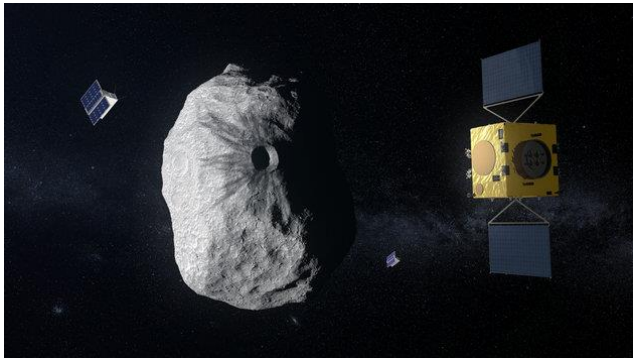
Operational Scenarios



Parameters:

Detector: 1024x768

Bit depth 16

Focal length: 135 mm => FOV 7.39 x 5.54 degrees, GSD 1.2m @ 10km

Diameter Didymos: 775m Didymoon: 163m, separation 1.18 km

Rotation Didymos: 2.26hrs, secondary period: 11.92 hrs

Things to be considered:

- Responsivity and offset variations: measurements of on-board BBs
- Stabilization time of the sensor and its implication on how to obtain a “science image”
- How to operate the instrument to get the best SNR in terms of sampling and measurement time

The above will need to be established from our test campaign but may be already known from earlier work with the ULIS pico 1024 sensor.

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Operational Scenarios – GNC measurements

GNC measurements:

- The requirement [TIRA_TEC_REQ001] is to retrieve images at a frequency > 1 frame/s. 1 image per second is likely a too high strict for the GNC purpose. This is clearly an upper limit as the AFC has 60 s between 2 image acquisitions
- There are 2 ways of using the images:
  - when the asteroid is fully covered: determine center of brightness.
  - In close by operations use features to track the movement. For the latter it is important to be able to have a high as possible contrast of the surface features. We thus need:
    - Sufficient angular resolution
    - As high as possible bit depth
    - Good flat-field (non-uniformity response correction) accuracy (Absolute radiometry is not important for GNC)
- We deliver an image, corrected for offset and non-uniformity (Further needed data processing is handled by the GNC team).

Operational Scenarios – Science measurements

Requirements:

- TIRA shall enable the retrieval of the surface temperature with an accuracy of < 5K over the range 200 – 400 K.
- Spatial resolution <3m at 8 μm from 10 km

For the above we need to take images of Didymoon at a TBD interval (depending on Mission Phase). The images need to be radiometrically calibrated, which will need measurements of the calibration “sources” (shutter closed) before and after the science measurement.

Typical duration of a measurement is in the order of a second => No impact of movement of satellite/asteroids (rotation on own and mutual axis) is expected.

Özgür you can add here more info

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Operational Scenarios – Measurements

Observation:

- To determine the responsivity and offset, each on-source measurement is preceded by a measurement of the “high emissivity” calibration source and followed by a “low emissivity” calibration source measurement. *We now assume the same for both GNC and science measurements (TBC)*

  => 3x1024x768x16bit = 37,8Mbit

- Questions/remarks:

- This is assuming 1 staring image, possibly the image quality can be increased by taking “raster measurements” (this is only the case for science measurements). For 4 raster positions: 3 additional images => doubling the data amount
- We are assuming that we do not perform on-board data processing for the science measurements. Unclear what we need to do for the GNC. Is the offset and non-uniformity correction performed on board?

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ANNEX 1. DATA VOLUME SUMMARY (NOMINAL MISSION)

	ECP (Mb/day)	DCP#1 (Mb/day)	DCP#2 (Mb/day)	DCP#3 (Mb/day)	ELP (Mb/day)	Total (Gb)
Duration (day)	*30*	*30*	*30*	*45*	*30*	*165*
AFC	*1 frame/30 min (32 h/day) 14 bit/pixel (no compression)*	*1 frame/h (ROSETTA) No windowing/no compression*	*No windowing/ no compression*	*No windowing/ no compression*	*No windowing/ no compression*	
Navigation	**469.8**	**234.9**	**234.9**	**234.9**	**234.9**	**45.8**
"Hot redundancy" 1 AFC for navigation 1 AFC for science	*D1: 2936 Mb D3: 910 Mb D6: 1761 Mb*	*D1: 2936 Mb D6: 1761 Mb D9: 8631 Mb*	*D4: 9450 Mb*	*D1: 2936 Mb D2: 440 Mb D5: 440 Mb*	*As DCP#3*	
AFC data volume	5607	13328	9450	3816	3816	36.0
Science	**186.9**	**444.3**	**315.0**	**84.8**	**127.2**	**36.0**
TIRI 1024 X 768 pixel 12 bit/pixel No filters	*585.105408*	*585.105408*	*0*	*226.492416*	*226.492416*	1.6
TIRI	**19.5**	**19.5**	**0.0**	**5.0**	**7.5**	**1.6**
PALT	*Out of range (TBC) HK only*	*16 h measurements*	*16 h measurements*	*16 h measurements*	*16 h measurements*	
Range	**0.0**	**7.2**	**7.2**	**7.2**	**7.2**	**1.0**
Cubesat	*HK only*		*16 h comms @ 200 kbit/s is too conservative*	*AFC + TIR + PALT???*		
ISL	**0.0**	**0.0**	**322.2**	**97.0**	**141.9**	**18.3**
TOTAL (per day)	**676.2**	**705.9**	**879.3**	**428.9**	**518.8**	
TOTAL SCIENCE DATA VOLUME						**102.7**

Data volume – Ozgur To be updated?

- For data volume considerations.
- ECP: (~20 km)
  - Didymoon shall be imaged every 30 deg. in longitude, from 5 equatorial and mid-latitudes, and from both poles. This is a total of (12x5+2) 62 images, corresponding to 780 Mbits with 16 bit.
  - Baseline: 62 images, corresponding to 780 Mbits /585 Mbits ?
  - Options : 12 orbital phase + 2 polar) x3 = 42 = 585 Mbits What about Phase angles ?
- DCP1: (~10 km)
  - Baseline: 62 images, corresponding to 585 Mbits
  - Req : 12 orbital phase + 2 polar x3 = 42 / Phase angles ?
  - Req: 12 images: 151 Mbits (1024 *768 pixels * 16 bits /pixel * 2 observations per flyby * 6 flybys)
- DCP3: (~5 km)
  - 12 observations :
  - 151 Mbits (1024 *768 pixels * 16 bits /pixel * 2 observations per flyby * 6 flybys)