

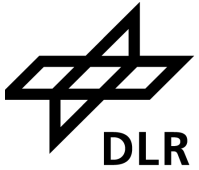
# MiniCAS – A Novel Type of Constellation Acquisition System

GSTM 08.10.2025

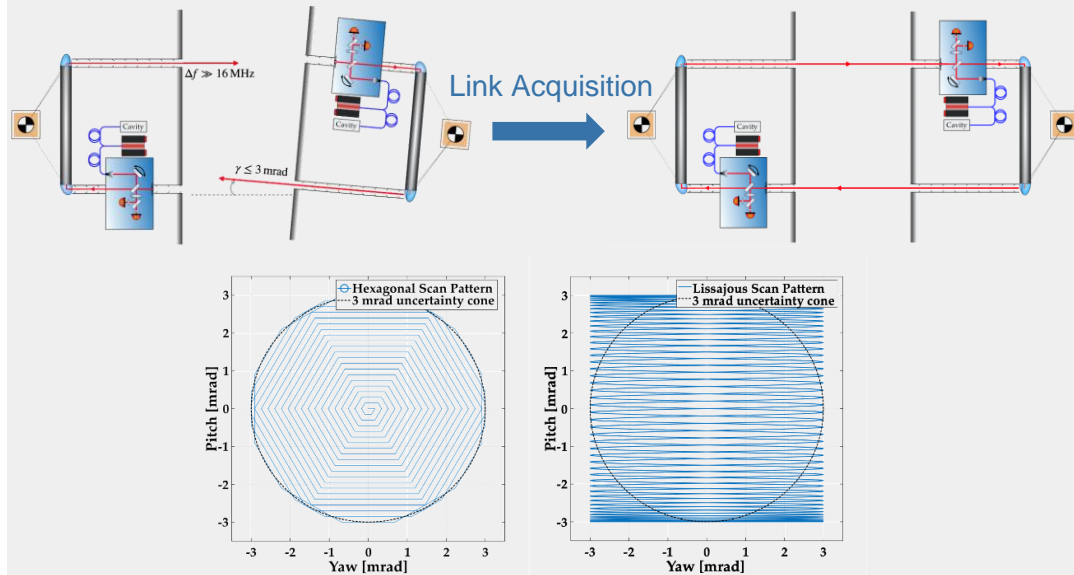
DLR-SI, Julia van den Toren



# MiniCAS – Measurement Principle



## Laser Link Acquisition



- Unknown errors in the estimation of the true line of sight
- Procedure ends after ~9hrs, data is downlinked, processed and pointing commands & frequency setpoints are uploaded
- Frequency differences between the lasers on the two spacecraft
- Missions without an integrated steering mirror cannot conduct this procedure

A. Koch, Dissertation, Leibniz University Hannover, (2020)

## MiniCAS

- Spacecraft A emits a divergent beam covering the uncertainty cone, captured and focused on spacecraft B by lens and InGaAs array.



- If spacecraft A tilts, the beam tilts, the section of the beam that enters the aperture does not show a change in the angle.

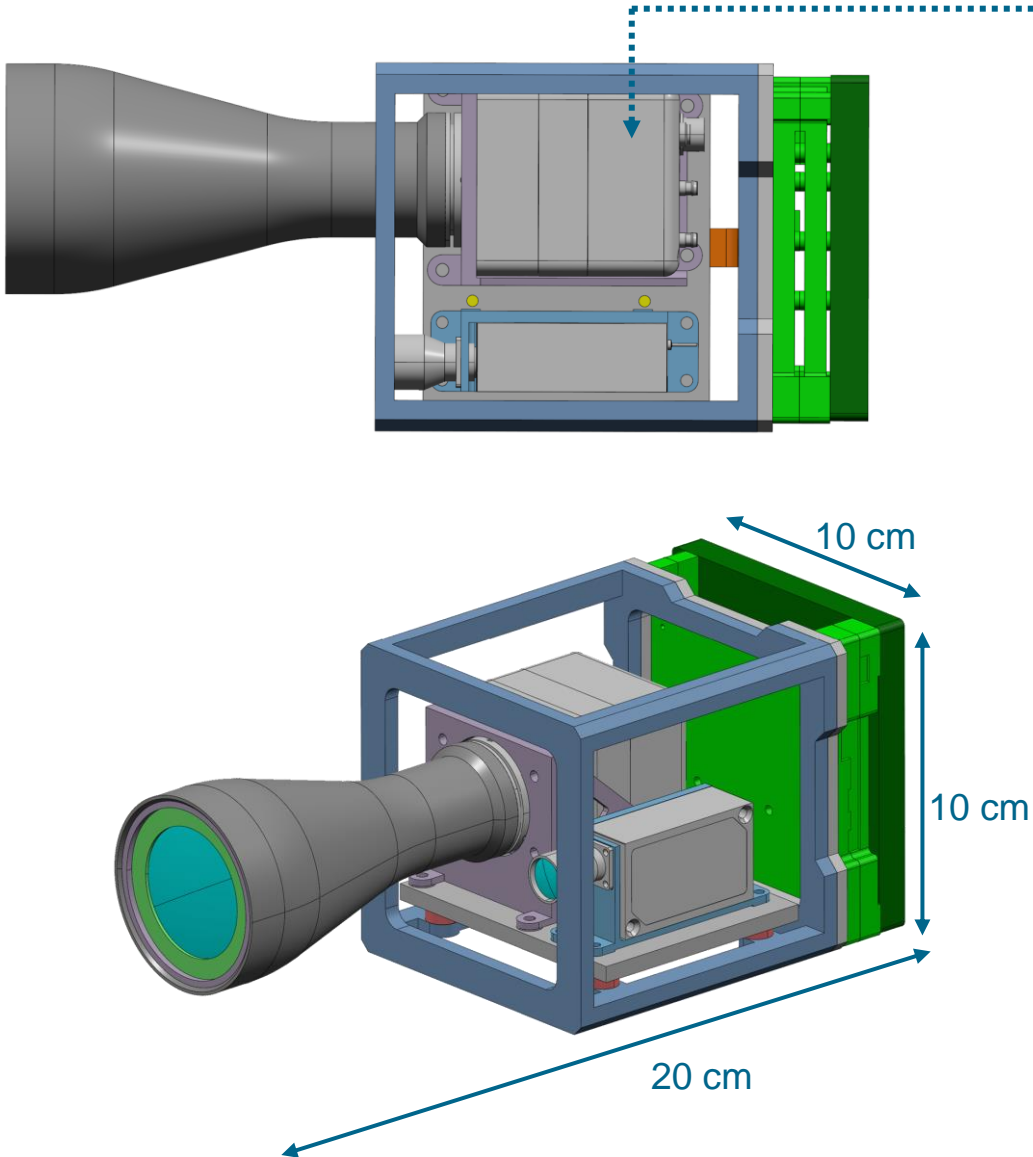
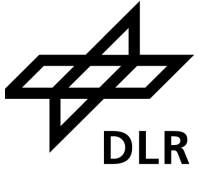


- A tilt of spacecraft B shifts the beam on the sensor, and this displacement provides precise orientation information.

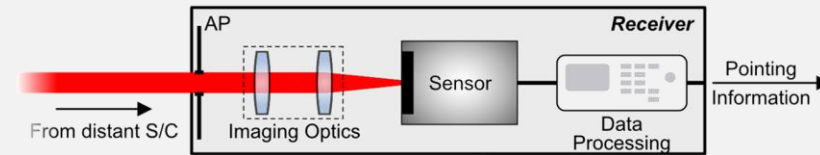


**MiniCAS:** compact optical system enabling instantaneous attitude acquisition with microradian sensitivity

# MiniCAS - Design



## Receiver

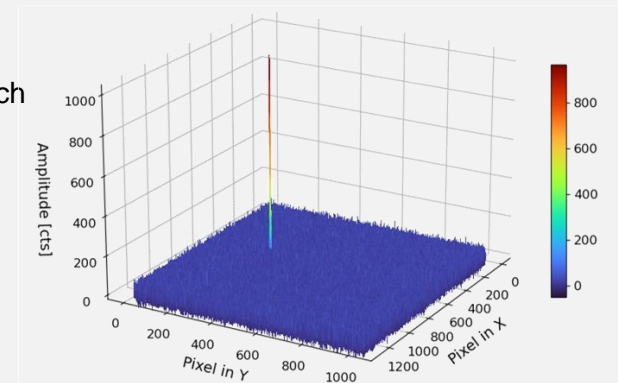
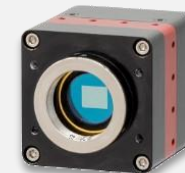


### Lens System:

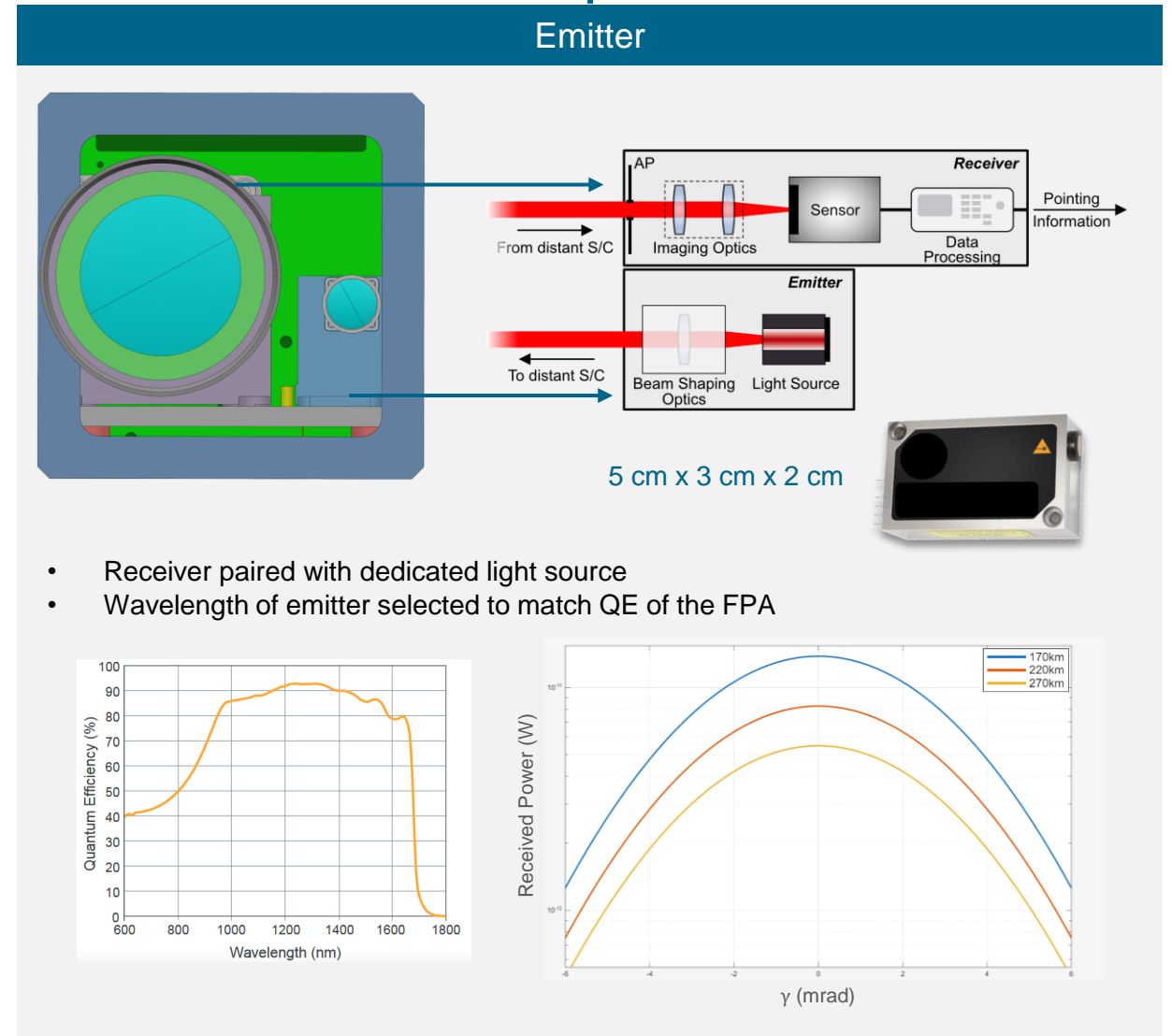
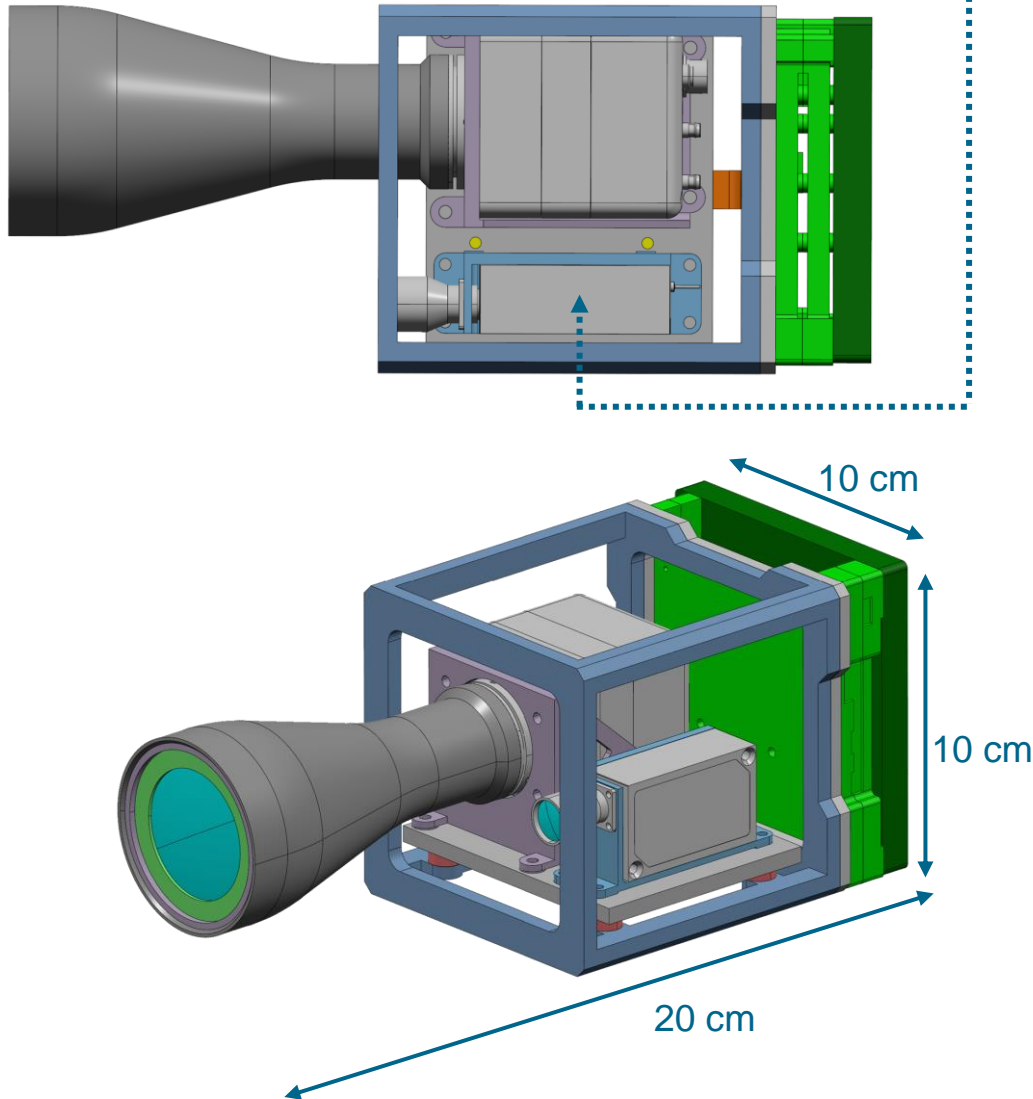
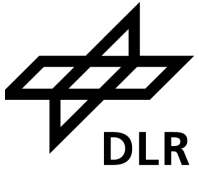
- Simulations to intentionally chose focal length and distances of the lens system to achieve a Spot Size, FoV, and Angular Sensitivity  $3\sigma$  that aligns with requirements

### InGaAs FPA with CMOS ROIC:

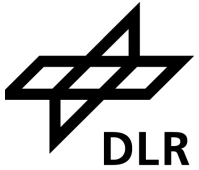
- 1280 x 1024 Pixel with 10  $\mu\text{m}$  pixel pitch
- Spectral response: 0.9 to 1.7  $\mu\text{m}$
- Read noise: 160  $e^-$  LG, 28  $e^-$  HG



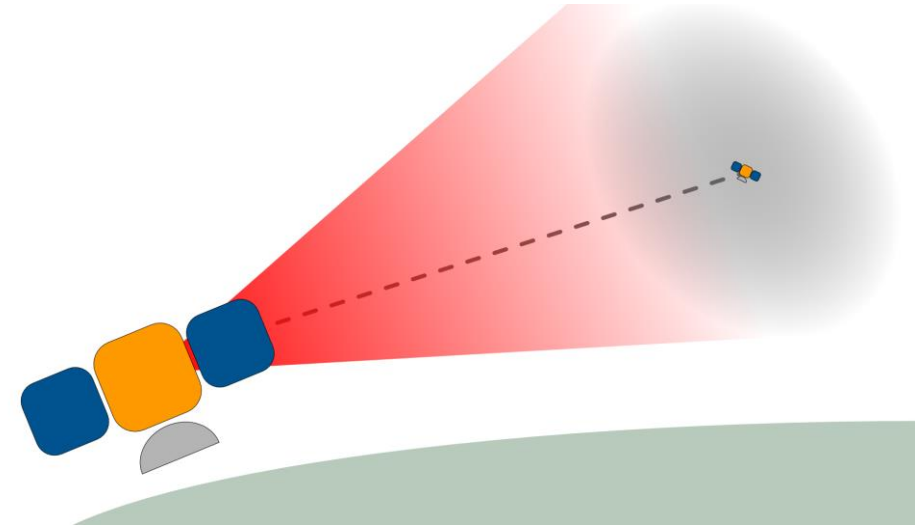
# MiniCAS - Design



# MiniCAS



Property	Preliminary values
Field of View (FoV)	$\pm 5$ mrad
Angular Accuracy	$\leq 10$ $\mu$ rad ( $3\sigma$ random error)
Detector	InGaAs FPA with CMOS ROIC
Output Data Rate	Goal: 10 Hz
Power Consumption	$\leq 10$ W
Mass (Emitter + Receiver)	$\leq \sim 2$ kg
Volume	$\sim 10 \times 10 \times 20$ cm total (Emitter + Receiver)
Nominal Operating Temperature	20°C



- MiniCAS is part of the DLR ADMIRE project with 13 institutes, targeting TRL 5 by 2026.
- Beyond intersatellite laser interferometers, MiniCAS could be applied to aircraft, drones, and structural monitoring.
- Investigations on additional star tracker mode to be added after 2026 are on-going  
→ Potentially beneficial for GRACE-3D scenario

More information  
about MiniCAS see  
our Home page:

