National Aeronautics and Space Administration

Advanced Pointing Imaging Camera (APIC)

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Program: Strategic

Project Objective:
Advanced Pointing Imaging Camera (APIC) is a **high-resolution imaging system** which simultaneously takes images of target and star field with a **two-axis control** capability, allowing rapid target imaging with **extremely precise pointing knowledge**. Such imaging data can be used to accurately determine the geophysical properties and high-resolution topography of target objects.

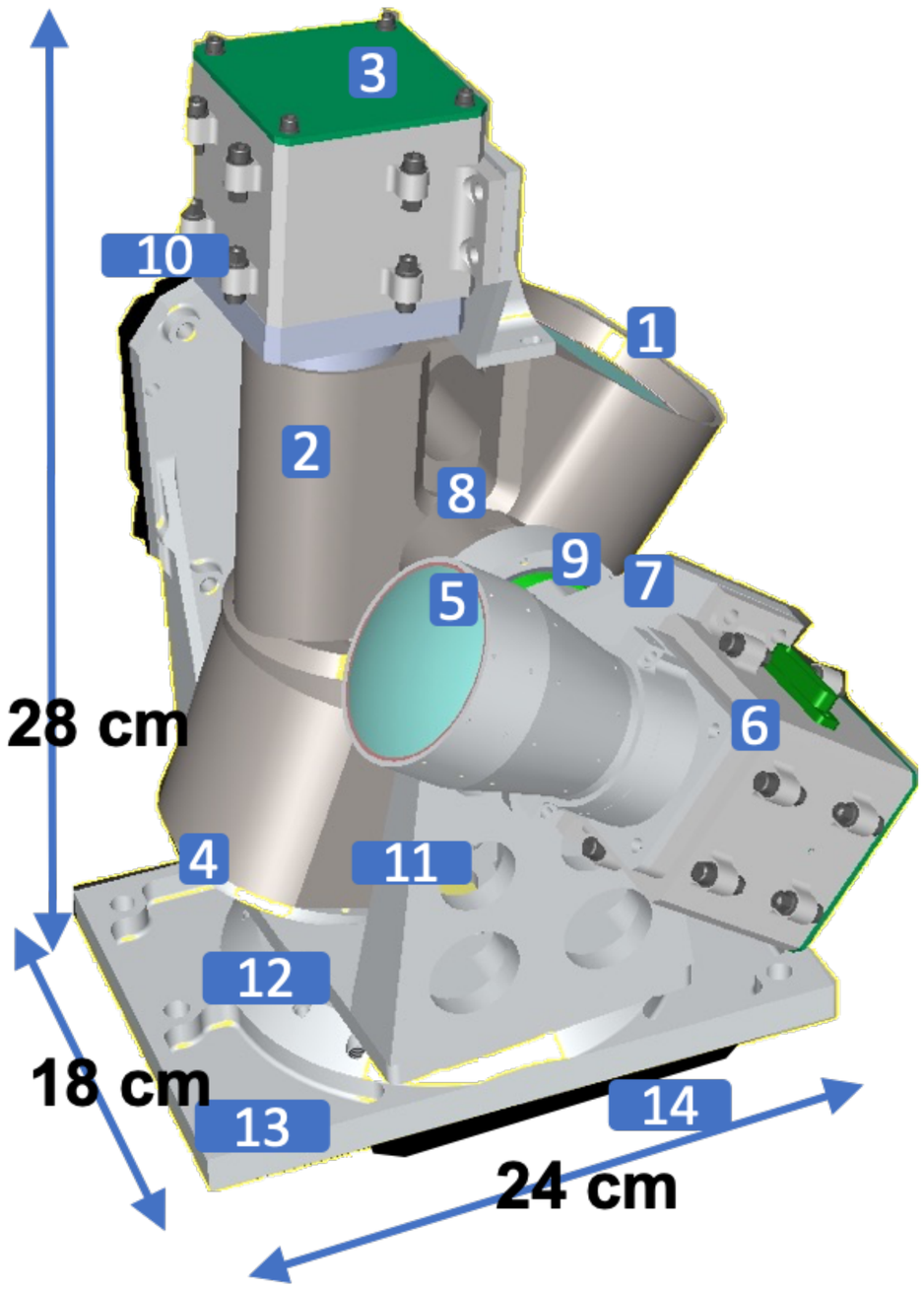
Science Objectives:
The main science application of APIC is to serve as an instrument which can provide the data for geodesy, geophysics, and geology to constrain the interior structure and to determine surface properties of planetary objects.
Specific science objectives include:
- Determination of geometric tidal flexing of natural satellites.
- Determination of rotational libration, nutation, and precession of natural satellites and asteroids/comets.
- Determination of topography.

Benefits to NASA and JPL:
A high-resolution imaging system with accurate pointing information and flexible control capability would significantly improve the measurements of target body's geophysical and geodetic properties, such as rotational state and surface topography. The technology would also improve the accuracy of the recovered gravity field of the target body and spacecraft orbits through optical navigation, which would benefit science and the mission overall.

Other US agencies that require small, high-powered optical instruments that are additionally gimbaled, for example to aid reconnaissance activities, could use these capabilities.

To the extent that the APIC instrument can reduce the cost of deep space science missions, this work will return more science for less investment.

FY19 Results:
- An EM unit was tested to show the NAC resolution of 18 µrad with the actuator rate accuracy of 5 mrad/s in the operational domain of 5 mrad/s to 0.5 rad/s (req's satisfied).
- Completed the build of a full flight unit with JPL Class-D processes and inspections.
- Performed functional and environmental tests of the full flight unit, including survival, thermal, vibration, and shock.
- All key components of the second flight unit were built, procured, and/or assembled, including cameras, optics, controllers with Class-D processes and inspections.

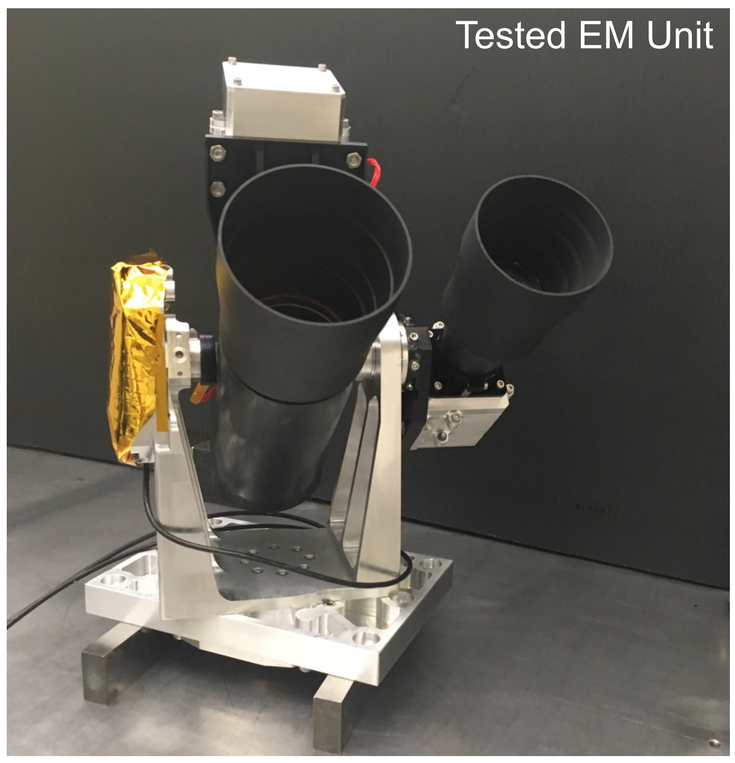


1. **Narrow Angle telescope Aperture**
2. **Narrow Angle telescope body**
3. **Narrow Angle camera body**
4. **Narrow Angle telescope fold-mirror**
5. **Wide Angle lens**
6. **Wide Angle camera body**
7. **Wide Angle camera support bracket**
8. **Optical bench elevation-axle**
9. **Trunnion bearings**
10. **Elevation actuator**
11. **"U-bracket" azimuth saddle**
12. **Elevation bearing**
13. **Base-plate/spacecraft attachment**
14. **Azimuth actuator**

Figure 1. APIC CAD design. APIC is a compact, low-mass, high-performance instrument with two-dimensional gimbaling capability, NAC with 18 µrad pixel size and 4° field of view, and the capability to perform <9 µrad pointing reconstruction of the NAC image via the WAC imaging (82 µrad and 18° field of view), which can also be used to take survey or context target images.

Table 1. Key characteristics of APIC.

Parameter	Values
Mass	6 kg
Power (continuous)	4 W
NAC Field-of-View	4°
NAC Focal Length	360 mm
NAC Aperture	60 mm
NAC iFOV	18 µrad
WAC Field-of-View	17.9°
WAC Focal Length	75 mm
WAC Aperture	50 mm
WAC iFOV	81 µrad
Pointing Knowledge	<10 µrad
Az Range	±180°
El Range	±90°
Az max rate	30°/s
El max rate	30°/s
RGB Band Pass Centers	0.610, 0.540, and 0.470 µm



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