Even Hubble’s seeing a growing number of satellite tracks

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A combination of space junk and a growing constellation of functional satellites like SpaceX’s Starlink have astronomers worried about the potential for orbital materials to interfere with observations. And justifiably so, given that researchers are currently arguing over whether one observation represents one of the farthest supernovae ever observed or a spent Russian booster.

This clutter is obviously a big problem for ground-based observatories, which sit below everything in orbit. But several observatories, including the Hubble Space Telescope, sit in low-Earth orbit, which places them below many satellites. And a new survey of Hubble images shows that it’s capturing an increasing number of satellite tracks in its images. So far, this hasn’t seriously compromised its science, but it clearly shows that orbiting observatories aren’t immune to these problems.

Leaving tracks

The work came from a citizen science project, the Hubble

Asteroid Hunter, which organized volunteers to search for the tracks asteroids left in long-exposure Hubble observations. If an asteroid happens to pass through Hubble's field of view during this exposure, it can leave a short streak in the resulting image. But the participants started noting that some of the streaks they were seeing crossed Hubble's entire field of view during a single image (the project maintains a forum where the volunteers can discuss their work).

Anything as distant as an asteroid can't move fast enough to leave tracks that long. So the only realistic explanation is something much closer: a satellite.

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This informal identification of satellites wasn't thorough enough to give us reliable statistics on their numbers. But it did give the researchers a dataset that was sufficient to train an AI system to identify tracks in a much larger database of images. (They actually trained two and confirmed that they gave consistent results.) Once trained, the AI was set loose on the full database of images from two Hubble cameras, the Advanced Camera for Surveys and the Wide Field Camera 3. The images were limited to those with a long enough exposure for a satellite to fully cross Hubble's field of view.

Not surprisingly, lots of satellite crossings were identified. The concerning thing is the trend. Between 2002-2005, 2.8 percent of the longer exposures taken by Hubble contained a satellite track. By 2018-2021, that fraction rose to 4.3 percent. Wide Field Camera 3, which wasn't active for the entire study period, also saw a significant rise. Depending on the camera, the rise over this period was 60 to 70 percent.

Dropping in on the constellations

The researchers note that the tracks show up more often at lower wavelengths; the satellites are less likely to be

visible in the UV. Satellites also showed up more often when Hubble was pointed along the equator. The researchers suggest this is an indication that most of the tracks are left by satellites in geostationary orbits, which are often situated along the equator.

Fortunately, most of the mega-constellations being put into orbit are below Hubble's altitude, so their addition hasn't really influenced these numbers. But Hubble's orbit has slowly been decaying over time, so it may ultimately end up dropping into the region where these constellations are present before its instruments start to fail. The researchers behind the work also note that several other observatories are in near-Earth orbits, and so could suffer from similar problems.

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