

Satellite Camera Systems Standing Guard of Planet & Its Orbits

TechRounder PDF Edition

Live article: <https://www.techrounder.com/technology/satellite-camera-systems-standing-guard-of-planet-its-orbits/>

By Vipin PG | Published August 5, 2022 | Updated August 6, 2022 | Format: Article | 4 min read

In brief

CubeSat camera systems help keep Earth and its orbits safe by spotting re-entering objects and tracking space debris in crowded LEO to prevent collisions and Kessler-syndrome chain reactions. They use lens-based multispectral/hyperspectral imaging (often with motion detection) and can fly in low-cost groups for wider coverage.

Key points

The article explains that as orbital launches rise, tracking objects that either re-enter Earth's atmosphere or drift through near-Earth orbits is increasingly critical for safety and future space exploration. Large re-entering objects that don't fully burn up can crash and cause serious damage, while freely floating debris in an increasingly crowded Low-Earth Orbit raises the risk of collisions with active spacecraft. It warns that accumulating debris could trigger the Kessler syndrome—a cascading chain of collisions and fragmentation that could make LEO effectively impassable and stall exploration plans. As a potential solution, the piece points to CubeSat camera systems mounted on standardized CubeSats ranging from 1 to 12 units, noting they use familiar optical principles to help monitor and manage these hazards.

As the number of orbital launches increases every year, so does the need for tracking any space-based objects that either re-enter our atmosphere or keep freely floating in the near-Earth orbits. Both cases are potentially hazardous for our planet's safety and future space exploration.

In the first scenario, an object re-entering the atmosphere will eventually crash. If this particular object is too large to burn in the dense layers of the atmosphere, it may cause significant damage.

In the second case of space-based objects freely floating in our orbits, there is always a danger of collision with the currently operational spacecraft. The Low-Earth Orbit (LEO) is growing increasingly crowded. As space debris accumulates, it can cause a chain reaction called the Kessler syndrome, a series of space collisions and eruptions that would make LEO impassable. This would put our space exploration plans on hold.

Fortunately, CubeSat cameras may offer actionable solutions to both of these problems. But what is the CubeSat camera, and how does it work? This article will quickly guide you through modern satellite camera system technology and explain how these systems keep our planet safe.

How Does Cubesat Camera Work? Satellite Camera System Explained

CubeSat cameras are installed on standard-built satellite CubeSats, with scalable dimensions ranging from 1 to 12 units. Such a satellite camera system works the same as any other type of optics used on Earth, it uses lenses to capture a reflected light signal from an object. For example, modern satellite camera systems can capture the following image:

- Panchromatic (black and white), sensible to all visible light wavelengths;

- Multispectral (or multizone), ranging from specific wavelengths across the infrared and ultra magnetic spectrum;
- Hyperspectral, capturing zones in all parts of the spectral range.

Today, most satellite camera systems capture multispectral and hyperspectral images because they are better suited for tracking the dynamics of moving objects. Another advantage of such systems is that CubeSat camera resolution is generally relatively low, but the bandwidth is wide. As a result, organizations using a satellite camera system to monitor space-based objects can react to potentially dangerous situations promptly.

Some CubeSat camera modules and systems also have motion detectors, increasing data accuracy and minimizing the risk of satellite and other spacecraft collisions. Finally, given the compact size of satellite camera systems, these systems can be deployed in groups.. But how busy are satellite camera systems tracking space objects?

What Are Satellite Camera Systems Tracking in Space?

As already mentioned, the primary goal of satellite camera systems for tracking space objects is to prevent collisions in space and ensure no damage is caused if one of those objects crashes down on Earth. If back in 1908, when a relatively small asteroid, just 30-50m in diameter, hit Siberia, destroying 2000 km² of forest land on impact, people had the satellite camera systems we have now; the disaster may well have been avoided.

NASA started using satellite camera systems to document potentially hazardous space objects back in 2004, and the ESA soon joined this initiative. As of 2005, satellite camera systems counted over 20,000 free-floating space objects, thousands of which may ring havoc on impact with our planet's surface. The majority of those objects are natural asteroids. Still, the increasing number of space launches has created an additional problem of artificial space debris that results from human activity in space.

Today, around 2,000 satellites are active in our planet's orbits. Most of those satellites are in LEO, which grows exceedingly crowded after each launch. The geostationary orbit hosting plenty of large satellites, mainly used for TV broadcasts, also has some defunct spacecraft. However, compared to LEO, the situation is not at all alarming.

According to ESA and NASA's estimates, over 3,000 defunct satellites are in space, and roughly 34,000 debris of 10+cm in diameter are freely floating in our orbit. A while ago, the ISS had to adjust its orbit height to avoid collision with a piece of debris, and some time before that, its robotic arm was put out of order by a single piece of space junk. So, satellite camera systems standing guard of our spacecrafts' and the planet's safety are busier than one may think.

Still, using a CubeSat camera will depend on one's goals because both satellites and imagers they carry are highly versatile. Besides tracking moving objects in space, satellite systems monitor the Earth for climate and environmental changes, track illegal activities, offer commercial agriculture insight, and watch out for any military dangers, offering next-to-real-time reconnaissance. And while the era of satellite camera systems started in the last century, we may soon see it reach its peak.

References

1. dragonflyaerospace.com - products - <https://dragonflyaerospace.com/products/>
2. en.wikipedia.org - wiki / Space_debris - https://en.wikipedia.org/wiki/Space_debris