GSAW 2020 Tutorial A:

Model Based Systems Engineering for Ground Systems

Length: Full day

Overview:

1. **MBSE Introduction and Overview**
   - Overview of Model-Based Systems Engineering
   - Fundamental Concepts of Modeling
   - Models of Computation
   - Example Application of Models in Systems Engineering

2. **Front End Diagrams**
   - Package Diagrams
     - Diagram, description, purpose, and benefits
     - Model organization
     - Package relationships (contains, imports, extends)
     - Specialized packages: views/viewpoints, libraries, profiles
   - Use Case Diagrams
     - Diagram description, purpose, and benefits
     - Use case, actor, and subject
     - Basic relationships: association, include, extend, and generalization
     - Scenarios
   - Requirements Diagrams
     - Relationship between requirements and use cases
     - Creating requirements diagrams
     - Requirements relationships to other model elements
     - Representing requirements in tables and matrixes
     - Building a use case model using the basic set of SysML constructs

3. **Structure Diagrams**
   - Block Definition Diagrams
     - Definition vs. usage;
     - Block features including value types, value properties, parts, references, and operations.
     - Block Definition Diagram description, purpose, and benefits; compartments; relationships between blocks including specialization and associations
     - Multiplicities
   - Internal Block Diagrams
     - Internal Block Diagram description, purpose, and benefits
     - Instantiations
     - enclosing blocks and representation of parts.
     - flow ports and standard ports
     - connectors and item flows

   - Parametric Diagrams
     - Interpreting constraint blocks on Block Definition Diagrams
     - Parametric Diagram description, purpose, and benefits
     - constraint properties, constraint parameters, and constraint expressions
     - connecting constraint properties and value properties with binding connectors
     - quantitative examples

4. **Behavior Diagrams**
    - Activity Diagrams
        - Activity Diagram description, purpose, and benefits
        - I/O flow including object flow, parameters and parameter nodes, and pins
        - control flow including control nodes
        - activity partitions (swimlanes)
        - and actions including decomposition of activities using call behavior action
        - send signal action
        - accept event action.
    - Sequence Diagrams
        - *Messages; Lifelines:* Selectors, lifeline decomposition, Activations (including nested).
        - *Interaction operators:* Advanced interaction operators, Combining interaction operators, Nesting interaction operators.
        - *Interaction Decomposition:* Interaction Use or References, Gates.
        - *Constraints:* Observations and Timing Constraints, State invariants.
    - State Machines
        - State Machine Diagram description, purpose, and benefits
        - states and regions including state, regions, initial state and final state
        - transitions including trigger by time and signal events, guard, and action (i.e. effect)
        - and behaviors including entry, exit, and do

Instructor: Mark McKelvin Jr., The Aerospace Corporation

Biography:
Dr. Mark L. McKelvin, Jr. is a Senior Engineering Specialist in systems and software engineering at The Aerospace Corporation and President of the INCOSE-LA Chapter. Dr. McKelvin specializes in the use of model-based engineering techniques to develop solutions to architecture design challenges for cyber-physical and software-intensive systems. He is also a Lecturer in the System Architecting and Engineering graduate program at the University of Southern California, Viterbi School of Engineering where he teaches courses in Model-Based Systems Engineering and Systems Engineering Theory and Practice. Prior to joining the Aerospace Corporation, Dr. McKelvin worked at NASA/JPL as a software systems engineer, electrical systems engineer, and a lead fault protection engineer on a major flight system. His interests are in the application of modeling, analysis, and design of engineered systems, including cyber-physical, embedded, and software systems. He holds a Ph.D. in Electrical Engineering and Computer Sciences from the University of California, Berkeley with an emphasis in Electronic Design Automation and a Bachelor of Science in Electrical Engineering from Clark Atlanta University.

Description of Intended Students and Prerequisites:
Familiarity with ground systems architecture and general systems engineering processes.

What can Attendees Expect to Learn:
MBSE background and fundamentals, Types and uses of SysML diagrams, use of SysML in an MBSE process.