

Elphel-Eyesis 4π

360° Panoramic Imaging System



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Elphel - Eysis 4 π

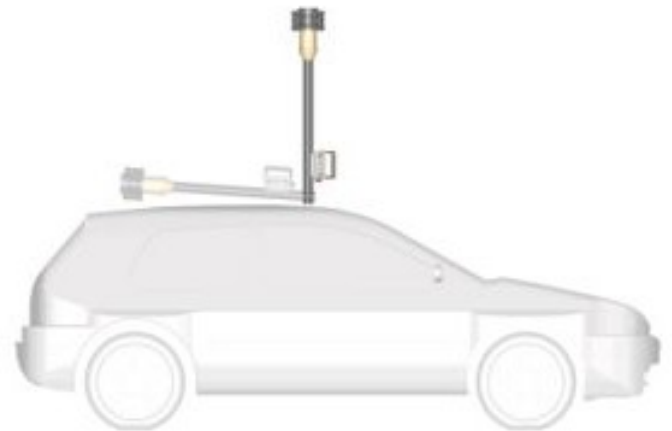
360° Panoramic Imaging System

Introduction

Elphel-Eysis 4 π is the second generation Panoramic Imaging System by Elphel Inc. It is able to capture high-resolution images in full 360 degrees and create 4 π spherical panoramas at a high frame rate. It is powered by 100% free software and open hardware.

Application

Elphel-Eysis 4 π is a complete solution for recording high resolution digital panoramic images. The actual recording device consists of a weatherproof camera head that contains the image sensor front-ends and lenses in spherical distribution to cover the entire 360 degree area. The rest of the electronic components as well as the SSDs for data storage are contained inside the camera pole. Camera head and pole are meant to be mounted on top of a vehicle or can also be carried around for backpack applications.



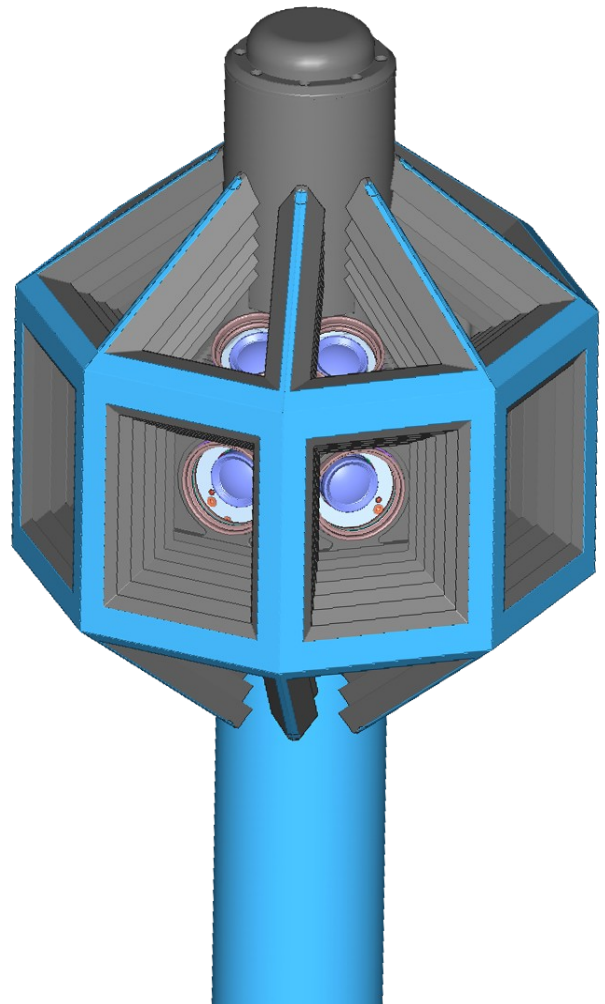
Camera Parameters

- 24 or 16 Sensors (5 Mpix each) *
- Uniform Resolution
- Resolution total - 64 or 48 Mpix (120 or 80 Mpix before stitching) *
- Up to 5 FPS at full resolution
- Up to 11 hours of recording at full resolution
- GPS powered geotagging
- Internal Measurement Unit (IMU) - 2400 recorded measurements per second
- Precise (1 μ s resolution) image capture synchronisation
- Images are synchronized with IMU & GPS
- Odometer / Pedometer Input
- Recording:
 - internal to 8/6 SSDs*
 - external over the Network
- 24/16 High Resolution Lenses *
- Optical Layout eliminates stitching errors caused by ERS distortion
- Raw or JPEG image format
- Weatherproof
- Power Consumption - 80W
- Web Based Recording GUI
- Free Software and Open Hardware

* differences between model:

Elphel-Eyesis 4 π -24

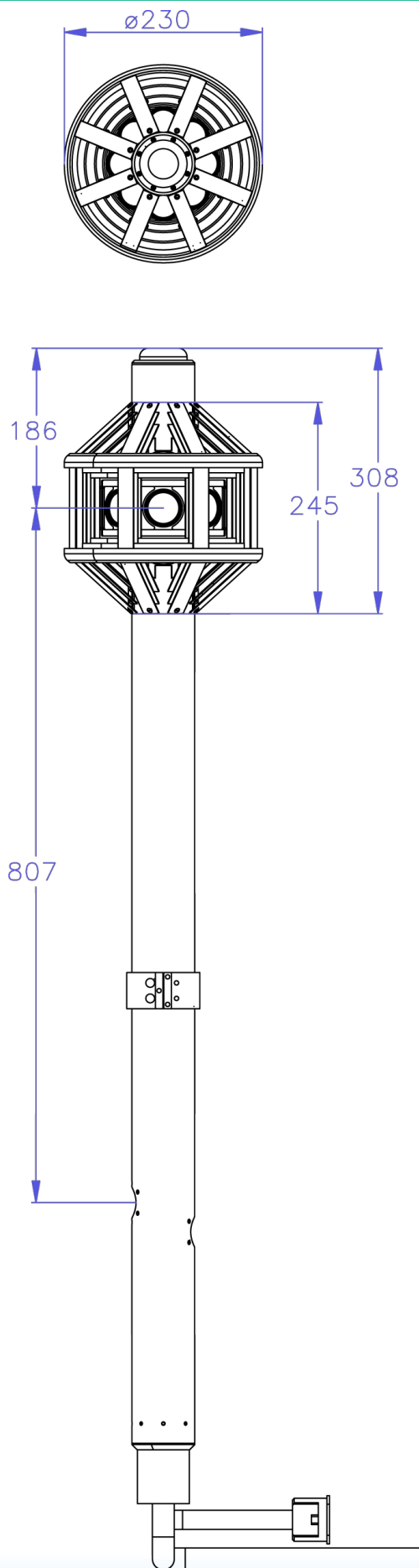
Elphel-Eyesis 4 π -16



Elphel-Eyesis 4 π Camera Head CAD Render

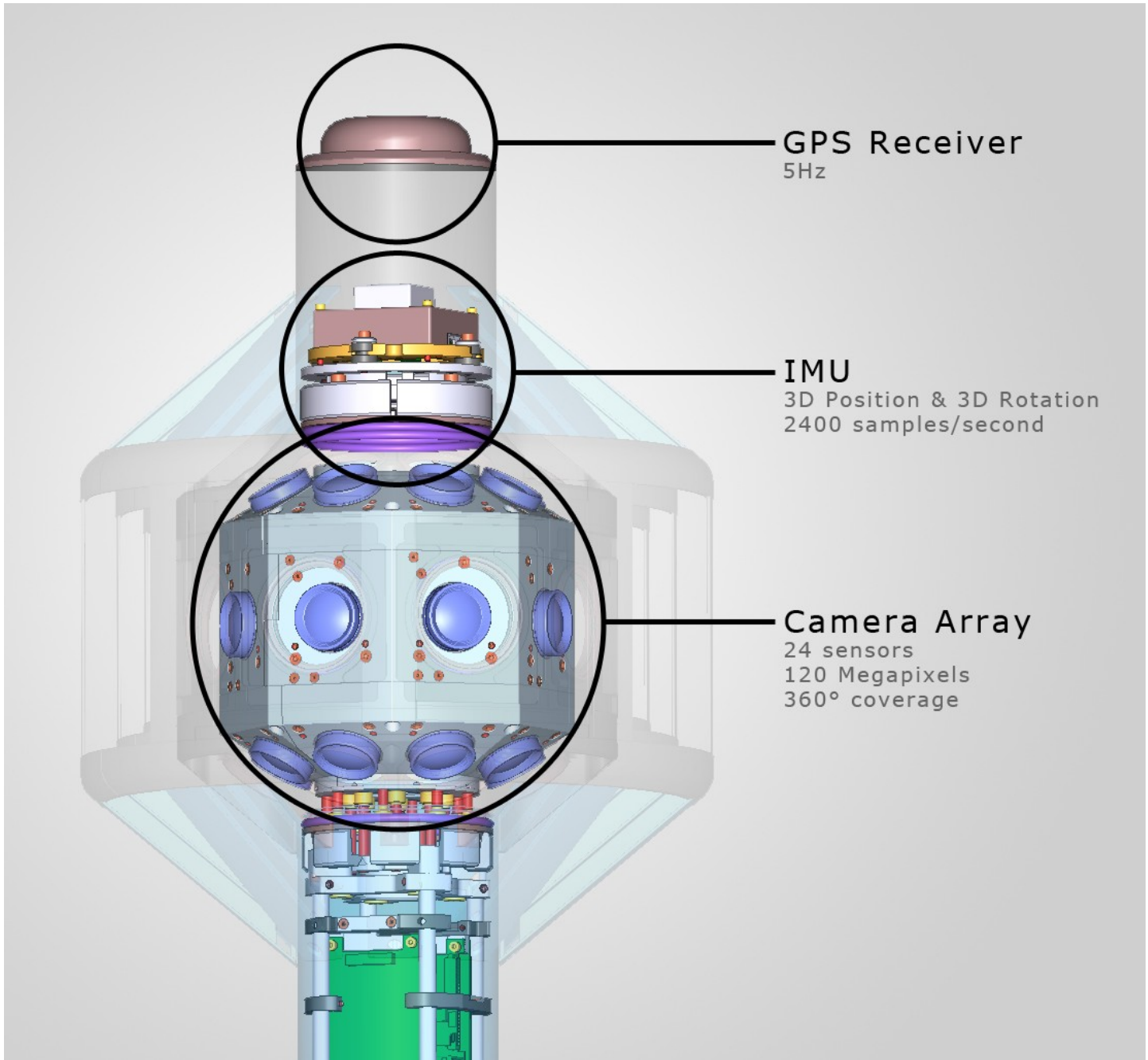
Dimensions

Drawing units: mm



Camera Head Contents Overview

The following schematic drawing shows the content of the *Elphel-Eyesis 4 π -24* camera head:



Technical Specifications

The following table shows the differences between the two-thirds of a sphere *Elphel-Eyesis 4π-16* and full sphere *Elphel-Eyesis 4π-24* system:

Parameter	Elphel-Eyesis 4π-16	Elphel-Eyesis 4π-24	Notes
Combined field of view (steradians)	3*π	4*π	
Number of image-sensors	16	24	
Angular resolution +/-30° from the horizon	≥4.2Mpix/steradian	≥4.2Mpix/steradian	1
Angular resolution +30° to +90°(zenith)	≥4.2Mpix/steradian	≥4.2Mpix/steradian	1
Angular resolution -30° to -90°(nadir)	none	≥4.2Mpix/steradian	1
Combined megapixels	80.0	120.0	
Combined megapixels (w/o overlapping areas)	48.0	64.0	
Combined megapixels (w/o overlapping areas, worst case resolution)	39.6	52.8	1
Distance between entrance pupils of adjacent horizontal lenses	46.5mm	46.5mm	
Distance between entrance pupils of horizontal and top/bottom lenses	50mm	50mm	2
Maximal frame rate	5fps	5fps	3
Maximal recording data rate	128 / 96MByte/s	128MByte/s	4
Maximal direct network data rate	80 / 60MByte/s	80MByte/s	4
GPS receiver	external/internal RS232	external/internal RS232	
GPS pulse-per-second input	yes	yes	
GPS position update frequency	5 - 10Hz	5 - 10Hz	
Inertial Measurement Unit (IMU)	ADIS163xx, ADIS164xx	ADIS163xx, ADIS164xx	
IMU Event Logger	2400 Samples per second	2400 Samples per second	
External Inputs	Odometer/Pedometer (10,000 pps)	Odometer/Pedometer (10,000 pps)	
Data unload	2x eSATA	2x eSATA	5
Storage devices type	1.8" SSD	1.8" SSD	5
Number of storage devices	6 / 8	8	4,5

Notes:

1. Angular resolution per pixel differs in the sub-camera FOV, minimal resolution is used.
2. The distance is measured from the entrance pupil of the horizontal lens to the entrance pupil of the lens immediately above/below.
3. Frame rate may be limited by the recording (or network if the SSD are not used) datarate for high compression quality (>0.3 bytes/pixel), required for the aberration correction.
4. For **Elphel-Eyesis 4π-16** 6 or 8 channels are possible with 3 or 2 sensors per channel.
5. Recording can be done over Network to external computer with hard drive at a lower frame rate.

Turnkey Solution Contents

- *Elphel-Eyesis 4π-16* or *Elphel-Eyesis 4π-24* - Spherical Panorama Camera
- Eyesis Computer for image download and post-processing
- SDK based on 10353 system board
- Software (complete solution for acquisition, processing and viewing)
 - SDK, shared with 10353 system board SDK
 - Eyesis GUI, web-based for system monitoring while operating the camera
 - Post-Processing Tools:
 - Image Extraction and Indexing: splitmov.php - plugin for ImageJ or movie2dng
 - Images format conversion: Elphel JP4 Reader for ImageJ plugin or standalone DNG-converter for using dcraw
 - Metadata Extraction: Exif2KML.php
 - Raw Footage Viewer and Selector - web based
 - Elphel Image Enhancement Plugin for ImageJ
 - Image Comparator for evaluating image enhancement result and fine-tuning correction parameters
 - Hugin Tools for Panorama Stitching
 - PanoramaTiling.php - splitting large panoramas for WebGL viewer
 - Panorama Sequence Editor - location, orientation, hot spot visibility for a sequence of panoramas

All software is FOSS (Free and Open Source Software) and all future software updates or new software will be available to previous customers.

Software may require integration with customer software depending upon camera hardware configuration and application.

Notes

- The car roof or packback mount is not included.
- A laptop to control and monitor recording is not included in the package.
- Elphel-Eyesis 4π can optionally operate without internal SSDs. Then Images have to be streamed over the network and stored on a computer receiving the image stream.

Some limitations apply:

- Datarate is limited to 60MByte/s with *Elphel-Eyesis 4π-16*
- Datarate is limited to 80MByte/s with *Elphel-Eyesis 4π-24*

Eyesis Computer

The Eyesis Computer is a high-end-workstation with small form factor. It is intended for image post-processing and **not** required for recording footage.

It comes with all Elphel developed software and tools required for processing panoramic images preinstalled.

- Small form factor Shuttle PC
- Intel Core i7-950 Quad-Core Processor
- 16 GB DDR3 RAM
- GeForce GTX 465 (Fermi) 1GB
- 2 TB HDD

configuration is subject to change

SDK

Software Development Kit for *Elphel-Eyesis 4π* is based on the 10353 system board, and is shared with NC353L camera.

SDK is available on the camera and for download from the Elphel website.

All Software developed for Elphel cameras is Open Source.

We actively pursue the users freedom to use, modify and share our hard- and software for any purpose with the GNU GPLv3 or later version. Elphel Inc.'s products are powered by 100% free software and open hardware. All documentation is available under the GNU FDLv1.3 or later version.

Hardware, schematics, PCB layout and mechanical design are released under CERN OHLv1.1 or later version.

Software

Complete SDK is available and ships with every *Elphel-Eyesis 4 π* order. Please note that the following screenshots were obtained with the first generation Eyesis camera with only 9 sensor front-ends.

The following screenshots show a few components of the software:

The screenshot displays the software's user interface. At the top, a panoramic view is shown with four segments labeled 'left', 'front', 'right', and 'rear'. Below the view are control buttons: 'Get previews', 'RECORD', and 'STOP'. Underneath are three line graphs corresponding to the 'left', 'front', and 'right' segments. The bottom left contains a configuration panel with tabs for 'Network', 'Camogm', 'Camera', 'Quality', and 'Other'. The 'Network' tab is active, showing IP addresses for three cameras and an update interval of 5 seconds. The bottom right features two tables: a system status table and a buffer status table.

N	t, °C	camogm status	camogm state	File size, MB	partition free space, GB	mount point (0-7)
1	31	on	"stopped"	0	unmounted	/var/0
2	31	on	"stopped"	0	unmounted	/var/0
3	31	on	"stopped"	0	unmounted	/var/0

read

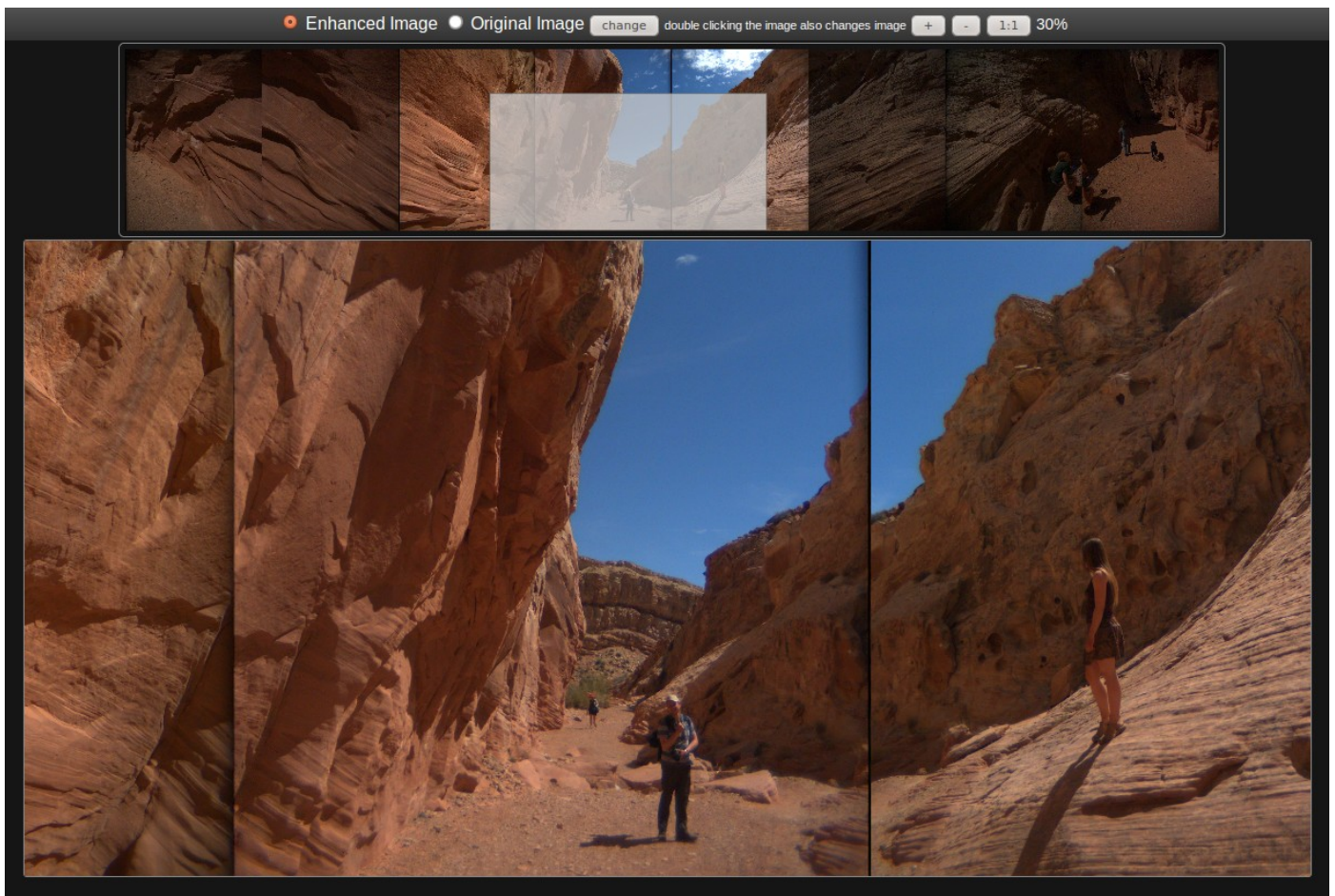
N	Buffer (important when recording)	Frame size, KB	Quality, %	Camogm last error code	Camogm log
1	free	2558	97		log
2	free	3169	97		log
3	free	3117	97		log

Clear

web-based GUI for controlling/monitoring live panoramic image acquisition



Tools for complete pipeline for postprocessing captured RAW image-sets: indexing, metadata extraction, RAW conversion, aberration correction, image enhancement, unstitched panorama preview, stitching.

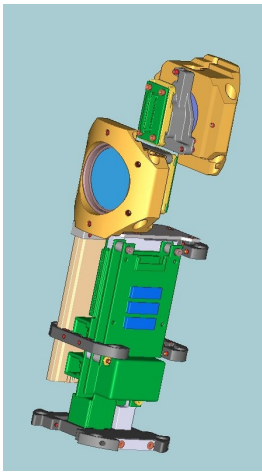


web based unstitched panorama previewer

Longitude, °	-110.698388	Heading:	217.68	View azimuth:	223.12	Texture size:	1427x7136	<input checked="" type="checkbox"/> Show plan	Timestamp:	04/22/2011 17:06:08.46693 UTC
Latitude, °	38.562246	Tilt:	-4.28	View elevation:	-0.48	Maximal zoom:	1	<input checked="" type="checkbox"/> Show cameras	Sun Azimuth:	122.05
Altitude, m	1429.72	Roll:	10.35	<input checked="" type="checkbox"/> Ortho		Current zoom:	0.525	<input type="checkbox"/> Show labels	Sun Elevation:	50.12
Description:	0: undefined		Navigation:	< >						

web-based stitched panorama viewer (and geo-data editor)

Future Software Development Plans



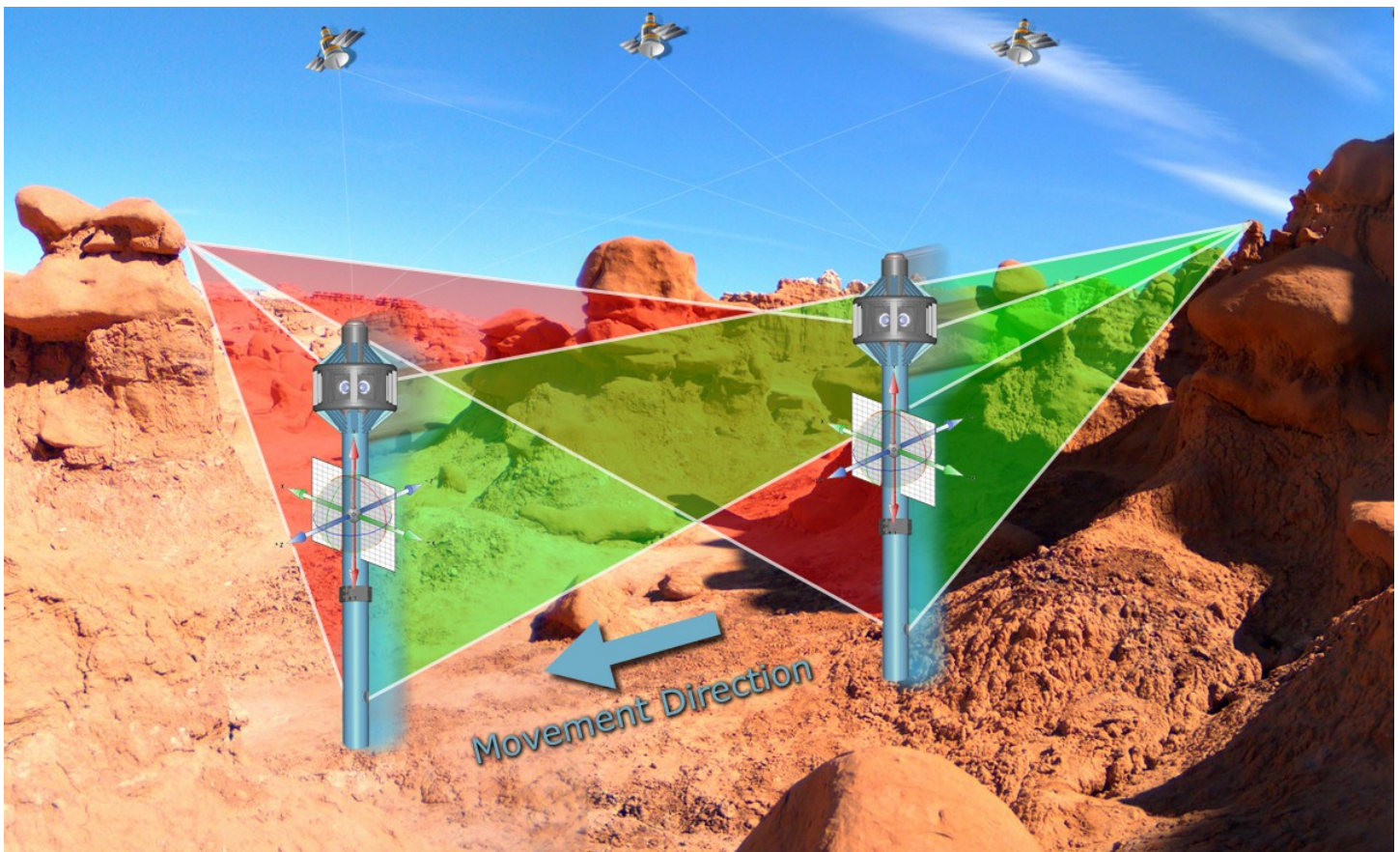
Additional 2 Sensor Modules

Approximately one meter below the main camera head we placed 2 additional sensors. The pair of additional lenses point sideways and have FOV overlap with the cameras above them.

So for the **planned 3D reconstruction** we do not need to double the number of sensors and have stereo-panoramic camera - it is sufficient just to have stereo measurements in some areas for precise positional data.

That will simplify distance measurement when the whole camera is in the motion and rotation. Correlating the same features in two (or more) stereo pairs (consisting of the main and additional images) will provide the relative positional information to be combined with the inertial data and used for the 3D reconstruction in the other areas, not just in the overlap FOV.

The following illustration shows how any point in the FOV is captured twice at the same time from both the camera head as well as one of the additional sensor modules inside the camera pole. The precise 3D position and rotation data from the IMU allow to also relate the depth information from shots that have been captured from different positions and while in motion to each other.



Order Contact

Elphel-Eyesis 4π-16 List Price: \$60,000.00 USD*

Elphel-Eyesis 4π-24 List Price: \$75,000.00 USD*

* GPL Discounts available

We are directly accepting orders and ship worldwide.

Please contact us for updates, lead time, quotes and if will you have any questions.

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