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TRACCIA 4

1) ILLUSTRARE LE PROPRIE ATTIVITÀ/ESPERIENZE PROFESSIONALI.
2) ELENCARE E DESCRIVERE I PRINCIPALI SISTEMI DI BORDO DI UN SATELLITE.
3) IL CANDIDATO DESCRIVA LE FUNZIONI DEL COLLEGIO DEI REVISORI DELL'ASI AI SENSI DELLO STATUTO.

Esercitazione:

4) IL CANDIDATO REALIZZI IN EXCEL UNA TABELLA DI DATI DI SUA SCELTA E POI IMPOSTI UNA REGOLA DI FORMATTAZIONE CONDIZIONALE DI SUA SCELTA.

Prova di Inglese:

5) LEGGERE E TRADURRE IL TESTO IN INGLESE SOTTOPOSTO DALLA COMMISSIONE.

multi-satellite constellation by looking at its response to a simple situation, such as one fire or a small group of uniformly distributed fires. This trial run will suggest how the system performs and how changes affect it. We can then apply this understanding as we develop more realistic simulations.

A related problem concerns using a baseline scenario to compare options and designs. Repeating a single scenario allows us to understand the scenario and the system's response to it. We can also establish quantitative differences by showing how different designs respond to the same scenario. But this approach tends to mask characteristics that might arise solely from a particular scenario. Thus, we must understand what happens as the baseline changes and watch for chance results developing from our choice of a particular baseline scenario.

Finally, mission simulations must generate usable and understandable information for decision makers—information that provides physical insight. Two examples are strip charts of various system characteristics and animated output. A *strip chart* plot is similar to the output of a seismograph or any multi-pin plotter, in which various characteristics are plotted as a function of time. These characteristics might include, for example, whether a particular satellite is in eclipse, how much time it spends in active observation, and the spacecraft attitude during a particular time step. Plots of this type give a good feel for the flow of events as the simulation proceeds.

A valuable alternative for understanding the flow of events is looking at an animation of the output, such as a picture of the Earth showing various changes in the target, background, and observation geometry as the satellites fly overhead. Thus, as Fig. 3-4 illustrates, an animated simulation of FireSat output could be a map of a fire-sensitive region with areas changing color as fires begin, lines showing satellite coverage, and indications as to when fires are first detected or when mapping of fires occurs. Animation is not as numerical as statistical data, but it shows more clearly how the satellite system is working and how well it will meet broad objectives. Thus, mission analysts and end users can assess the system's performance, strengths and shortcomings, and the changes needed to make it work better.

3.3.3 Commercial Mission Analysis and Mission Utility Tools

Creating a mission utility simulation for your specific mission or mission concept is both time consuming and expensive. It is not uncommon for the simulation to be completed at nearly the same time as the end of the study, such that there is relatively little time to use the simulation to effectively explore the multitude of options available to the innovative system designer.

In my view, the single largest step in reducing software cost and risk is the use of commercial, off-the-shelf (COTS) software. The basic role of COTS software in space is to spread the development cost over multiple programs and reduce the risk by using software that has been tested and used many times before. Because the number of purchasers of space software is extremely small, the savings will be nowhere near as large as for commercial word processors. Nonetheless, reductions in cost, schedule, and risk can be substantial. Most COTS software should be at least 5 times cheaper than program-unique software and is typically 10 or more times less expensive. In addition, COTS software will ordinarily have much better documentation and user interfaces and will be more flexible and robust, able to support various missions and circumstances.

The use of COTS software is growing, but most large companies and government agencies still develop their own space-related software for several reasons. One of the

TRACCIA 2

1) *ILLUSTRARE LE PROPRIE ATTIVITÀ/ESPERIENZE PROFESSIONALI.*
2) *NELLA FILOSOFIA DI SVILUPPO DI TECNOLOGIE PER APPLICAZIONI SPAZIALI DEI MODELLI, A COSA SERVE IL MODELLO STM (STRUCTURAL THERMAL MODEL)?*
3) *IL CANDIDATO DESCRIVA GENERICAMENTE I PRINCIPI DI BUON ANDAMENTO (ECONOMICITÀ, EFFICACIA E EFFICIENZA), IMPARZIALITÀ, PUBBLICITÀ E TRASPARENZA NEL DIRITTO AMMINISTRATIVO, ANCHE IN RIFERIMENTO ALLA COSTITUZIONE ITALIANA.*

Esercitazione:

4) *IL CANDIDATO REALIZZI IN POWER POINT UNA PRESENTAZIONE CHE CONTENGA UN GRAFICO A DISPERSIONE (X,Y) DI UNA CURVA DI SUA SCELTA.*

Prova di Inglese:

5) LEGGERE E TRADURRE IL TESTO IN INGLESE SOTTOPOSTO DALLA COMMISSIONE.

manufacturer recover the WaferSat materials and define what is to be done on the next flight? Payload operations will have a major impact on the cost of both the spacecraft and mission operations. As discussed in Chap. 15, payload operations may be done by the same facility and personnel that handle the spacecraft or, similar to the Space Telescope, may be an entirely different operations activity.

4. ***Determine the Required Payload Capability.*** What is the throughput and performance required of the payload equipment to meet the performance thresholds defined in Step 2? For FireSat what is the specification on the equipment needed to meet the temperature, resolution, or geolocation requirements? For WaferSat, how many wafers of what size will it produce? For mobile communications, now many phone calls or television channels must it handle simultaneously?

5. ***Identify Candidate Payloads.*** Here we identify the possible payloads and their specifications. For simple missions there will be a single payload instrument. For most missions, there will be multiple instruments or units which frequently must work together to meet mission requirements. Different complements of equipment may break the tasks down in different ways and may even work with different aspects of the subject. Thus, a system designed to identify the source of solar storms may have an imager and a spectrometer or a magnetometer and an instrument to map small temperature fluctuations on the photosphere or in the solar wind.

6. ***Estimate Candidate Payload Characteristics.*** Here we need to determine the performance characteristics, the cost, and the impact on the spacecraft bus and ground system so that we can understand the cost vs. performance for each of the viable candidate systems. Payloads will differ in their performance and cost, but also in weight, power, pointing, data rate, thermal, structural support, orbit, commanding, and processing requirements. We must know all of these impacts to conduct meaningful trades.

7. ***Evaluate Candidates and Select a Baseline.*** Here we examine the alternatives and make a preliminary selection of the payload combination that will best meet our cost and performance objectives. In selecting a baseline, we must decide which elements of performance are worth how much money. The payload baseline is strongly related to the mission baseline and can not be defined in isolation of the rest of the parts of the mission and what it will be able do for the end user.

8. ***Assess Life-cycle Cost and Operability.*** Ultimately, we want to determine mission utility as a function of cost. This process was described in detail in Chap. 3. Typically it will not be a simple cost vs. level of performance characterization. Rather it is a complex trade that requires substantial interaction with potential users and with whatever organization is funding the activity. It may become necessary at this point to relax or prioritize some of the mission requirements in order to meet cost and schedule objectives. For FireSat we may decide that only one type of fire or one geographic region will be addressed. For WaferSat we may reduce the purity, the size of the wafers, or the throughput.

9. ***Define Payload-derived Requirements.*** In this step we provide a detailed definition of the impact of the selected payloads on the requirements for the rest of the system (i.e., the spacecraft bus, the ground segment, and mission operations). FireSat will have power, pointing, geolocation, and data rate requirements. WaferSat may care very little about pointing and geolocation, but will have requirements on the spacecraft cleanliness levels and jitter control. These, in turn, may levy secondary requirements such as storage for onboard commands or thermal stability for pointing and jitter control.

TRACCIA N. 1

1) *ILLUSTRARE LE PROPRIE ATTIVITÀ/ESPERIENZE PROFESSIONALI.*
2) *DESCRIVERE BREVEMENTE LE CONSEGUENZE SULL'UOMO O SUI MATERIALI CAUSATE DALL'ESPOSIZIONE IN AMBIENTI CON ALTI LIVELLI DI RADIAZIONI.*
3) *MISSIONI E OBIETTIVI DELL'ASI COME DECLINATI DAI DOCUMENTI ISTITUZIONALI VIGENTI.*

Esercitazione:

4) *IL CANDIDATO REALIZZI UNA/DUE SLIDE IN POWER POINT CHE SINTETIZZINO LA SUA ESPERIENZA DI RICERCA.*

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preparation and boost. We must also consider safety issues, but RTG sources are probably safer than most propellants. The design must ensure that the generator remains intact and shielded even during catastrophic launch failure.

Using rotating machines to generate primary power is another design with potential. Closed-cycle, thermal engines should be nearly twice as efficient as solar cells, and rotating generators can provide sine-wave AC power with better regulation than solar-cell designs.

10.4.7 Structures and Mechanisms

The spacecraft structure carries and protects the spacecraft and payload equipment through the launch environment and deploys the spacecraft after orbit injection. The load-carrying structure of a spacecraft is *primary structure*, whereas brackets, closeout panels, and most deployable components are *secondary structure*.

We size primary structure based on the launch loads, with strength and stiffness dominating its design. The size of secondary structure depends on on-orbit factors rather than boost-phase loads. Secondary structure only has to survive but not function during boost, and we can usually cage and protect deployables throughout this phase.

Each of the launch boosters provides maximum acceleration levels to be used for design (see Chap. 18). These acceleration levels or load factors are typically 6 g's maximum axial acceleration and 3 g's maximum lateral acceleration. These levels work for conceptual design, but some designers prefer to increase them by as much as 50% during early design phases. During preliminary sizing, we must remember that the primary structure must carry some weight, such as kick motors and propellant, which will drop away before orbit injection. Section 11.6 discusses structural design and presents methods for preliminary structural sizing.

We use cylindrical and conical shell structures and trusses for primary structure, commonly building them out of aluminum and magnesium with titanium for end fittings and high-strength attachments. Composite materials have seen limited use in primary structure to date but they will become more common. We can size primary structure by modeling it as a cylindrical beam which is mass loaded by its own weight and the spacecraft's components. The lateral load factors applied to this beam produce a moment that is a function of axial location. Compression in the extreme section of the beam carries the moment. By adding the axial load to the moment-induced, compressive load, we can estimate the critical load, which in turn sizes the primary structure (see Eq. 11-42). In these preliminary sizing calculations, we can exercise much license in assuming symmetry and in simplifying the loads. We can iterate the skin gage to withstand stress levels and check the tubular design for buckling (see Sec. 11.6.6).

We use a similar approach to size a truss-based primary structure. We reduce the truss to its simplest form by successively removing redundant members until we reach a statically determinant structure. Simply combining loading conditions allows us to size the truss members.

We must also locate and mount components on the basic, load-carrying cylinder or truss. Most electronic components have rectangular symmetry and are mounted with lugs or bosses integral to their housings. Mounting requirements include loads, good thermal contact with the mounting surface, and good electrical contact. Aluminum honeycomb is an excellent mount for components. It attaches to longeron-stringer frames to form a *semi-monocoque* (load-carrying skin) structure. Honeycomb sheets with composite faces occasionally substitute for other approaches.

TRACCIA N. 6

1) *ILLUSTRARE LE PROPRIE ATTIVITÀ/ESPERIENZE PROFESSIONALI.*
2) *LA SCOPERTA DI ACQUA LIQUIDA AL DI SOTTO DELLA SUPERFICIE DI MARTE È CONDIZIONE SUFFICIENTE PER AFFERMARE CHE IL PIANETA POSSIEDE LE CONDIZIONI DI ABITABILITÀ?*
3) *GLI STAKEHOLDERS DELL'ASI, E IN PARTICOLARE I PRINCIPALI ENTI PUBBLICI DI RICERCA CON I QUALI L'AGENZIA INTRATTIENE COLLABORAZIONI.*

Esercitazione:

4) *IL CANDIDATO REALIZZI IN WORD UN DOCUMENTO CHE CONTENGA LE DOMANDE DELL'ESAME AGGIUNGENDO INTESTAZIONE E PIÈ DI PAGINA DI SUA SCELTA.*

Prova di Inglese:

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9.2 Mission Requirements and Subject Trades

Defining requirements and constraints for space missions occurs as described in Chaps. 1 and 2. The overall mission requirements dictate the technical performance of the payload, while the mission concepts and constraints determine the operational implementation for the mission. Frequently the technical specification and operations concept for payloads are interrelated. For example, increasing temporal resolution (revisit) may reduce the requirement for spatial resolution in an optical sensor system. We must ensure that the mission requirements capture the fundamental needs of the users without constraining the designer's ability to satisfy these requirements through alternate technical means.

For FireSat we begin with the overall mission requirement to detect, identify, and locate forest fires, then consider the level of detail needed to satisfy the mission. Often it is useful to articulate the questions that need to be answered or the decisions that need to be made based on sensor data. Possible questions for the FireSat mission planners include:

- Can a new fire be detected within 2 hours? Twenty minutes?
- What is the geographic extent of the fire?
- Can smoldering fires be distinguished from flaming fires?
- What are the primary combustibles (can fires burning organic material be distinguished from petroleum and chemical fires)?
- What direction is the fire spreading and how quickly?
- How much smoke and ash is the fire generating?
- Where is the fire burning hottest?
- At which locations would additional firefighting efforts to contain and suppress the fire be most effective?
- What other sources of information exist from air-, ground-, or space-based sources?
- If available, how might other sources of information be used?

Specific mission objectives and priorities addressed by these questions will determine the specific observables linking payload performance with mission performance. To choose a remote sensing payload, the key steps to a disciplined and repeatable design begin with determining the elements of information that we need to address the problem. We must specify the physically observable quantities that contribute to elements of information about the problem in sufficient detail to ensure they can be detected by a spacecraft payload with sufficient resolution to provide meaningful insight into the subject.

Establishing performance thresholds provides a framework for trading off performance across a number of different design features. For all missions, payload performance evaluation categories include physical performance constraints and operational constraints. Examples of physical performance constraints include limits on spatial, spectral, radiometric, and temporal resolution. Operational constraints include sensor duty cycle limits, tasking and scheduling limits on sensor time, and resource contention (inability of the sensor to view two targets of interest simultaneously).