MATLAB EXPO 2018

DiSTERaP
Distributed Simulation Test Environment for Rapid Prototyping

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Distributed Simulation Test Environment for Rapid Prototyping

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Development and production of Full Missile System
To create and analyze a Missile and Missile System physical model to
- Flow down requirement
- Code Generation
- Missile and Missile System Performance Evaluation
- Rapid and Robust prototyping
To help in understanding the structure and behaviour of the system
- To help in designing the system before we commit to building it
- To understand product behaviour (both desirable and undesirable)
- To help in trade-off studies
- To help in developing specifications
- To help in product integration and testing
- To help in planning trials
- To help in training in the use of the system

- To help quantify system performance
- To help in demonstrating that we have met the customer requirements

To help in specifying, developing and proving software to be developed for the system
To understand the performance of the system in scenarios where we cannot do trials, for example:
- What is the probability of survival of a ship?
- Will a faulty missile hit the launch aircraft?
- What is the system performance in heavy countermeasures?
Distributed Simulation Test Environment for Rapid Prototyping

To have a distributed simulation architecture to support the rapid development and the testing of future missile systems.
MBD-A Model-Based Design Approach

All in one Simulation

Trade Off Analysis
Performance Evaluation

Real-Time MC Analysis

Code Generation

WCU Prototyping
• GNC ALGO IN 6DOF SIMULATION
• WELL DEFINED TEST PLAN

DEVELOPED & TESTED “STAND-ALONE”

• REAL TIME TEST (CiL)
• AUTOMATIC TEST ARCHITECTURE FROM SIMULINK MODEL
• AUTOMATIC SIMULATION MANAGEMENT USING MATLAB

ALGORITHM DESIGN Simulink

MONTE CARLO CAMPAIGN Simulink Model

MONTE CARLO CAMPAIGN Prototype Board

AUTOCODED BOARD

HWIL
- System Engineer develops the Models in Simulink
- Generate C code, from the Model, in automatic mode
- Test the algorithms on Real Time Target
- Analyse the results and update the models if it is necessary
- Repeat the process as far as will be obtain satisfactory results
Example of Missile Simulation

- TARGET
- Other System Component
- Umbilical / DATA - LINK
- SEEKER EO
- Inertial Measurement Unit
- GPS
- Other Sensors
- Weapon Control Unit (WCU)
- ACTUATORS
- MOTOR
- MISSILE DYNAMICS & ENVIRONMENT MODEL

Guidance Navigation and Control algorithms performance evaluation in simulation (MiL – Model in the Loop)
Guidance Navigation and Control algorithms performance evaluation on WCU prototype (CiL – Computer in the Loop)
HW Analysis performed in early phase of Project

A. GCN Algorithms performance evaluation directly on prototype of WCU made in the first phase of design

B. GCN Algorithms performance evaluation directly on different HW with comparison purpose
Communication with Real-Time Computer
- Receive
  - Simulation Equipment Bus (LRF, IMU, GPS)
  - Simulation Umbilical & Data-Link Messages
- Send
  - Seeker / Motor on
  - Wing Deflection

Communication with Gimbal
- Receive
  - Tracking Message (on-call)
  - Gimbal Status
- Send
  - Set Mode / Set Position

SW INTERFACE EMBEDDED IN SIMULINK MODEL USING LEGACY CODE TOOL
DiSTERaP and DO178C Certification Process

FROM REQUIREMENT TO VERIFICATION/VALIDATION ON PROTOTYPE OF WCU

Defined from GOLDEN MODEL

DiSTERaP

Performance Assessment PIL

Code Generation

System Requirements

- Simulink 3DOF Model
- MBSE

Functional & Performance Requirements

Safety Requirements

- ARP 4754

STAKEHOLDER REQUIREMENTS

SW HLR

SW LLR

DO-331/DO178C

Verification & Validation on Prototype of WCU

All SW Requirements are linked to GCN,MM Function

Performance Assessment
Code Certification:

- Pass through different stages
- Provide evidence of compliance with specification and standards
  - ✔ For each stage a certain number of certified document will be produced

Provide evidence that used SW and HW are certified: Qualification Plan
SUMMARY

- Development Algorithm
- Performance analysis

- Prototype of final WCU
- ARM Processor
- POSIX Library OS

Next Step: Validate «on Flight» WCU fully developed using DiSTERaP Approach
Development Phase

ADD:
- Robustness to design: GCN Algorithms development considering HW performance

REDUCE
- V&V Time
- Time to market

~ 50% time saving

Test on Embedded Board

SW Implementation

Algos/Model Design (Simulink/MATLAB)

~ 50% time saving

time

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Key Takeaways

1. Models established as golden reference companywide
2. Time-consuming programming tasks eliminated
3. Simulations and analysis accelerated

USE OF «GOLDEN MODEL» AS A KEY DRIVE FACTOR IN YOUR DESIGN, IN FULL PRODUCT DEVELOPMENT PHASE
Thank you

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