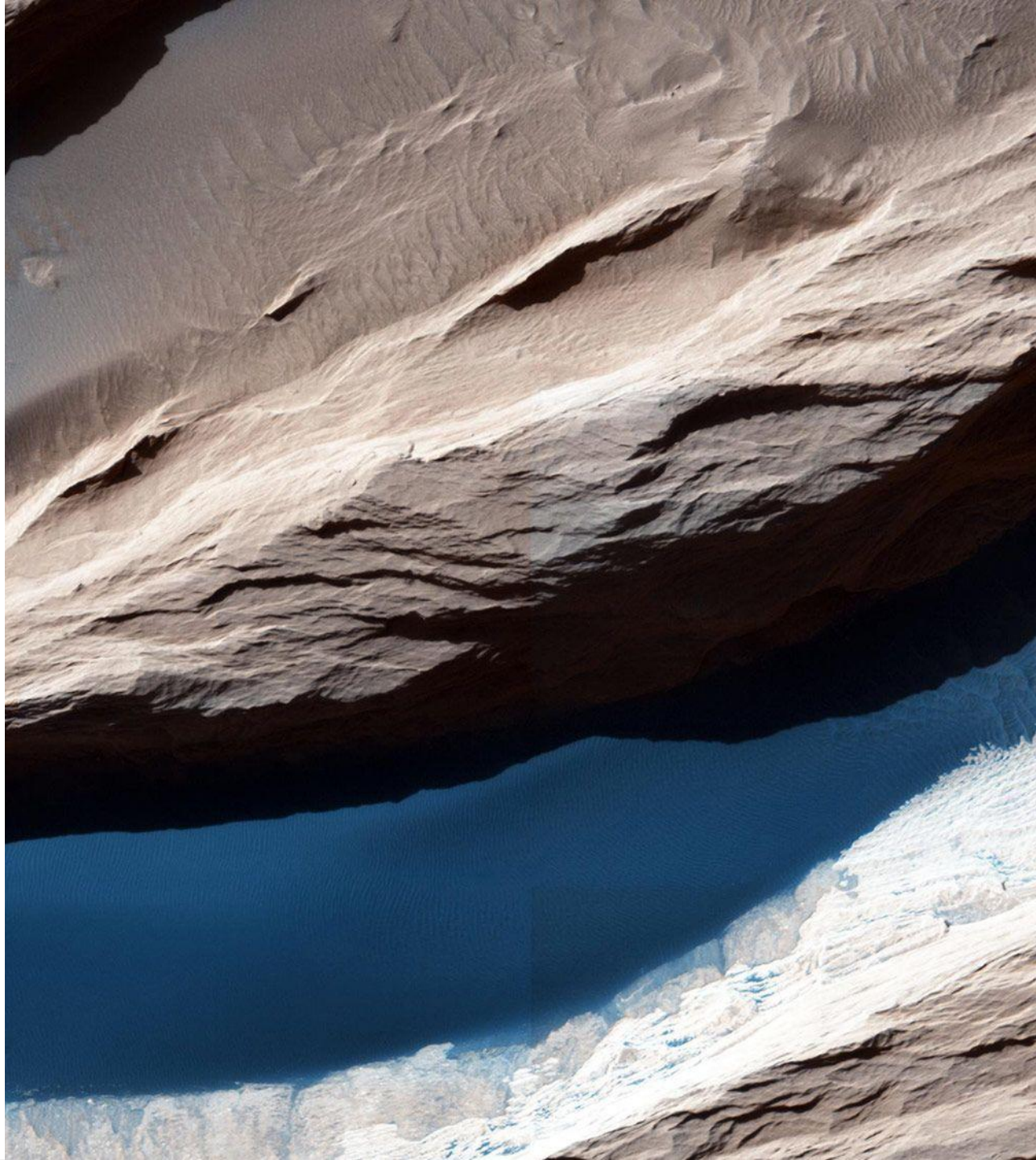
MARS NAVIGATION CHALLENGES

H.E.R.M.E.S.

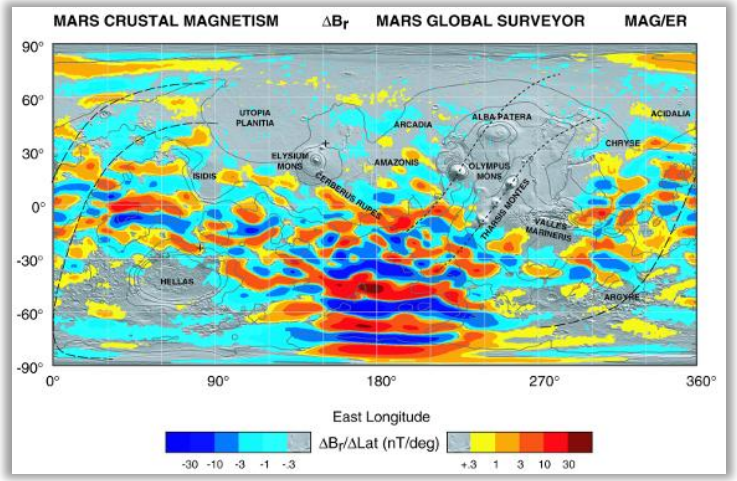
BY: ZACH CRUZ

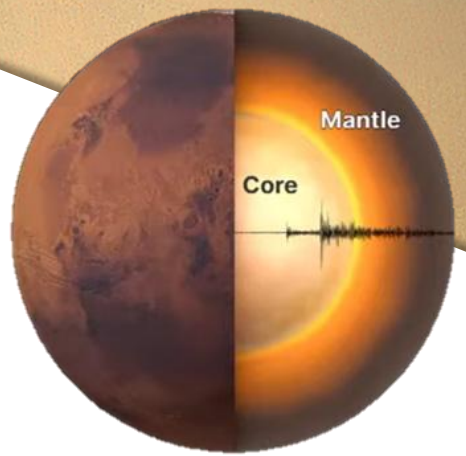


WHAT WE KNOW NOW

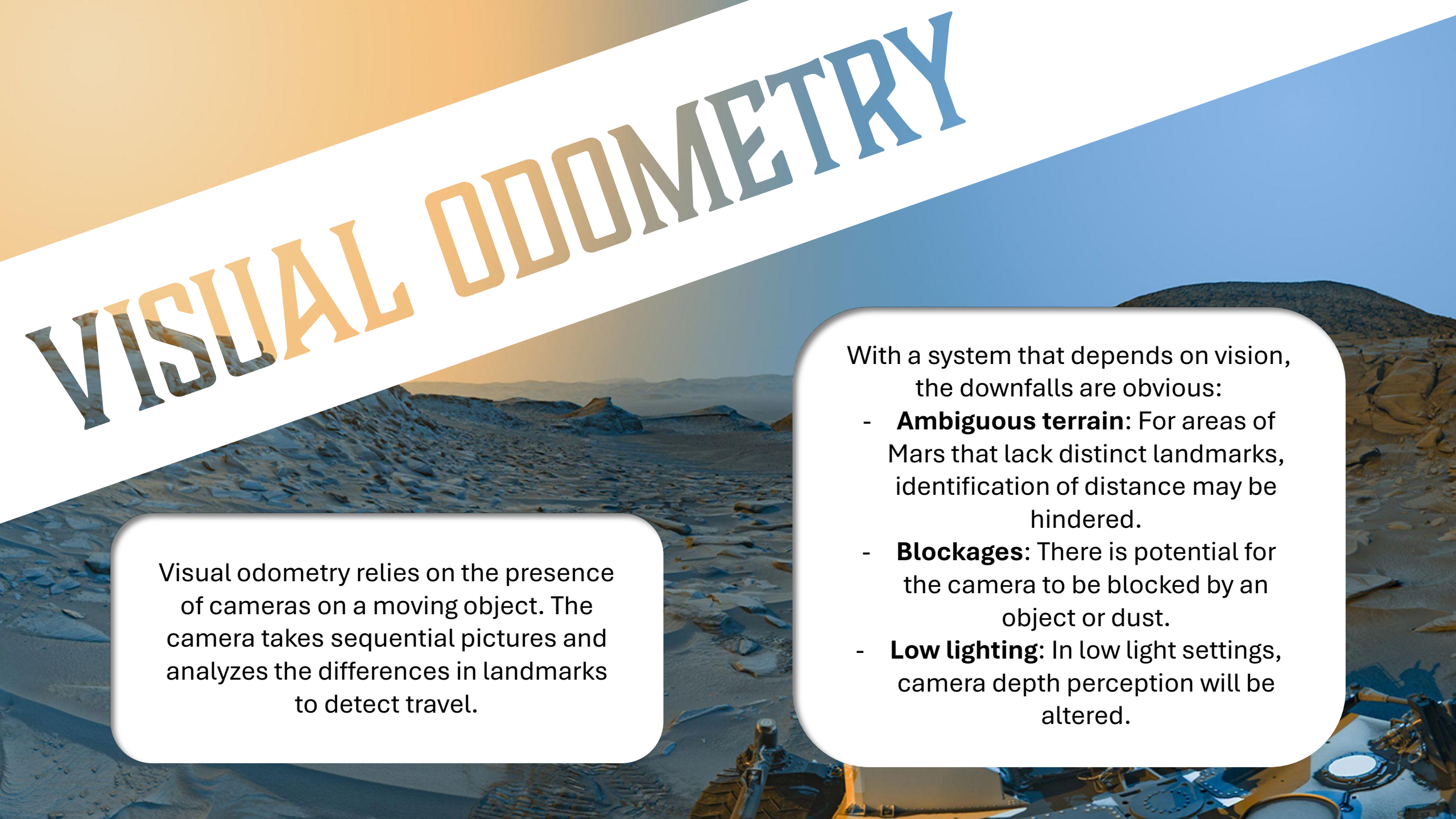
Earth's Global Positioning System (GPS) is dependent on a satellite constellation surrounding the planet. This does not exist on Mars, eliminating the prospect of using GPS on Mars.

Magnetic compasses would not work on Mars because of its nonexistent global magnetic field. Mars possesses patchy crustal magnetic fields much stronger than Earth's (30 times stronger). This is because Mars' core cooled to its Curie point when the global magnetic field was still active, retaining what magnetic fields were left at the time of cooling. Mars crustal magnetic fields' strength range from 10nT to 1300nT, which pales in comparison to Earth's global magnetic field (25,000nT to 65,000nT).





VISUAL ODOMETRY



Visual odometry relies on the presence of cameras on a moving object. The camera takes sequential pictures and analyzes the differences in landmarks to detect travel.

With a system that depends on vision, the downfalls are obvious:

- **Ambiguous terrain**: For areas of Mars that lack distinct landmarks, identification of distance may be hindered.
- **Blockages**: There is potential for the camera to be blocked by an object or dust.
- **Low lighting**: In low light settings, camera depth perception will be altered.

SAFETY: EVA CREWS

Extravehicular activity crews on Mars would need to be very accurate. To sustain life for an extended period on Mars, many landers would need to be delivered very close to each other.

One of the best ways to help an EVA crew navigate and share information is using Inertial Measurement Units (IMUs). IMUs utilize gyroscopes and sensors to measure acceleration and rotation.

DUST STORMS

The biggest issue posed by Martian dust storms is the lack of visibility. According to Hille (2015), Martian dust storms are unlikely to rip apart mechanical equipment, seeing as winds cap out at around 60 miles per hour. However, the electrostatically charged dust creates major issues for sensors and solar panels, as the dust sticks to virtually anything. In a similar sense, dust storms themselves generate massive clouds that make sensors and cameras obsolete.

Because the electrostatically charged dust sticks to most surfaces, it is likely that it will lodge itself in mechanical components and erode them over time.

SO WHAT DO WE DO?

To account for the lack of a magnetic field, it will be critical that HERMES components are radiation-resistant, and that space blankets are adequately used to protect from radiation.

Any solar panels utilized in the communication architecture should be over-engineered (bigger than they need to be), so that blockages due to dust storms will not have bearing on the required amount of solar energy.

In order to combat the electrostatic dust particles, creating electrically charged self cleaning dust shields would help to ensure longevity of solar panel life.