32

Task #3: Autonomy, Asteroids, & Answers

Objective: Explain how NASA Engineers use code & autonomy to operate spacecraft remotely, and what important science came from OSIRIS-REx

- Issue: Where to Land? → Map surface
- Focus Breaking away from surface, orbiting, and landing Back
  - Life cycle
  - Can't see through telescope
- 200 M miles away → 18 min input Lag → No telep → Autonomous Landing
- Issue: Larger sample than expected → spewing rocks → Stange phase precision

1) Within the context of Space Exploration, autonomy essentially means the act of self control. The robot moves itself, rather than being intentionally moved manually.
2) It was 200 M miles away, meaning the radio waves used to communicate with the probe would have an 18 minute delay.
3) The probe misses landing improperly, damaging sample, wiping them arms and other complications. Autonomous programming helped it make corrections on the fly to account for these risks.
4) Both the asteroid & the probe are moving and the probe is landing on potentially hazardous terrain, NFT helped ensure a safe landing.
5) Coding is probably the most important factor in this mission. Extensive edge cases, errors, ~~fallbacks etc~~ and other complications could have occured, thus the code base needed to be large, error proof, and full of redundancys.
6) At this scale, where data takes 18 min to be recieved, and receiving commands 18 min after input, the code needs to be full proof because we cannot fix mistakes on time.
7) The code would be operating in conditions impossible to perfectly simulate on Earth. Programming this, requires extensive test cases.
8) Yes, there is no advancement we can make that will let us communicate faster than the speed of light, and as we travel further and further from Earth, that makes autonomy more & more needed.
9) One example is that to overcome the harsh terrain, NASA scanned Bennu for a year befor landing. Another example is that the reality (computational model of Bennu was incorrect, so they used data from orbiting cams to fix it for a better landing. Overall, the engineering process was used heavily in remote code pushes to maximize the efficacy of the mission.

~~What did we learn?~~

- Microcrystals of Trona indicating previous Sodium-Rich water
  - Fosters organic molecules
  - PH > 7
- Amino Acids & Nucleobases are abundant on Bennu
  - 1 120 Amino Acids
  - All 5 Nucleobases found on Bennu - A first for an aerospace sample
- Ammonia Rich Samples
  - Rich agricultural fertilizer
  - Too close to sun to form now → Must've formed in past

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Table Of Contents

Pg #	Title /Activity	Date
1-4	Table of contents	
5-6	Opening Reflections	12/21/25
7-8	Planetary Defense	12/22/25
9-14	Are We Alone?	1/04/26
15-16	Satellites & Telescopes	1/04/26
17-20	Careers	1/10/26
21-27	Orbital Mechanics	1/11/26
28-29	Perserverance Parachute Code	1/11/26
30-31	MARS Rover	1/12/26
32	Autonomy, Astecoids, & Answers	1/24/26