Attitude and Orbit Control System (AOCS)

- **AOCS is needed to get the satellite into the correct orbit and keep it there**
- **Orbit insertion**
- **Orbit maintenance**
- **Fine pointing**
- **Major parts**
- **Attitude Control System**
- **Orbit Control System**

ORBIT INSERTION - GEO

- TWO BASIC TYPES OF GEO INSERTION:
- High-Energy Apogee Kick Motor firing

  . A few minutes, symmetrical about apogee

- Low-Energy AOCS burn

  .Tens of minutes to > one hour burns, symmetrical about apogee

  .Uses Dual-Mode thrusters; i.e. thrusters used for

ORBIT MAINTENANCE - 1

- Must Control Location In GEO &Position Within Constellation
- Satellites Need In-plane (E-W) & Out-of-plane (N-S) Maneuvers To Maintain The correct Orbit
- Leo Systems Less Affected By Sun and moon But may need more Orbit-phasing control
-

ORBIT MAINTENANCE - 2

- GEO STATION-KEEPING BURNS ABOUT EVERY 4 WEEKS FOR +-0.05
- DO N-S AND E-W ALTERNATELY
- N-S REQUIRES ^10x E-W ENERGY
- RECENT APPROACH USES DIFFERENT THRUSTERS FOR E-W AND N-S

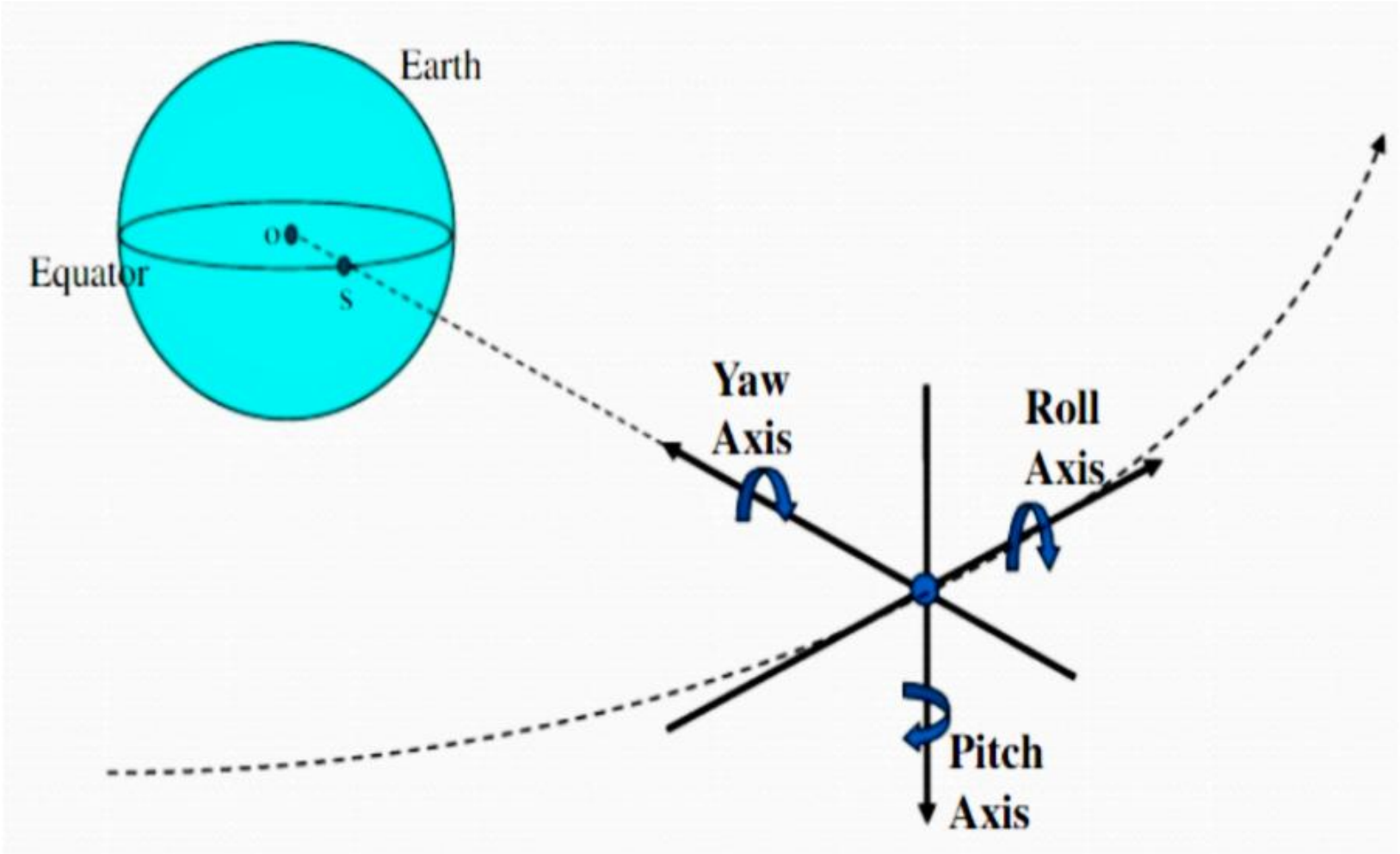
FINE POINTING

- SATELLITE MUST BE STABILIZED TO PREVENT NUTATION (WOBBLE)
- THERE ARE TWO PRINCIPAL FORMS OF ATTITUDE STABILIZATION
- BODY STABILIZED (SPINNERS, SUCH AS INTELSAT VI)
- THREE-AXIS STABILIZED (SUCH AS THE ACTS,GPS, ETC.)

DEFINITION OF AXES - 1

- ROLL AXIS
- Rotates around the axis tangent to the orbital plane (N-S on the earth)
- PITCH AXIS
- Moves around the axis perpendicular to the orbital plane (E-W on the earth)
- YAW AXIS
- Moves around the axis of the subsatellite point

DEFINITION OF AXES



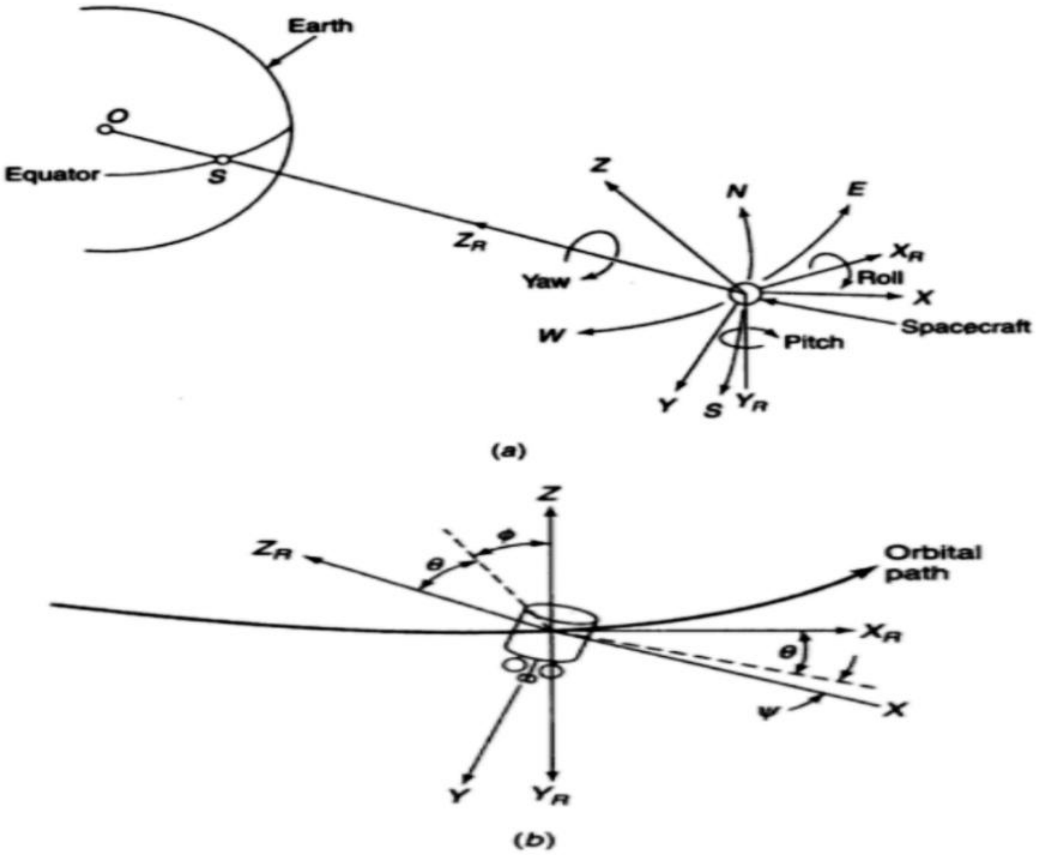


FIGURE 3.4 (*a*) Forces on a satellite. (*b*) Relationship between axes of a satellite.

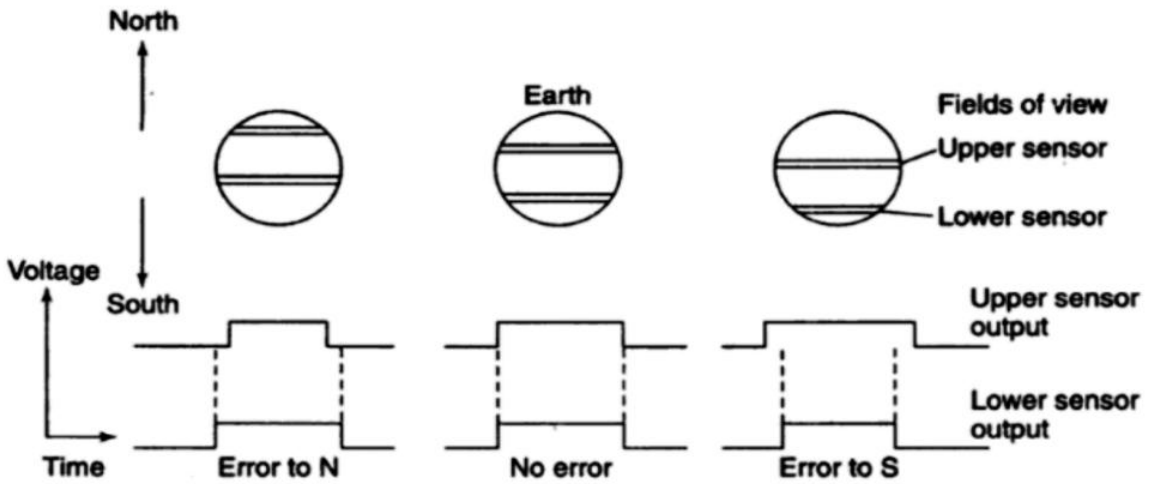


FIGURE 3.5 Principle of N–S control of a spinner satellite using infrared Earth sensors.

Figure 3.5 illustrates how an infrared sensor on the spinning body of a satellite can be used to control pointing toward the earth. Figure 3.6 shows a typical control system loop using the technique illustrated in Figure 3.5. The control system will be more complex for a three-axis stabilized satellite and may employ an onboard computer to process the sensor data and command the gas jets and momentum wheels.

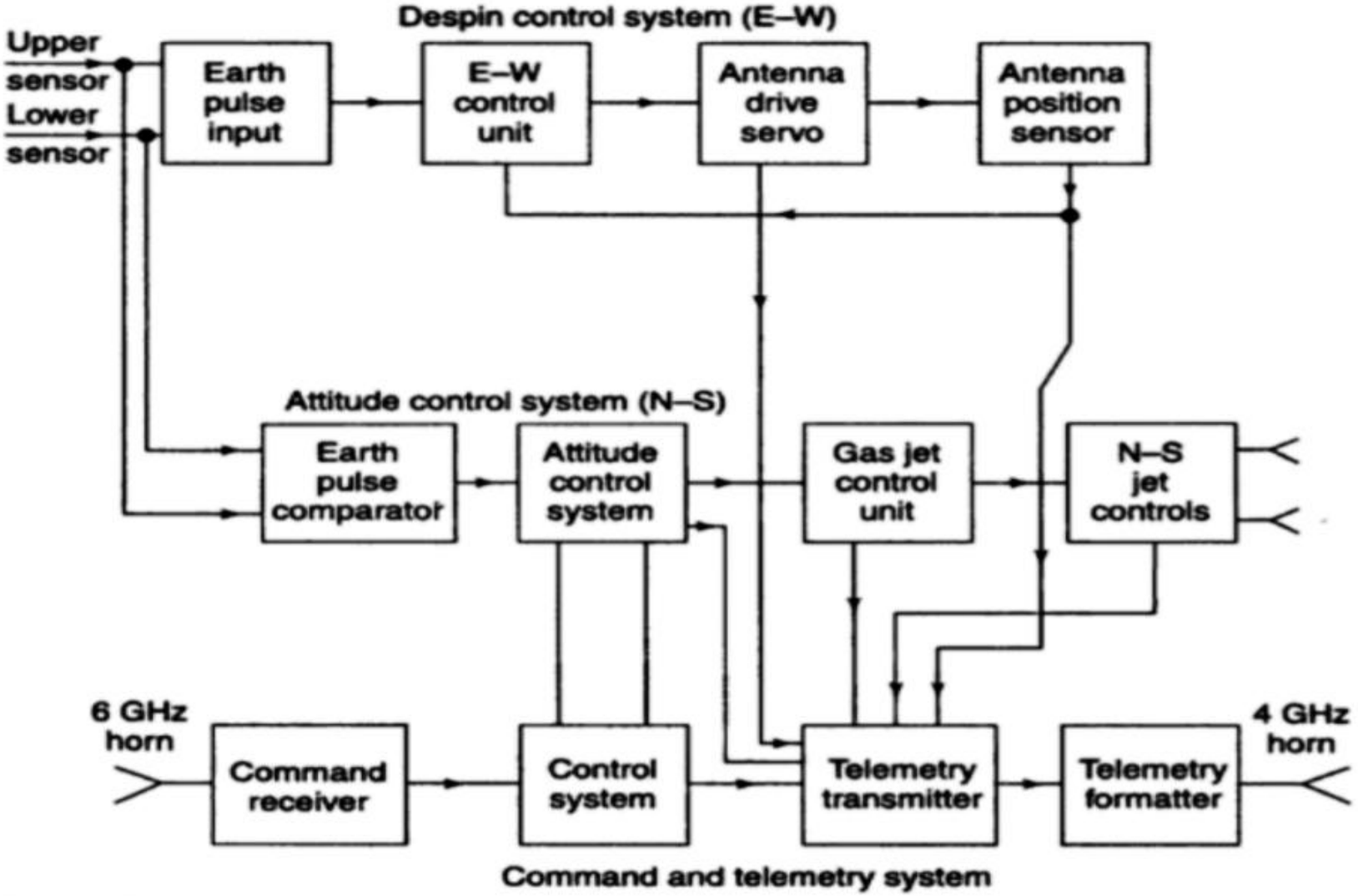


FIGURE 3.6 Typical onboard control system for a spinner satellite.