

# Space System Verification and Validation

## A Satellite Hardware Learning Laboratory

### Course Description

This 3 or 4 day Space Systems Verification and Validation course provides participants with the processes, industry standards, information, and tools necessary to implement or evaluate a credible verification and validation program.

Emphasis is on practice over theory using a fully-functional (hardware and software) desktop (non-flight) 3U CubeSat — EssentialSAT (ESat) as the system of interest. Using ESat, the course follows the logical development of the assembly, integration and verification (AIV) Plan for a hypothetical mission — NanoMet-2 – designed to deliver large scale meteorological imagery from LEO. NanoMet-2 serves as an end-to-end V&V engineering case study to examine the complete traceability from design requirements to verification requirements to verification event implementation and close out. Application of MBSE tools for managing this process is highlighted.

Participants are provided with key lectures and resources and asked to use these processes, tools and information to develop validation and verification plans and then implement them in a hands-on laboratory where they will learn by doing.

### Course Objectives

At the end of this course you'll be able to...

- ◆ Explain the end-to-end SE process and how it applies to system (and lower level) requirements definition, allocation, validation and verification.
- ◆ Describe the purpose and scope of key documents required in the validation and verification processes, and describe typical errors committed.
- ◆ Describe various methods of V&V, when they are appropriate, and how they are used as part of a verification plan for a system of interest
- ◆ Determine appropriate circumstances and applicability of verification methods to prototype and proto-flight systems.
- ◆ Analyze representative verification plans, test sequences and activities for an example system of interest (spacecraft).
- ◆ Develop, evaluate and implement a master verification plan for a space system including hardware, software and associated ground support equipment (GSE).
- ◆ Apply processes and techniques in a hands-on workshop associated with a system of interest.
- ◆ Use applicable NASA, ECSS, DoD and Industry Standards and lessons learned to support system V&V decisions and activities.

### Course Materials

- A complete set of course notes with copies of all slides used in the presentations.
- An e-copy of the *Applied Space Systems Engineering* textbook

### Course Topics

- ◆ Intro to Space Systems Engineering
- ◆ The NanoMET-2 System of Interest
- ◆ Validating Requirements & Models
- ◆ Preparing for Product Verification 1
- ◆ Verification for the Launch & Space Environment
- ◆ Environmental Test Venues
- ◆ Preparing for Product Verification 2
- ◆ Implementing Product Verification
- ◆ Software Verification & Validation
- ◆ V&V of COTS
- ◆ Validating Products and Flight Certification
- ◆ Integrated hands-on exercises throughout

### Who Should Attend

Test engineers, systems engineers, payload principle investigators, subsystem engineers or project managers involved in any phase of the product life cycle.

### Testimonials

*"The concepts that were taught around [V&V] are pivotal and directly related to [my] tasking in the coming year."*

*"Learned how...to review V&V planning from a broader system engineering perspective."*

*"I now have a broader perspective on V&V throughout the design/implement timeline."*