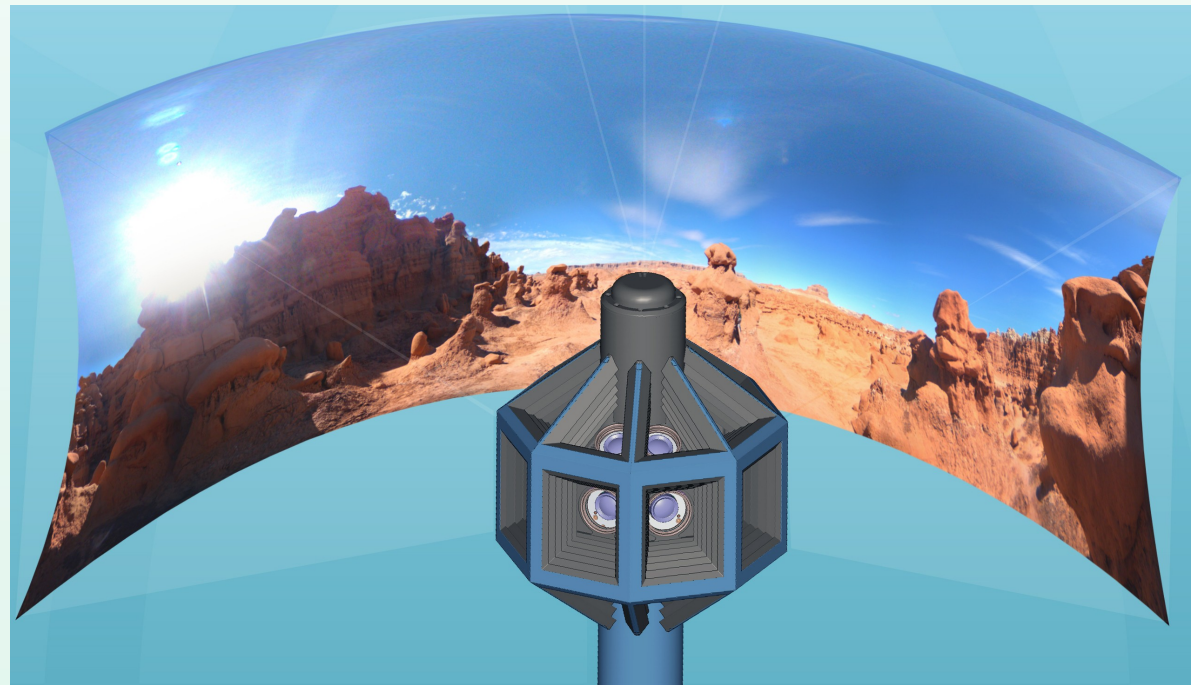


10 years of Open Hardware

Designing and Manufacturing Hi-resolution, Hi-Frame Rate Cameras
Free Software and Open Hardware



Hardware: NC353L

Tech specs:

5 Megapixel CMOS Sensor

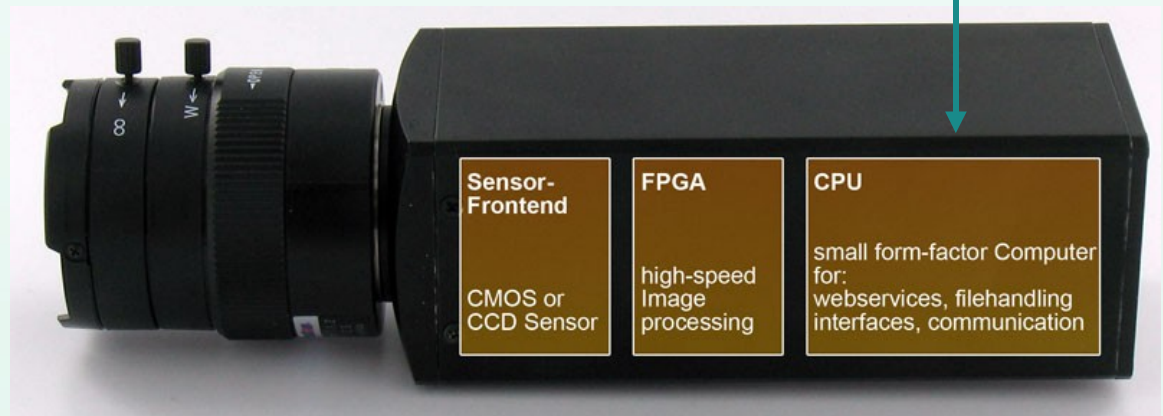
Exchangeable Lens (c-mount)

75 Megapixels/second Throughput

FPGA with Image pipeline

Embedded Linux computer

(webserver, Ethernet, USB, SATA connections)



Applications: Document Scanning



Elphel Model 323

35-mm format Kodak CCD image sensor

11 megapixels resolution (4008 x 2672)

2 fps framerate

Nikon F-mount

Applications: Panoramic Imaging



WIKIPEDIA
The Free Encyclopedia

- [Main page](#)
- [Contents](#)
- [Featured content](#)
- [Current events](#)
- [Random article](#)
- [Donate](#)

- Interaction
 - [About Wikipedia](#)
 - [Community portal](#)

Article [Discussion](#)

Google Street View

From Wikipedia, the free encyclopedia
(Redirected from [Streetview](#))

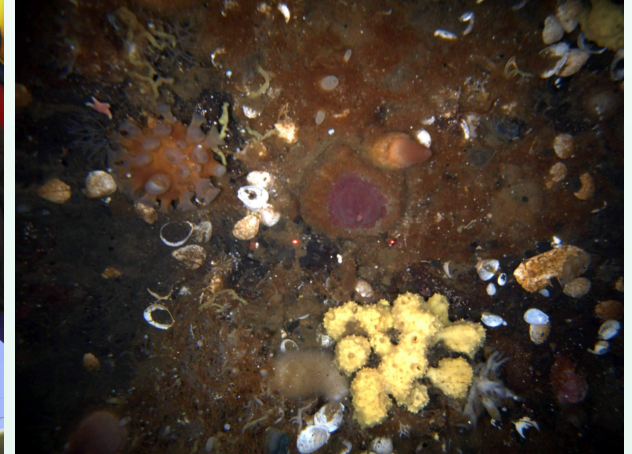
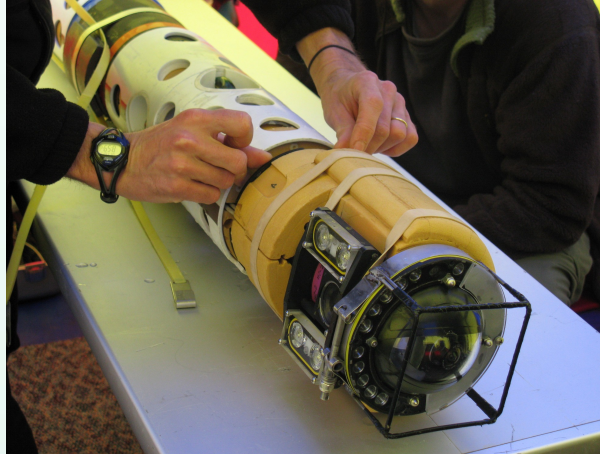


This article **may need to be updated**. Please update this article to reflect the [talk page](#) for more information.

Google Street View is a technology featured in [Google Maps](#) and [Google Earth](#) that provides [panoramic](#) views on May 25, 2007, originally only in several cities in the United States, and has since gradually expanded to include

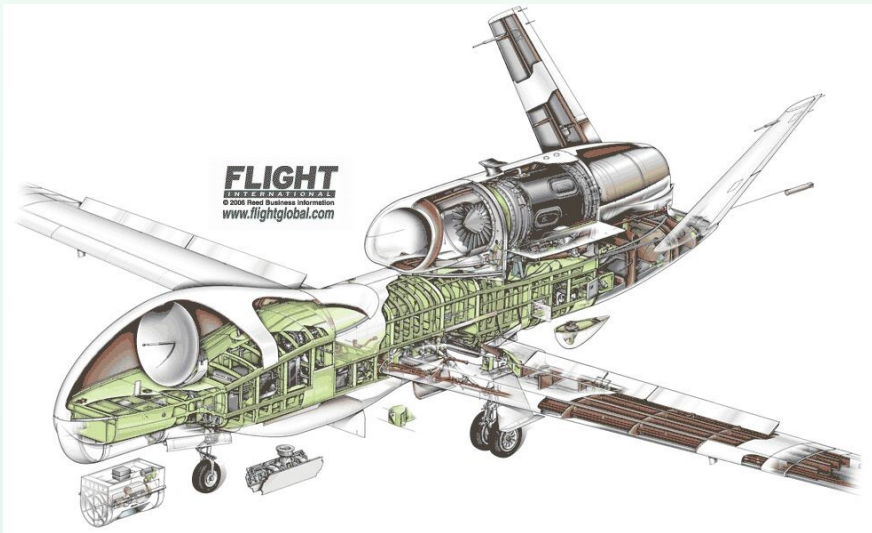
Google Street View displays images taken from a fleet of specially adapted cars. Areas not accessible by car, like sometimes covered by *Google Trikes* ([tricycles](#)) or a [snowmobile](#).^[2] On each of these vehicles there are nine directional units for positioning and three laser range scanners for the measuring of up to 50 meters 180° in the front of the car and Wi-Fi [hotspots](#).^[3] Recently, 'high quality' images are based on open source hardware cameras from Elphel.

Variety of Applications: SCINI - Antarctic Underwater Exploration Robot

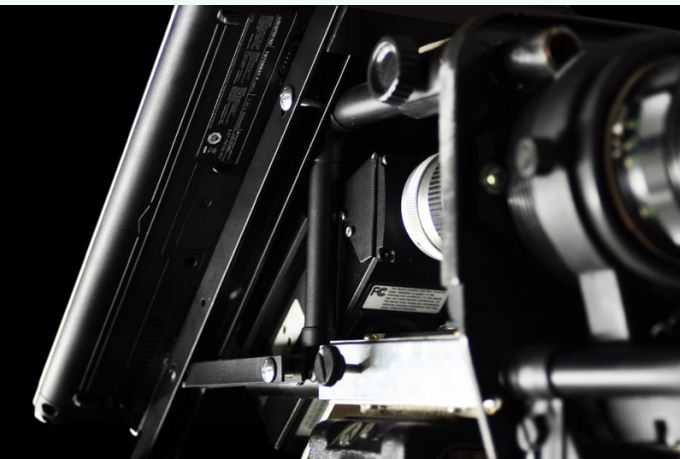


Moss Landing Marine Lab

Applications: NASA Global Hawk UAV Aerial Near Space Exploration



Applications: Apertus - Open Source Cinema Project



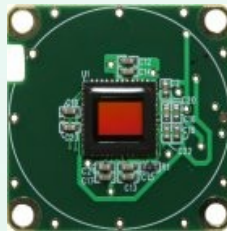
Boards Overview



10353 System Board



10369 IO Board



10338 Sensor Board



10359 Multi Sensor Board

Camera Configurations



Basic camera NC353



Stereo



GEO



HDD

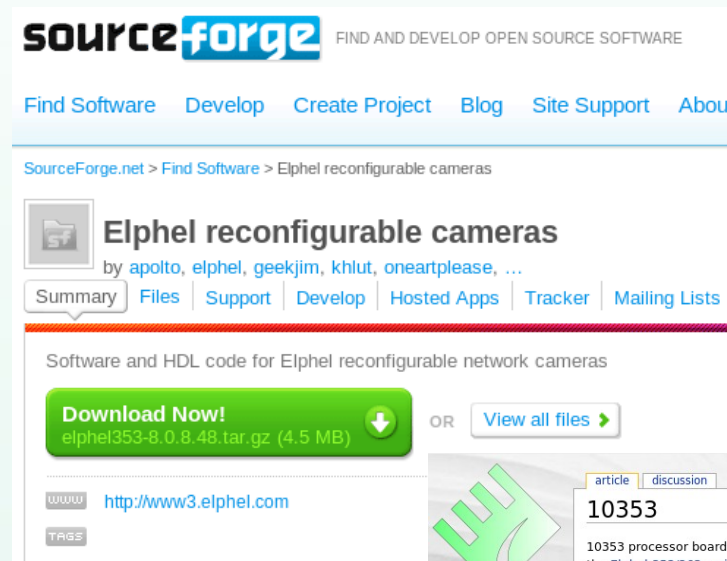
`/* source is inside */`

Camera is reconfigurable and user/developer friendly.
Controlled through a web-based user interface.

- HTML, JavaScript, PHP
- C, C++
- Verilog HDL



- Code is on the **SourceForge.net**



sourceforge FIND AND DEVELOP OPEN SOURCE SOFTWARE

Find Software Develop Create Project Blog Site Support About

SourceForge.net > Find Software > Elphel reconfigurable cameras

Elphel reconfigurable cameras
by [apolto](#), [elphel](#), [geekjim](#), [khlut](#), [oneartplease](#), ...

Summary Files Support Develop Hosted Apps Tracker Mailing Lists

Software and HDL code for Elphel reconfigurable network cameras

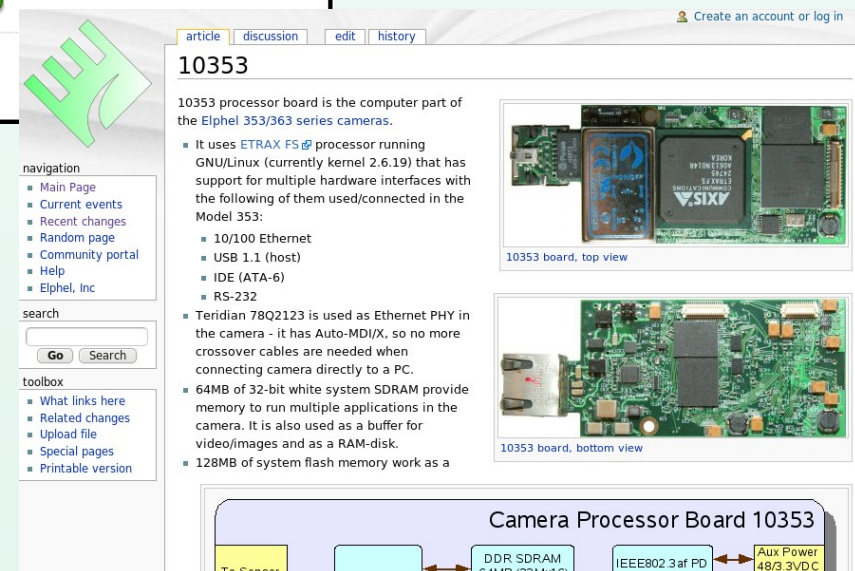
Download Now!
elphel353-8.0.8.48.tar.gz (4.5 MB)

OR [View all files](#)

<http://www3.elphel.com>

TAGS

- Schematics, PCB layout & Documentation are available on **wiki.elphel.com**



article discussion edit history

10353

10353 processor board is the computer part of the Elphel 353/363 series cameras.

- It uses ETRAX FS processor running GNU/Linux (currently kernel 2.6.19) that has support for multiple hardware interfaces with the following of them used/connected in the Model 353:
 - 10/100 Ethernet
 - USB 1.1 (host)
 - IDE (ATA-6)
 - RS-232
- Teridian 78Q2123 is used as Ethernet PHY in the camera - it has Auto-MDI/X, so no more crossover cables are needed when connecting camera directly to a PC.
- 64MB of 32-bit white system SDRAM provide memory to run multiple applications in the camera. It is also used as a buffer for video/images and as a RAM-disk.
- 128MB of system flash memory work as a

10353 board, top view

10353 board, bottom view

Camera Processor Board 10353

To Sensor → DDR SDRAM 64MB (32Mx16) → IEEE802.3af PD → Aux Power 48/3.3VDC

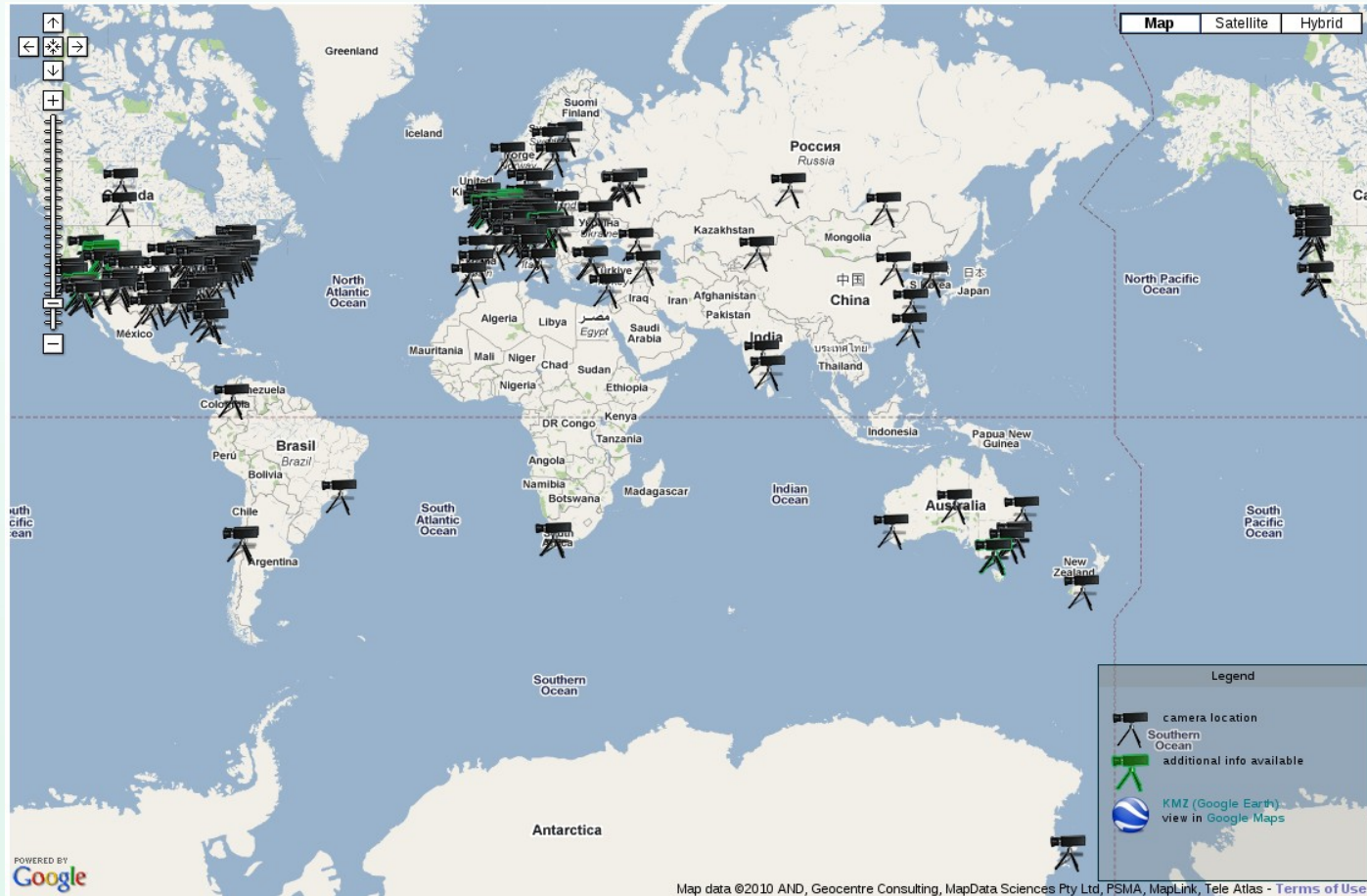
Licenses:

- *GNU GPL V3*
- *GNU Free Documentation License V1.3*
- *CERN Open Hardware License V1.1*

Camera users around the world

Open Reconfigurable Design

High End Product



Eyesis - Panoramic Camera



Street Panoramas

Nature Trail Panoramas

Indoor Panoramas

Entertainment

Video games



Interface for Camera Controls



left front right rear

Get previews
RECORD STOP

Network Camogm Camera Quality Other

Camera 1 IP: 192.168.0.221
Camera 2 IP: 192.168.0.222
Camera 3 IP: 192.168.0.223
Apply

Update Interval, seconds: 5 Set Clear

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	<div style="width: 100%; background-color: green; display: inline-block;">free</div>	2558	97		log
2	<div style="width: 100%; background-color: green; display: inline-block;">free</div>	3169	97		log
3	<div style="width: 100%; background-color: green; display: inline-block;">free</div>	3117	97		log

Clear

Post-processing Tools

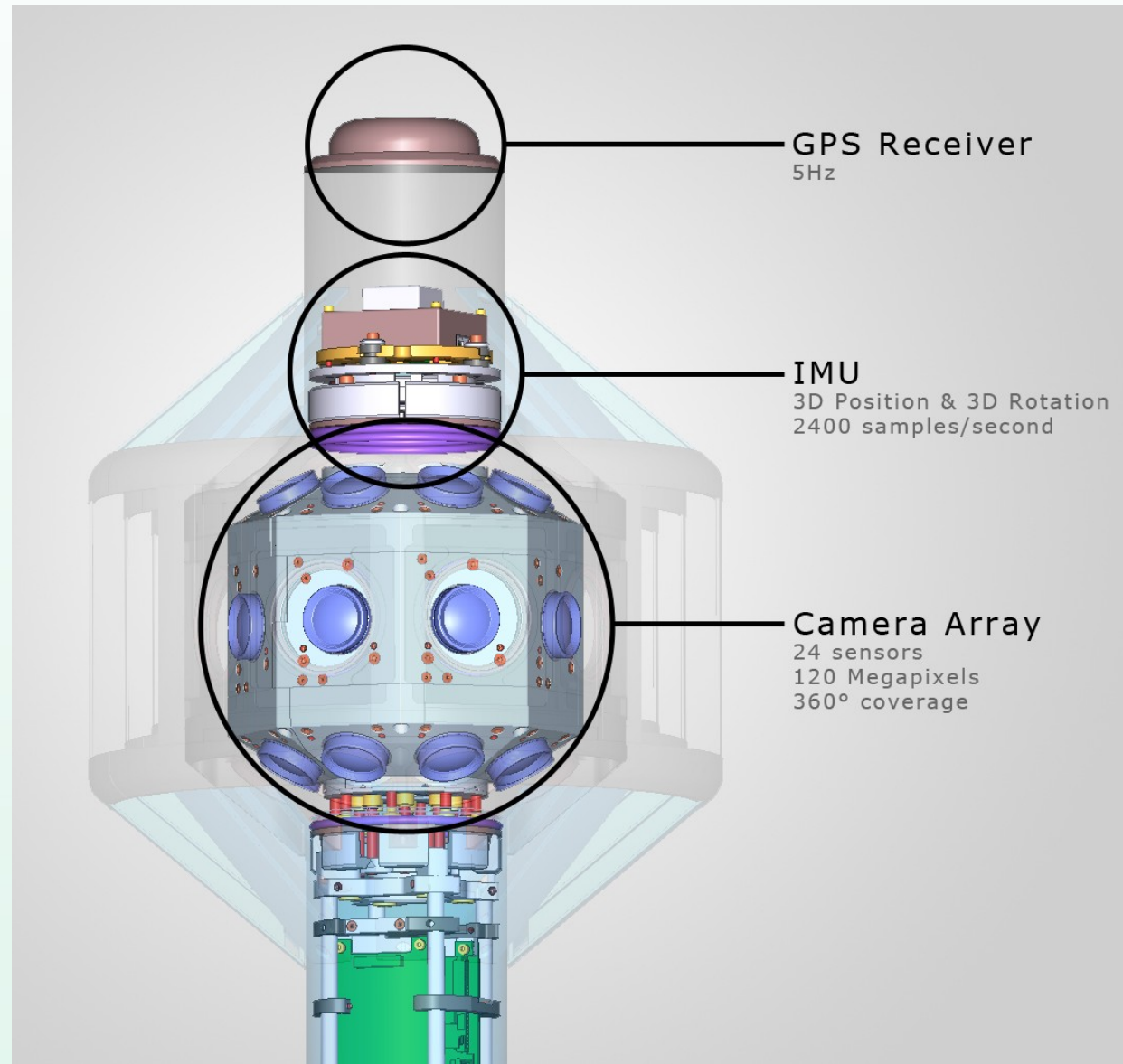
- Image extraction and Indexing
- Metadata extraction
- RAW conversion
- Aberration correction
- Image enhancement
- Panorama stitching - Hugin
- Integration with map



Panoramas are integrated with Open Street Map

Current Developments: Eysis 4 π

- Full Sphere Panoramic Camera
- High Resolution: 120 Mpix, total (64 Mpix - panorama)
- Images are synchronized with GPS and IMU – allows precise position and orientation of panoramas

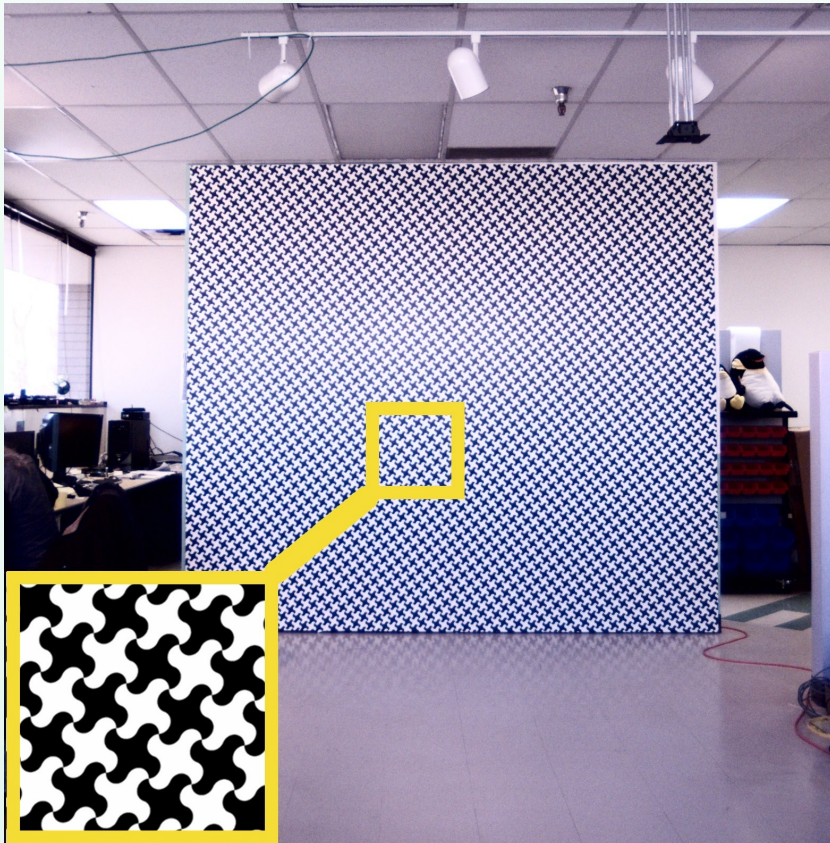


Eyesis 4π R&D

- Camera Calibration
 - Aberration and Distortion Correction and Image Sharpenning
 - Camera as a measurement tool for Photogrammetry
- Inertial Measurement Unit (IMU) :
 - 3D Position and Orientation
 - Compensate for Rolling Shutter Distortion
- 3D Reconstruction

Camera Calibration

optical aberration measurement and correction developed for Eysis cameras



Lens is aligned and centered with sensor

Aberration Correction - Results

With 1/2.5" 5 megapixel sensor we achieved average sharpness improvement over the image area around 40% compared to the raw images, effectively doubling the resolved pixel count.

Before

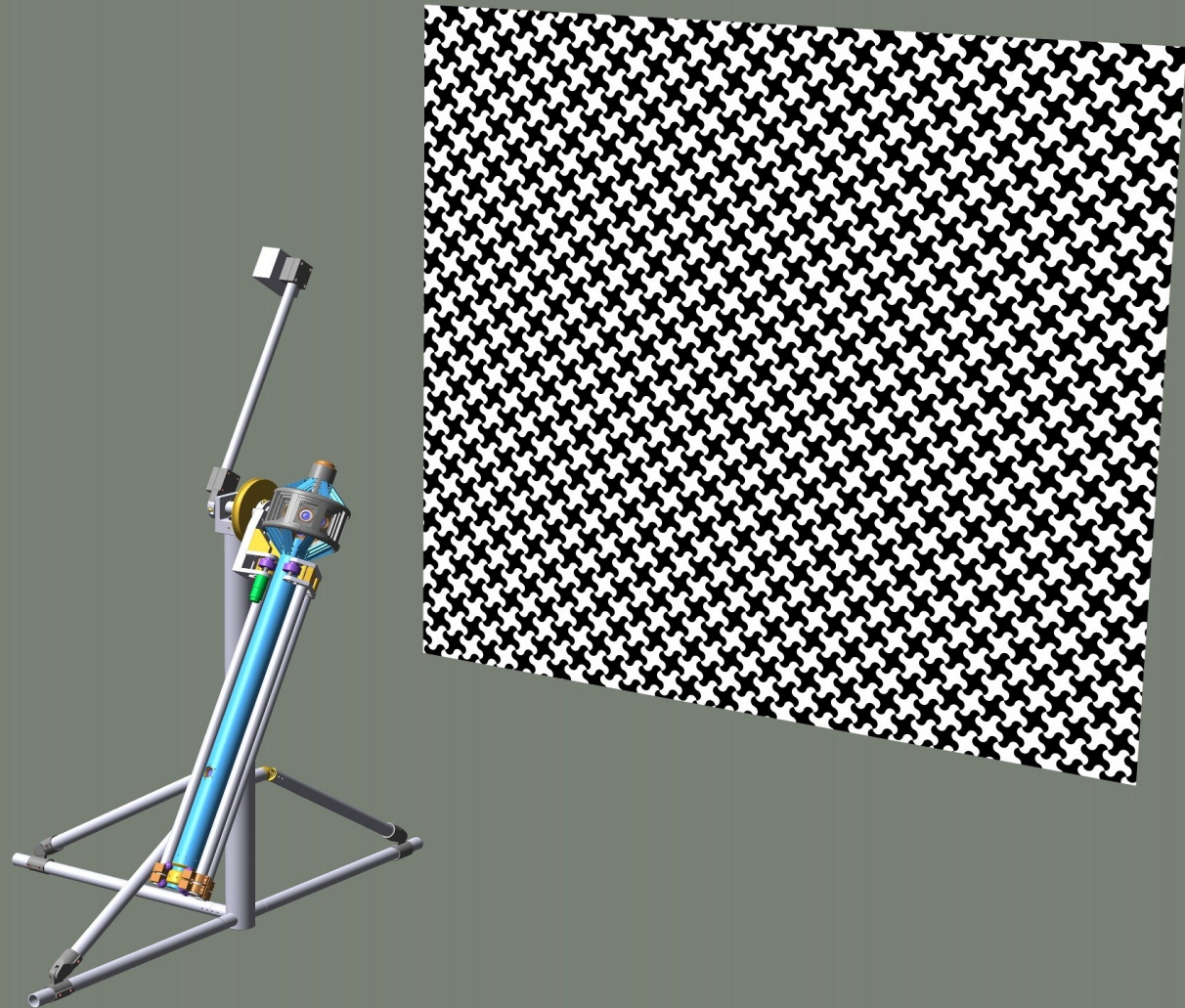


Photogrammetry

Camera as a measuring tool
– needed for 3D
reconstruction

Precise Angle Measurement

IMU calibration – for higher
precision



Inertial Measurement Unit (IMU):

- Position and Orientation of camera for Panorama Sequencing



Maps Settings ?

Longitude, °	-110.698388	Heading:	217.68	View azimuth:	223.12	Texture size:	14272x7136	<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:		< >					

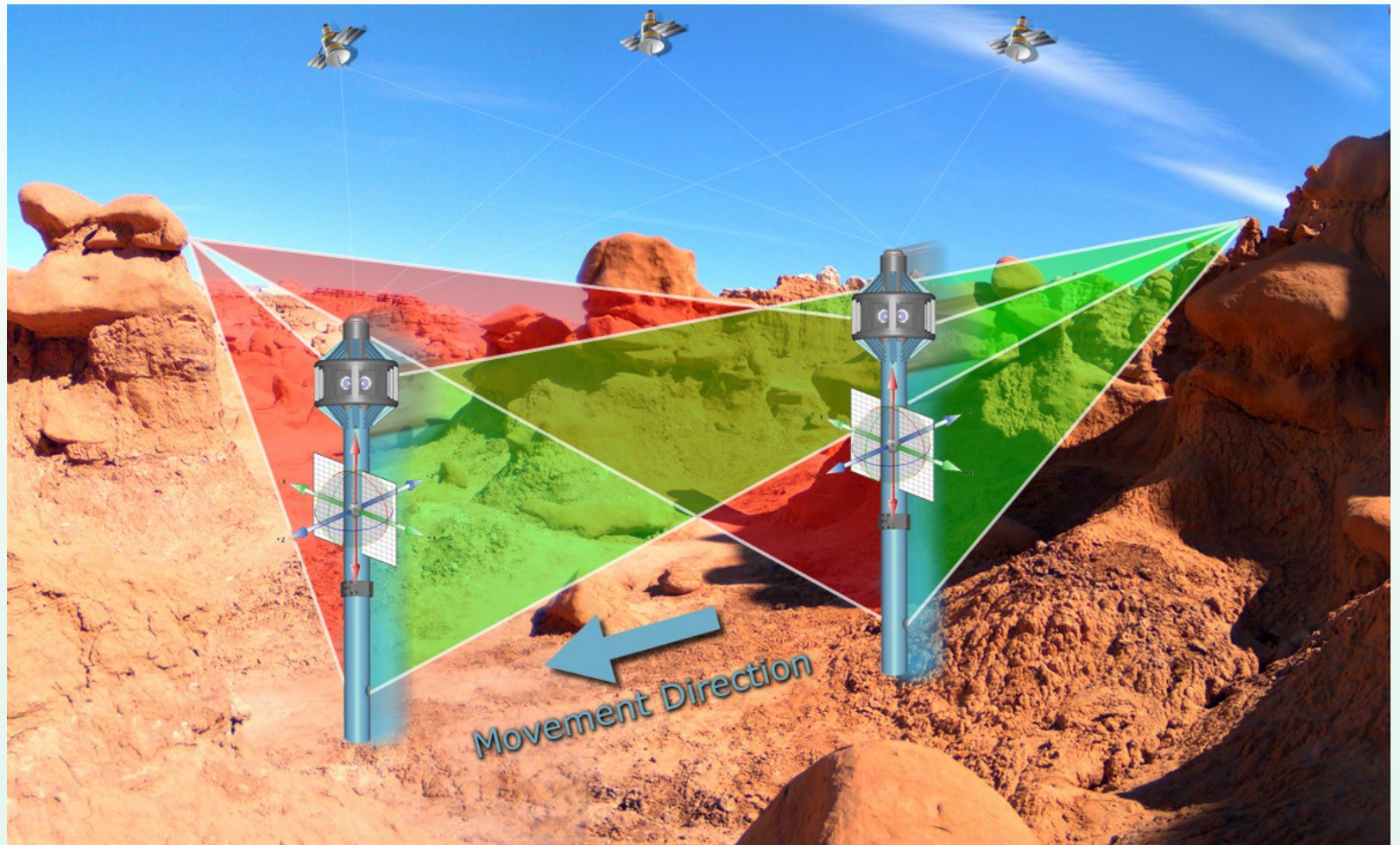
hide info [Permanent Link](#)

Inertial Measurement Unit (IMU):

- Compensate ERS (Electronic Rolling Shutter) distortion (like in the cell phone), by recording position /orientation of camera several times within each frame



Optical Measurement of camera position and orientation at 2 shots



HDR with moving camera,
will be possible with textures on 3D mesh



Research Projects

- Image processing: optical aberration and distortion correction, image enhancement
- IMU data processing for rolling shutter correction
- IMU -position and orientation
- 3D Reconstruction
- HDR with moving camera

More information is available:

www3.elphel.com

Development Blog: <http://blog.elphel.com/>

Documentation: wiki.elphel.com

Code: SourceForge.net

Visit our office: 1405 W 2200 S ste. 205, SLC ,UT