UNIVERSITY OF Southampton

Chapter 5: Mission Analysis

Lecture 15 – Impact on spacecraft & recap

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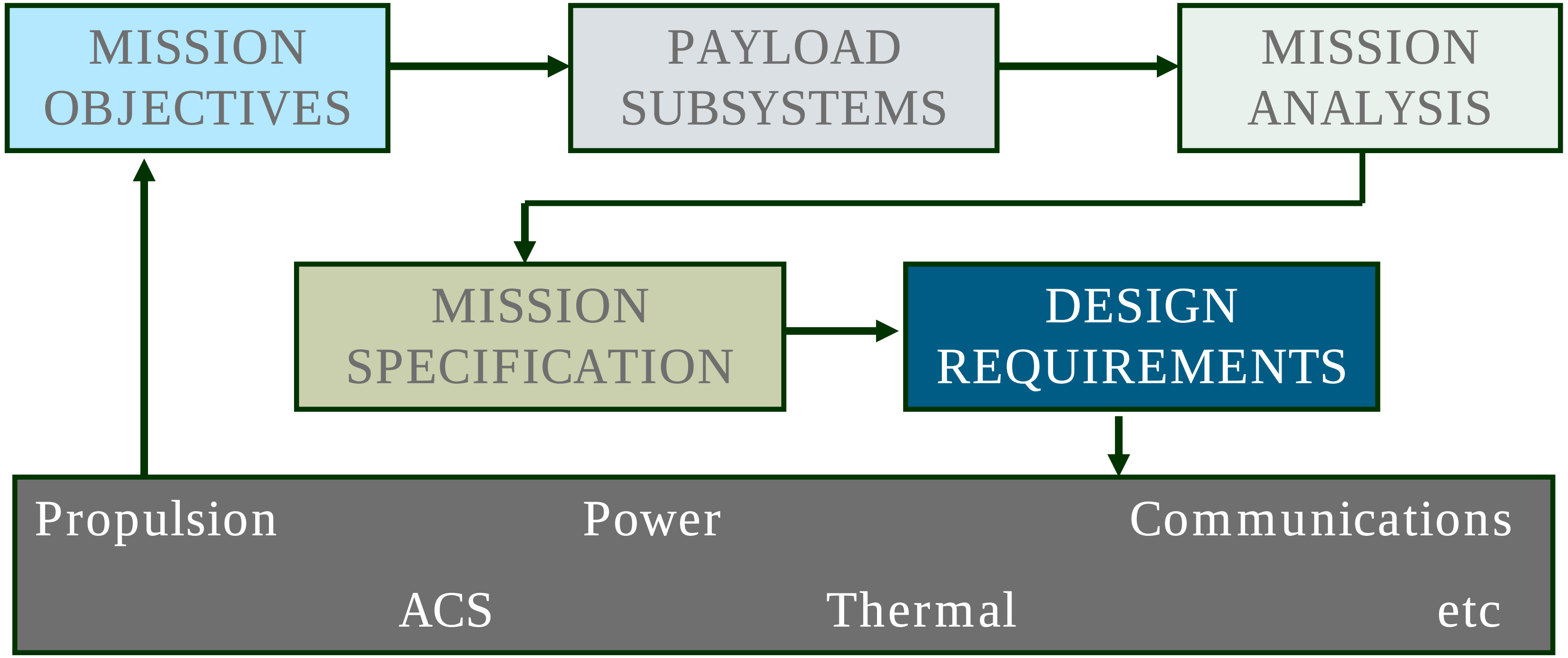
Overview of lecture 15

- This is a short lecture that highlights how the choice of orbit affects the spacecraft sub-systems
  - This is covered only at a high level and through the use of an example
    - The example shows how the selection of a LEO or GEO solution can affect the propulsion, power, thermal & communications sub-systems

- The lecture also looks back at the mission analysis chapter to remind you of the key things we looked at

Impact on spacecraft

- Mission analysis is a systems-level activity that has a large impact on overall spacecraft design, leading to an iterative design methodology:



Impact on spacecraft

- Mission analysis is a systems-level activity that has a large impact on overall spacecraft design, leading to an <u>iterative</u> design methodology:

Example	**Top-level impact of orbit choice on S/C subsystems: LEO vs. GEO**
Propulsion	Primary propulsion required for transfer to GEO, but not (necessarily) for LEO
Power	Eclipse history in LEO differs from GEO. Impact: - different array size, different battery requirement Radiation environment in LEO less severe than GEO Impact: - differing array and electronics degradation

Impact on spacecraft

- Mission analysis is a systems-level activity that has a large impact on overall spacecraft design, leading to an iterative design methodology:

Thermal	Differing eclipse histories influence solar thermal input to S/C Impact on thermal control
Comms & Data Handling	Differing ground station coverage and transmission path length. Impact: - comms link, comms system design (range rate), antenna pointing, solid state devices (radiation env.)

Mission analysis is a very influential system-level activity

Recap of chapter 5

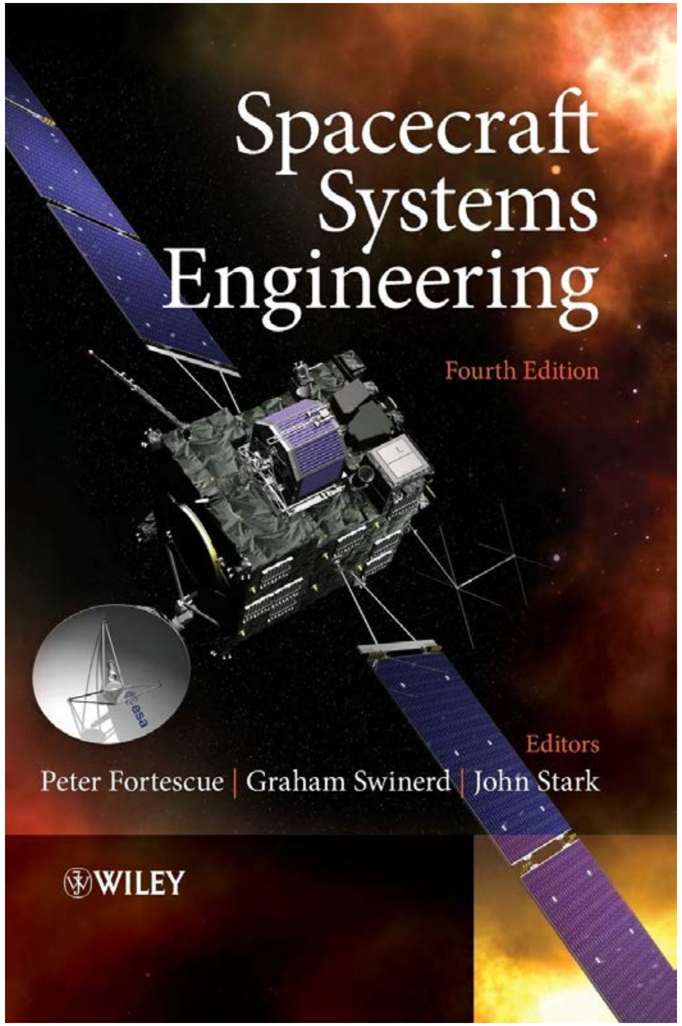
- The contents of this chapter were divided into 15 recorded lectures & activities:

1. Introduction to mission analysis
2. Kepler's Laws
3. The ellipse equation
4. Orbital motion – part 1
5. Orbital motion – part 2
6. Confirming Kepler's Laws
7. Orbital elements
8. Orbit visualisation activity
9. Orbital energy
10. Orbital energy worked example
11. Orbital transfers
12. Hohmann transfer visualisation activity
13. Hohmann transfer worked example
14. Orbit selection
15. Impacts on spacecraft & recap

- We started with the work by Kepler and Newton to understand the motion of planets around the Sun (and, hence, the motion of spacecraft around planets or the Sun)
- We used mathematics (Newton's Laws & calculus) to prove Kepler's Laws of Planetary Motion
- We looked at how to describe & define an orbit using orbital elements.
- We used energy considerations to define the "energy equation", which allowed us to calculate the speed of a spacecraft anywhere on its orbit
- We made some assumptions about impulsive transfers & used the energy equation to calculate the "delta V" for a fundamental transfer manoeuvre: the Hohmann transfer.
- We looked briefly at how to select an appropriate orbit and then considered the impacts on the spacecraft subsystems

Activity

- If you have not yet looked at chapters 4 & 5 of Fortescue, Stark & Swinerd, then you can do so now:
  - Chapter 4, up to an including the “Specifying the Orbit” section
  - Chapter 5, up to and including the “Mission Analysis” section
  - Access to the e-book is available via the Library website: https://onlinelibrary.wiley.com/doi/book/10.1002/9781119971009



See you next time!

- See you for the coursework briefing and Chapter 11