Reverse Engineering 1

Missions – Homework 1

- Understand the mission high level goals
- Identify mission drivers, if any
- Perform the mission functional analysis
- Identify its main phases
- Link phases to ConOps and functionalities
- Understand the on board scientific instruments primary utilisation:
    - Correlate goal-to payloads functions
    - Correlate p\l to conops\phases
- Start correlating functionalities-phases trajectory design (MA understanding)
- Start reverse the trajectory design per phase towards the Dv budget justification and retrieval.

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Reverse Engineering 2

Missions – Homework 2

- Understand the mission propulsion architecture
- Indentify the solutions for **primary and secondary** propulsion and clarify the rationale for the adopted design
- Find the rationale for and justify the selected propulsion type and architecture according to:
  - Operations\phases
  - ΔV budget breakdown
- Understand and justify, through reverse sizing:
  - Propellant selection and masses
  - Tanks sizing (propellant\pressurant),number, material adopted
  - Pressurant selection and masses
  - Feeding strategy selection and sizing
  - No of thrusters
  - Positioning of thrusters in the configuration
  - Positioning of tanks and lines in the configuration

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Reverse Engineering 3

Missions – Homework 3

- Understand the mission TTMTC architecture
- Indentify the solutions for TTMTC subsystem and clarify the rationale for the adopted design
- Find the rationale for and justify the selected TTMTC type and architecture according to:
  - Operations\phases
  - Data volume to transfer space2ground
- Understand and justify, through reverse sizing:
  - Frequency selection, datarate, band
  - Signal manipulation (encoding, modulation, etc)
  - Antenna selection, type,characteristics and numbers correlated to which frequency and for which data transfer
  - Ground station selection: where, which size\frequency\datarate
  - Amplifier selection
  - Contact strategy: contact windows duration and data volume transferred per contact (average)
  - Link budget U\D
  - Positioning of the antennae the configuration
  - Subsystem architecture

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Reverse Engineering 4

Missions – Homework 4

- Understand the mission AOCS architecture
- Indentify the solutions for AOCS subsystem and clarify the rationale for the adopted design
- Find the rationale for and justify the selected AOCS type and architecture according to:
  - Control mode
  - Pointing budget

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- Understand and justify, through reverse sizing:
  - Poiting budgets inputs for each subsystem involved: AKE, APE, drift, rates
  - Attitude sensor suite selection according to mode – redundancy included
  - Attitude actuator suite selection according to mode
  - Attitude sensor sizing according to pointing knowledge needs, per mode
  - Disturbances effects, slew manuevers, per mode\phase
  - Attitude actuator sizing according to disturbances and requested slew maneuvers per mode (torque, angular momentum, thrust, dipole, etc) – redundancy included
  - Fuel mass sizing according to: attitude SK, maneuvers, desaturation, if any
  - Subsystem budgets: mass, power, data
  - Positioning of the sensors and actuators in the s\c configuration

Reverse Engineering 5

Missions – Homework 5

- Understand the mission TCS solutions
- Indentify the solutions applied for the TCS subsystem and clarify the rationale for the adopted design
- Justify the selected TCS architecture according to:
  - External\internal thermal fluxes encountered along the mission phases
  - Requested temperature intervals to be respected on board
- Understand and justify, through reverse sizing:
  - Cold and hot case selection, along the whole mission
  - Adopted control strategy, passive &\or active (e.g.painting,blankets, strips,heaters, etc)
  - Selected materials and areas for passive control
  - Needed electric power for active control, if any
  - Units specifically controlled, if any
  - Subsystem budgets: mass, power, data
  - Positioning of the control components (e.g.surfaces, radiators, heaters, peltier, etc) in the s\c configuration
  - Imposed specific pointing direction for any passive control surface

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Reverse Engineering 6

Missions – Homework 6

- Understand the mission EPS solutions
- Indentify the solutions applied for the EPS subsystem and clarify the rationale for the adopted design
- Justify the selected EPS architecture according to:
  - Electrical Power&Energy requested by on board s\s in each mission phases
  - Operational profiles and available sources (i.e. distance from the Sun, Aspect angle,etc)
- Understand and justify, through reverse sizing:
  - Power budget supplied per phase\mode per subsystem
  - Primary source selection and sizing: area\configuration, mass, power demand, #, topology (if applicable), conversion efficiency
  - Secondary source selection and sizing (if any): mass, #, size, energy density, topology, DOD
  - Primary source regulation adopted strategy
  - Bus regulation adopted strategy
  - Subsystem budgets: mass, power, volume, data
  - Positioning of the components in the s\c configuration: PV arrays\wings, battery packages, RTGs
  - specific pointing direction requirements

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Reverse Engineering 7

Missions – Homework 7

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- Understand the configuration of the space segment
- Understand and justify, through reverse sizing:
  - the overall vehicle shape and appendages distribution according to their operational needs and technical requirements
  - The launcher interface location and featuresand the vehicle configuration when in the launcher fairing
  - the distribution of the elements on the external surface: location, distance\proximity with other components, direction of the FOV, pointing needs, shadowing, etc. according to their operational requisites and constraints
  - the distribution\location of the internal elements with respect to their functionality and operational requisites and constraints: CoM balancing, thermal dissipation

Missions – Homework 7

- Understand the OBDH subsystem desing for the mission
- Identify and describe the adopted architecture in terms of:
    - OBDH components
    - OBDH adopted bus
- Justify the selected OBDH through reverse engineering sizing according to:
    - OBC features as frequency and throughputs by similiarity
    - On board memory size

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