Microgravity Mission

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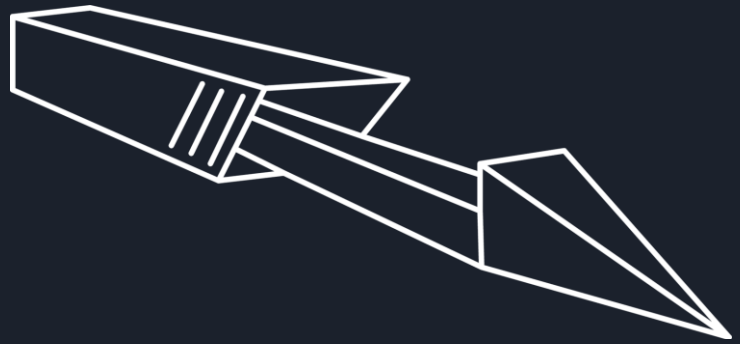
Problem

- Construct a model for a space probe to land on and explore an asteroid
- Use minimal jumps to avoid damaging probe
- No thrusters
- Create a method for selecting asteroids

Idea #1

- **Anchor/Harpoon**
  - Launches harpoon to contact the asteroid
  - Maneuver with grappling hook technique
  - Issue
    - Only landing
    - Require wheels
    - Slow exploration

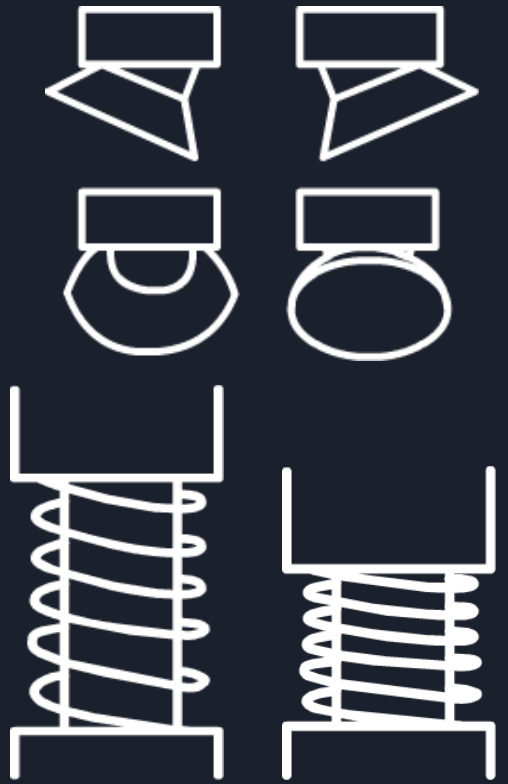


Idea #2

- **Magnets**
  - Launches a magnetic material at the asteroid
  - Probe activates a magnet to attract it to the asteroid
  - Uses opposite polarity magnet to be repelled and explore asteroid
  - Can reuse landing magnet
  - Issues:
    - Effective range of magnetic field is too short
    - Full potential only utilized by asteroids made of metal (ex: Iron)
    - Magnets could affect internal equipment
    - Size and weight of magnets would effect probe size

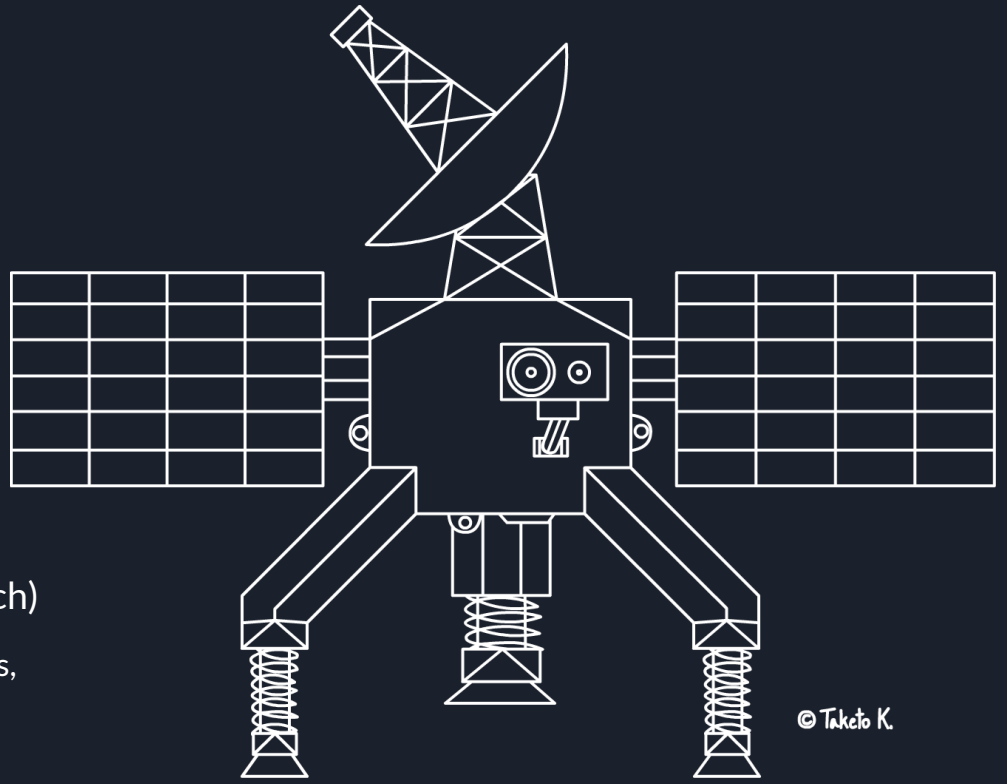
Final Model

- **Rotational Foot**
  - Changing Direction of the probe (Tilt)
  - Strong rubber like material
    - Longer operation
    - Prevent friction on the asteroid
- **Mechanical Spring**
  - Stress relieve mechanism
  - Kinetic energy adjustment
  - Self launch
  - Tilt angle



Space Probe Model (Spec)

- Quad Legs (Main)
- Alternate Leg (optional)
- Satellite Dish (Top)
- Solar Panel (Z-axis)
- Front Camera (Main; Front)
- Sample Collector (Bottom; hatch)
- 4 Rotatable Camera (Back, Z-axis, bottom)



Equations

- R = Asteroid Radius
- r = Probe search radius
- n = Theoretical min. number of jumps

$$4\pi R^2 = n\pi r^2$$

$$n = \frac{4R^2}{r^2}$$

$$R = \frac{r}{2}(\sqrt{n})$$

$$r = \frac{2R\sqrt{n}}{n}$$

- Assumes asteroid can be approximated to be spherical
- Assumes entire asteroid can be explored
- Assumes maximum efficiency

Asteroid Bennu

Discovery Date: September 11, 1999

Material: Rock (Carbon)

Distance from Earth: Over 340 mil Km

Average Surface Temp: 259K (-14°C)

Gravity = ~6μg

R = ~246m

r = 50.0m

n = 96.82 ⇨ ~97 jumps

*More Bennu Asteroid Info
101955 Bennu, *NASA*, 25 April 2019
https://solarsystem.nasa.gov/asteroids-comets-and-meteors/asteroids/101955-bennu/in-depth/

Twist

- How will adding/removing wheels affect the model
- How can the model be adapted for various propensities to roll
- What role the the size and shape of the asteroid play in the model
- If the asteroid size changes, how will this impact our predictions
- Determine a way for the probe to travel around the circumference
- Adapt the model to determine the best way to move along the given path