The lens as a key factor in challenging imaging applications

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- Product Manager Business Unit Industry since 2021
- Studies in electrical engineering
- Career started as an optical designer
- Developed high-end lenses for industrial, photographic and cinematographic applications
- Worked several years as sales engineer and key account manager





Founded in 1913 by Joseph Schneider
Headquarters in Bad Kreuznach, Germany
Worldwide offices in Los Angeles, New York, Shenzhen, Hongkong and Singapore

Fully vertically integrated manufacturing

Development → **Manufacturing** → **Module integration**

Optical design | Mechanical design | Components | Coating | Assembly | Quality inspection

Components of an imaging system

Typically required

Illumination
- Defines spectral range and visibility of features

Lens
- Defines image quality on sensor and system dimensions

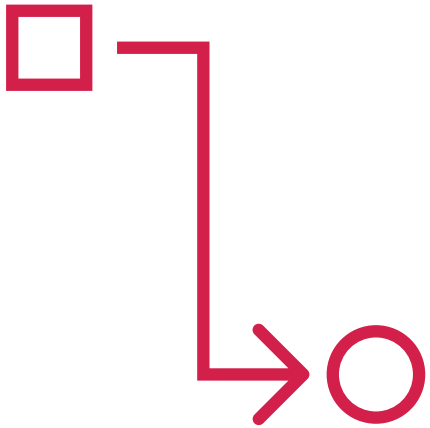
Sensor / camera
- Defines resolution, speed and spectral range

Electronics / software
- Defines image processing features

Typical lens selection process

How it should not be – but often is

- Vision system designers often are no optical experts
- What‘s not known is saved for last
- All components are selected except for the lens
- Finally a lens is chosen which only somehow fits to the rest



The performance of the vision system is not as good as it could be!

What to choose first?

First I chose the …

Illumination
- Oh, there is no reasonably priced lens for this spectral range

Lens
- Oh, the image circle is so small, I don’t find a sensor with enough resolution

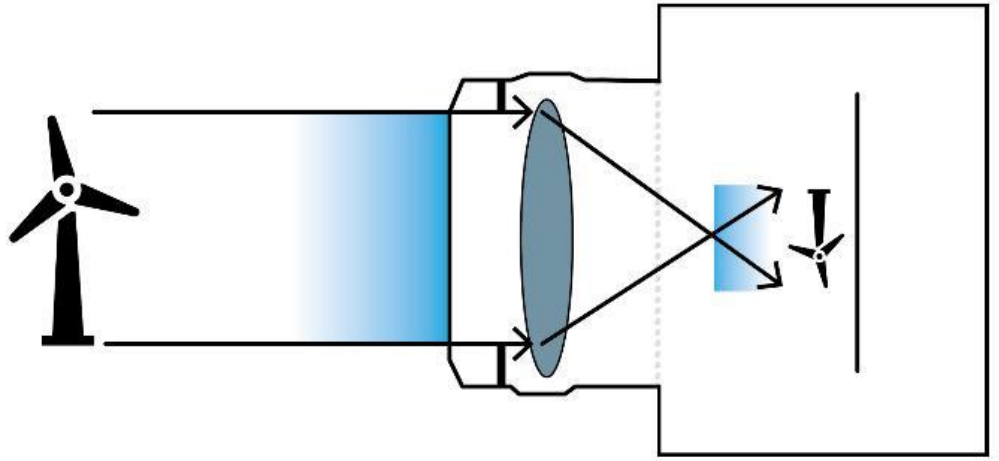
Sensor / camera
- Oh, all lenses that work with this sensor are too heavy for my system

Electronics / software
- Oh, it does not make sense to think about electronics / software when I don’t have a camera yet

What to choose first?

The best option

All components are determined together in a single process in which the advantages and disadvantages of all components are weighted against each other.



The lens selection process

Parameters influencing the choice of lens

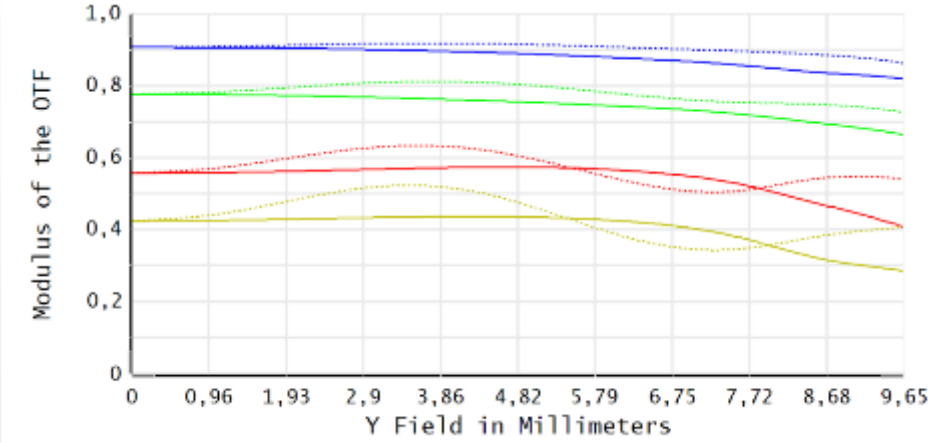
- Sensor and pixel size
- Sensor characteristics
- Mechanical interface
- Object size / Magnification
- Working distance
- Spectral range
- Optical performance
- Light efficiency
- Depth of focus
- Perspective
- Size / weight
- Mechanical stability
- Fixed focal length / zoom
- Motorization
- Availability
- Cost

Example: Object distance and MTF

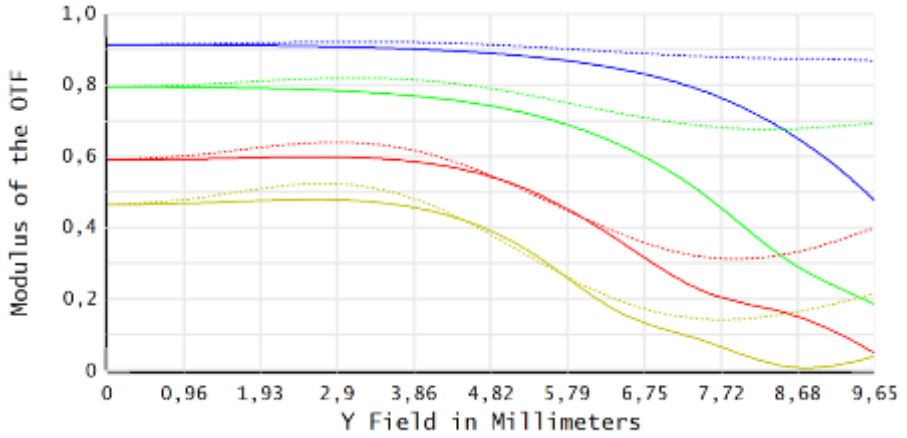
How lens performance depends on working distance

Lenses are typically optimized for a specific working distance range. When used out of this range a dramatic loss of image quality may occur – as shown in below example of the JADE F2.8/25mm lens.

Working distance 500 mm - 20/40/80/120 lp/mm



Working distance infinity – 20/40/80/120 lp/mm

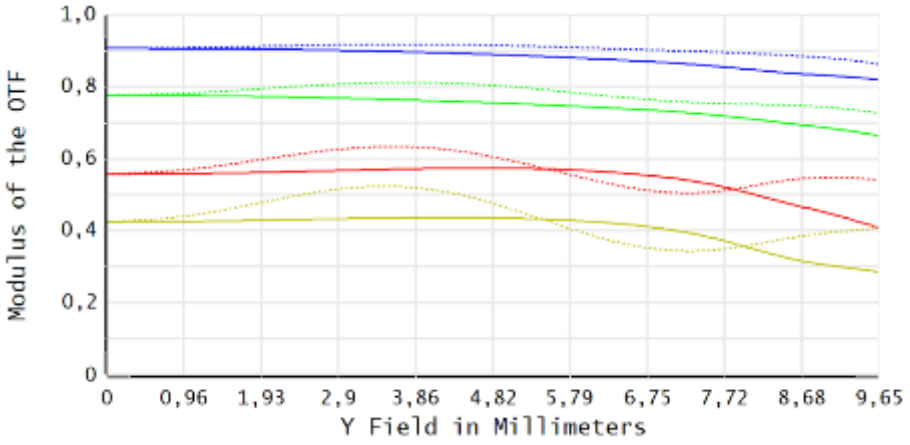


Example: Spectral Range and MTF

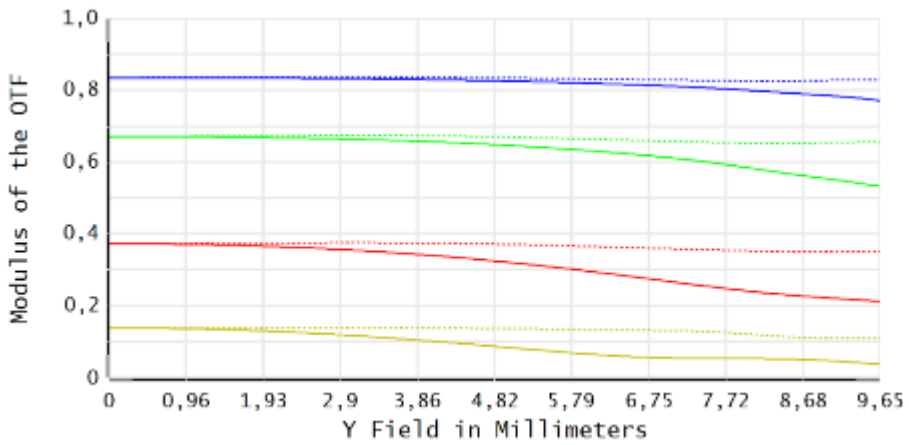
How lens performance depends on spectral range

Lenses are typically optimized for a specific spectral range. When used out of this range a dramatic loss of image quality may occur.

Working distance 500 mm – visible spectrum



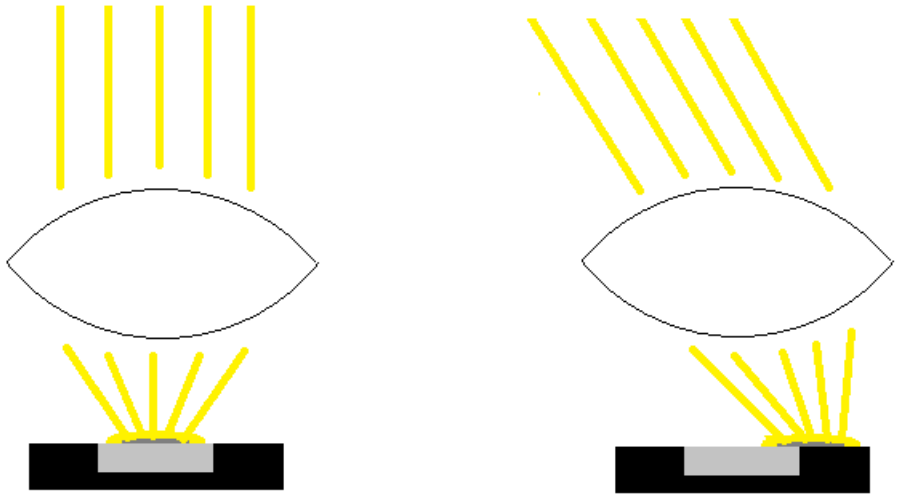
Working distance 500 mm – visible + NIR spectrum

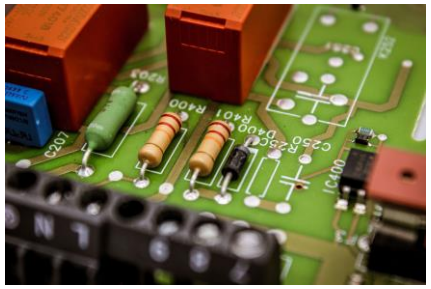


Example: Sensor characteristics

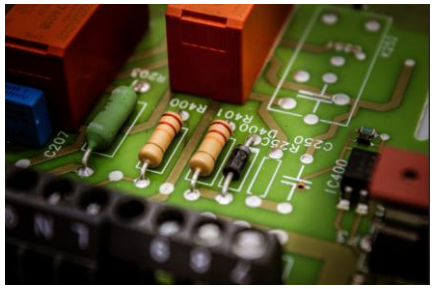
The influence of the chief ray angle (CRA)

Most image sensors are equipped with microlenses on the pixels to increase energy efficiency. However, these microlenses can result in light at a certain angle not being projected onto the effective pixel surface. This results in shading effects at the edges of the image if the lens does not take this effect into account.





Corrected Lens



Uncorrected Lens

Example: Mechanical stability

Standard vs. Ruggedized and Stabilized

The lens may be exposed to high mechanical stress during operation. Or there are particularly high demands on image stability. A standard lens often cannot meet these requirements and special solutions as ruggedized or stabilized lenses are required.

Feature	Standard	Ruggedized	Stabilized
Shock resistance	50g	100g	100g
Secured mechanics	-	+	+
Stabilized image position	-	-	+
Image position hsift <1µm	-	-	+
Vibratin resistance	-	+	+

Summary of key points

Don’t just look at the individual component but above all at the entire system

- Each component of the vision system is a key factor for the final performance
- All components must be technically coordinated to ensure the optimal function of the vision system

Lens selection

- Don’t save the lens for last
- Don’t only consider basic parameters but all crucial lens features when choosing the lens

Contact us

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