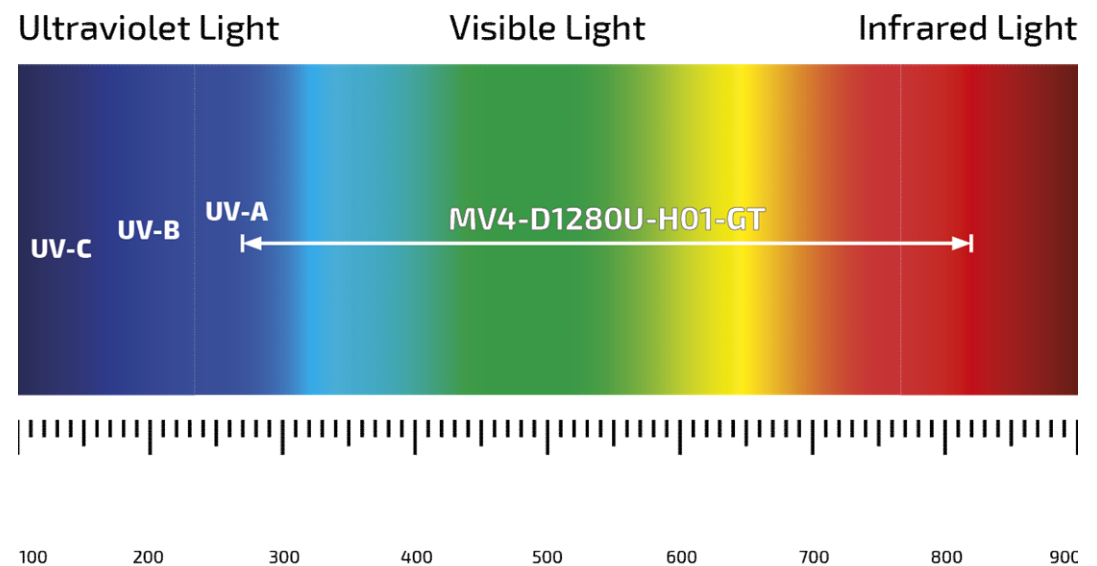


**Modern CMOS sensors are evolving faster than ever,
which allows new applications to be solved!**

Spectral wavelengths and quantum efficiency (QE)

What is quantum efficiency (QE)?

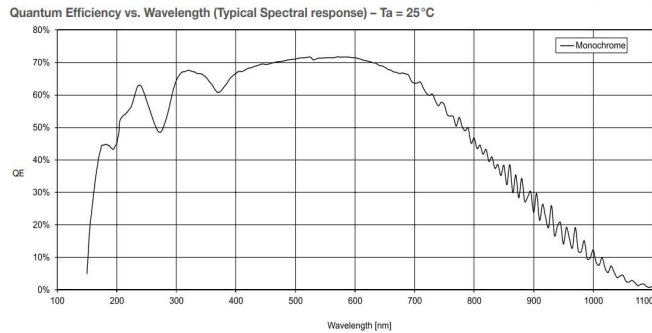
- ➔ How much incoming electromagnetic radiation is transferred into detectable electrons.



**The higher the quantum efficiency,
the more light / electrons are available for analysis.**

Different wavelengths need different sensor materials

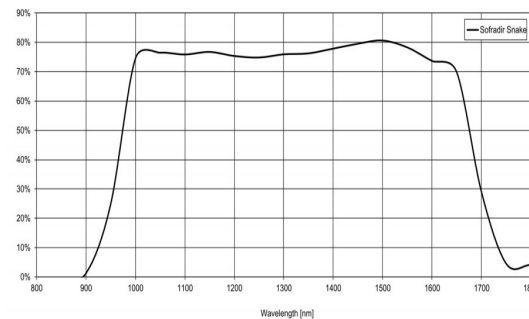
MV4-D1280U-H01-GT



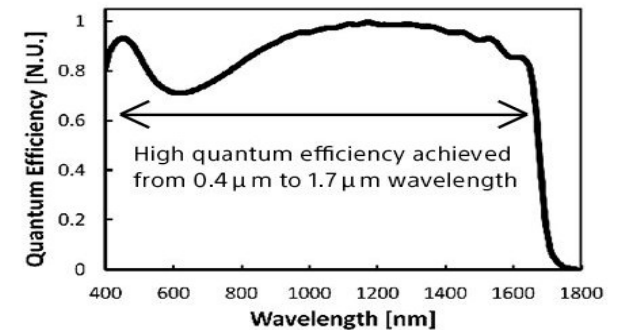
Silicon Sensor
(from 170 nm – 1000 nm)

MV3-D640I-M01-144-G2

Quantum Efficiency Image Sensor



InGaAs Sensor
(from 900 nm – 1800 nm)



SenSWIR IMX990
(from 400 nm – 1700 nm)

A specific sensor technology for your specific imaging requirement.

New interfaces are changing the market

- ➔ **10GigE**, N-BaseT and GigE are the dominant interfaces
- ➔ **25GigE** (and 100 GigE) is under discussion but too new in the market
- ➔ **USB** is popular for single camera, low-cost applications but not considered as industrial-grade standard and thus rarely used
- ➔ **CameraLink** is slowly declining because most of the applications can be switched to 10 GigE
- ➔ **CameraLink HS** is an exception – few customers request it
- ➔ **CXP** is successful in Asia, but European and American markets have slow acceptance
- ➔ **MIPI Camera Serial Interface (MIPI CSI-2)** is gaining traction in low end applications



The GigE family interface is the most flexible and best price / performance ratio for the majority of applications.

New global shutter sensors

High-resolution, high-speed, large sensors and small pixels

Type	Megapixel	Resolution	Sensor Size	Pixel Size	Speed
GSPRINT	21	5120 x 4096	29.5mm (APS-C)	4.5 μm	500 fps @10 bit
GMAX	65	9344 x 7000	2,3"	3.2 μm	71 fps @10 bit
GMAX	103	11276 x 9200	46.6mm	3.2 μm	28 fps @12 bit
IMX411	151	14208 x 10656	66.7mm (Medium)	3.76 μm	4 fps @10 bit

**All resolutions and speeds are available
but beware of your optics limiting your application.**



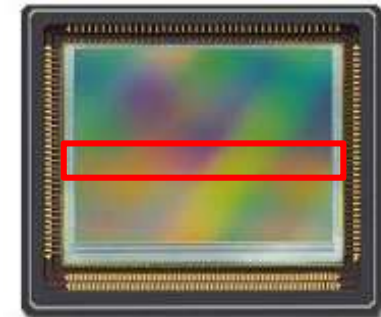
Is line scan technology obsolete?

LINE SCAN

- ➔ Line scan is great for X by infinite Y resolution applications
- ➔ Line scan optics have limited selection, hard to find and expensive

AREA SCAN

- ➔ Area scan cameras offer more flexibility
- ➔ Much greater sensor & camera selection (including non-visible)
- ➔ Area scan cameras can be ROI'ed down to a few pixels in height to increase acquisition speeds
- ➔ Camera focusing is very easy compared to line scan cameras



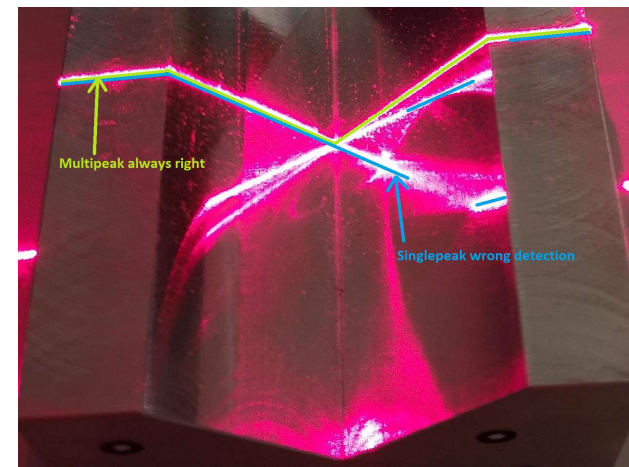
Our conclusion: Use an area scan camera ROI'ed down for maximum flexibility.

Embedded - 3D pre-processing & intelligent algorithms



In camera FPGA algorithm – acquire & process in camera in real-time

- ➔ Larger on-board FPGA allows more powerful pre-processing
- ➔ Offload extreme demands of image pre-processing from the CPU & GPU
- ➔ Permits real-time 3D performance
- ➔ Reduces the need for server-class computers
- ➔ Allows use of “standard” and embedded computers
- ➔ Photonfocus’ MultiPeak 3D FPGA algorithm permits intelligent selection of laser lines on highly reflective materials



Our conclusion: Using the camera’s on-board processing for intelligent functionalities accelerates your application.

Embedded vision platforms for all your needs!



Standard camera models

- ➔ Chose from a wide range of standard cameras



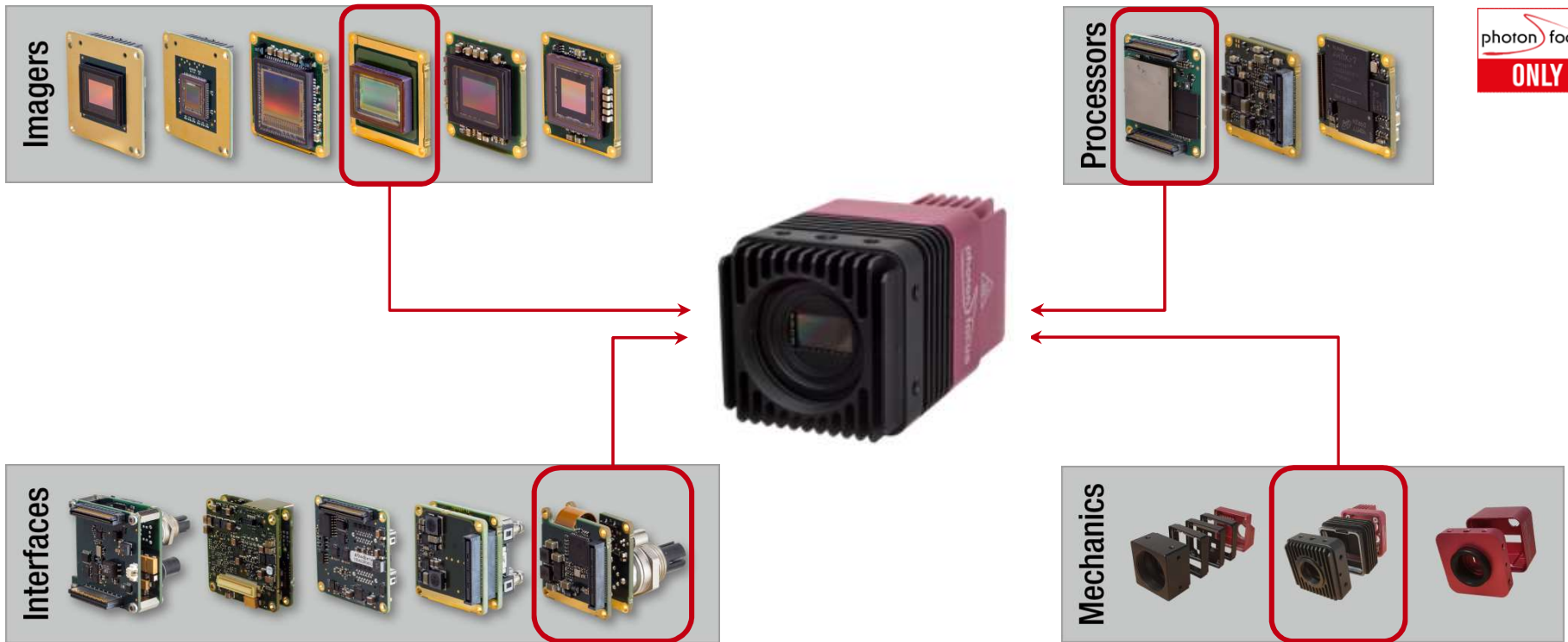
Modular camera set-up

- ➔ Thanks to our modular camera concept, we can quickly and easily adapt to meet your requirements.

Custom-design

- ➔ With 20 years of experience in camera and sensor development, we are ready to discuss your projects!

Intelligent modular camera set-up

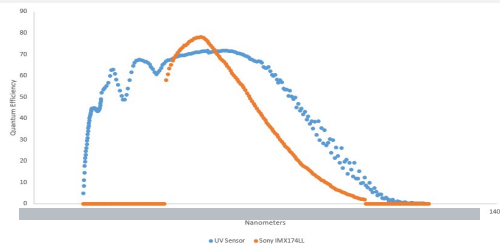


Camera trends

photonSPECTRAL camera platform

UV camera

- ➔ Global shutter & BSI technology
- ➔ Quantum efficiency > 40% in UV and NIR.
- ➔ Broader detection options for Machine Vision applications



SWIR camera

- ➔ High-res with up to 300fps
- ➔ Large 15 μ m pixels with 1200:1 SNR
- ➔ Uniquely up to 256 ROIs for pushbroom applications



Hyperspectral camera

- ➔ “Snapshot” cameras up to 2MP at 42fps
- ➔ Choice of spectral sensors with 4, 16, 25, 120 & 150 bands
- ➔ Spectral range of 400-1,000nm



These non-VIS cameras open a great range of new applications and broader detection possibilities.

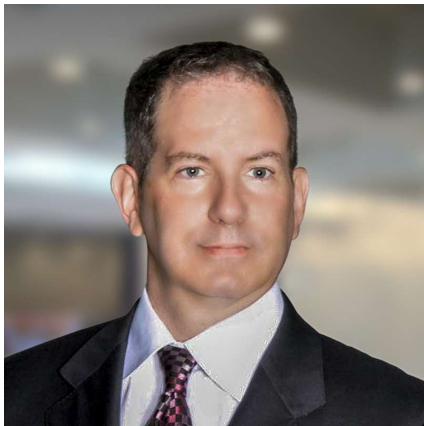
In summary



- ➔ Non-VISible spectrum cameras open new applications for you
- ➔ High-speed is now available at the sensor and at the interface levels
- ➔ High-resolution and speed are now available for mainstream applications
- ➔ Smart, embedded and modular cameras are accessible for smaller and more unique applications

Photonfocus meets your needs on ALL these points!

Contact us!



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Thank you very much for your attention!

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