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Avionics & Weapons System Flight Test

Instructor: Robert McShea

August 28-31, 2006
San Diego, CA

Spreadsheet Aided Engineering

Instructors: Dr. Tom R Mincer & David R McDaniel, M.S.

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Professional Education International



Avionics & Weapons Systems Flight Test

Focus

This four-day course addresses the evolution of the flight test program: the need for the flight test program, assets required and the data types identified. The mystery of decrypting 1553 data, setting realistic testing goals and analyzing test data are explained. The types of Time Space Position Information (TSPi) are discussed as well as their relationship with test requirements. The differences in test programs and organizational structures are explained as well as the test community's relationship with the customer. The latest advancements in data acquisition, correlation, merging and analysis will be studied with an emphasis on true performance vs. the predicted. Each section contains an in class exercise used to reinforce the lecture series. A new section on Statistics Requirements for the Flight Test Engineer has been added at the request of previous participants. This section will attempt to answer the age old question, "How many test points do I need?" The lecture is augmented with video instruction as well as real life examples of flight test success and failures.

Instructor



Robert E. McShea, B.S. Aeronautical Engineering, Syracuse University, **Director**, Avionics and Systems Academic Programs at the **National Test Pilot School**, Mojave, CA. Responsible for the formulation, preparation and instruction of all Avionics and Weapons Systems taught at the school. Mr McShea was formerly employed as a Senior Technical Specialist at the Northrop-Grumman Corporation in Palm-dale, California. His primary responsibilities include the integration, development and test requirements definition or the B-2 RADAR. Prior to that assignment, he was employed by the Grumman Corporation in Calverton Long Island as a

Group Manager for Avionics and Weapons Systems Test, Test and Evaluation Department. His responsibilities included the development and test of new and upgraded avionics and weapons systems. A collateral duty involved the development of lectures on Flight Test Methodology and Requirements presented to potential FMS customers. Past positions within Grumman include: Project Engineer, F-14D Super Tomcat, Lead Test Conductor and Team Leader, F-14D upgrade, Research Engineer, Inertially Guided Technology Demonstrator, and Lead Vehicle Systems Test Engineer, X-29A Forward Swept Wing Technology Demonstrator. Mr. McShea was formally a Captain in the US Air Force flying as a Weapons Systems Officer in the F-4 C/D/E aircraft. He has presented and published papers for AIAA: Flight Testing of the X-29A Technology Demonstrator and SFTE Symposium Advanced Techniques in Avionics Systems Flight Test .

Audience

This course is designed for personnel involved with requirements definition, integration, development and test of avionics and weapons systems. Although the course is slanted to the test of systems in flight, the concepts are valid for ground and flight labs as well. Engineers new to the field as well as test managers will gain useful information from the course. Time is allotted within each section to discuss problems/questions which may be of particular interest to individual participants. No previous course or prior experience is required.

Outline

Overview

- What is Flight Test
- Why is there a need for Flight Test
- Program Concepts/Goals
- Contractual Requirements
- DTE/OTE Differences
- Demonstration/Spec Compliance

System Architecture

- 1553/1760 Bus Overview
- Data Words and Messages
- Bus Controllers and Remote Terminals
- Other Data Busses (ARINC 429, EBR-1553, IEEE 1394b)

Range Sources/Attributes/TSPi

- Types of Time, Space, Position Information
- Accuracies
- Sensor Fusion
- GPS/DGPS
- Threat Emitter Ranges

Crew Station Evaluation and Human Factors

- Purpose of the Crew Station Evaluation
- Minimum Crew Requirements
- Workload and Workload Assessment
- Subjective Rating Scales

Controls and Displays

- Types of Testing
- Evaluation and Functional Tests
- Requirements and Pertinent Documentation

Statistics Used in Avionics Testing

- Circular Error Probable
- Distributions
- Confidence Intervals
- Determination of Data Collection Requirements

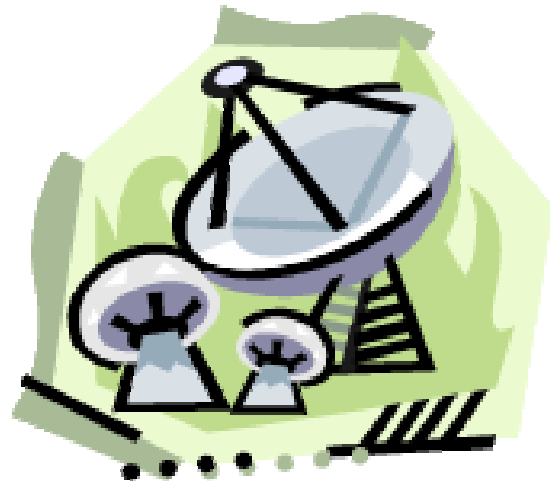
Typical Avionics and Weapons Systems

- Electro-magnetic Interference and Compatibility (EMI/EMC)
- Communications
- INS
- GPS
- RADAR
- EO/IR

A Typical Flight Test Program

- Defining the Test
- Asset Planning
- Estimating
- Preparation of the Test Plan
- Test Objectives/Points/Cards
- Brief. Debrief and Conduct of Flight
- Flight Analysis and Reporting

Lessons Learned



Spreadsheet Aided Engineering

Workshop Instructors



Tom R. Mincer, Ph.D., Founder and President of SpreadsheetWorld, Inc. and Professor of Mechanical Engineering, California State University, Northridge (CSUN). Dr. Mincer is widely recognized as an early pioneer in the extensive use of Excel, VBA and FORTRAN DLLs in engineering. In 1985, he initiated extensive use of Excel into

the curriculum at CSUN by integrating it into the courses on systems design, computational methods and computer-aided-engineering. For the past 15 years he has worked extensively in the areas of systems design, simulation and optimization using the Excel Structured Spreadsheet environment. In 1995, he extended his efforts to industry by launching his popular hands-on workshop on **Spreadsheet Aided Engineering**, which has now been taught over 150 times to engineers from over 150 companies worldwide. Alumni from these workshops exceed 2,500 engineers. This workshop is offered on a regular basis at over 30 companies. Dr. Mincer founded SpreadsheetWorld to extend the training services to include development of a high quality line of engineering XLToolboxes, and process consulting services to enhance the implementation of the best practices and methods taught in his workshops for individuals and teams.



David R. McDaniel, M.S., Vice President, Applications Development, SpreadsheetWorld, Inc. and former Asst. Professor of Aeronautic, U.S. Air Force Academy. Mr. McDaniel made extensive use of Excel spreadsheets and VBA programming as a flight dynamics flight test engineer at the Air Force Flight Test Center at Edwards Air Force Base, California while testing and evaluating the B-2A and B-1B aircraft. He manages the continued upgrades for the SpreadsheetWorld Toolbox Manager as well as the ongoing development of specialized toolboxes which are integrated into Excel using the Toolbox Manager. Mr. McDaniel specializes in advanced Excel/VBA techniques such as the use of class modules, the development of custom dynamic link libraries, and the integration of these capabilities into higher level modeling and analysis loops. He has been teaching courses covering these topics as well as many other workshops for the past five years at various locations.

Computer Requirements

Attendees must bring their own laptop and have a complete installation of Excel, a CD-ROM drive and a mouse. Verify that the Solver; Analysis Toolpak Add-ins and the Excel and VBA help files have been installed.

Audience & Prerequisites

Engineers from all disciplines find these courses immediately useful, practical and eye-opening. Participants should have a computer background including basic keyboard and Excel skills.

Course Description

This workshop is designed to have an immediate impact on the way that Excel Spreadsheets are used in the engineering process. The underlying key to this change is for the user to gain experience and knowledge on the use of Visual Basic for Applications (VBA) in Excel. Extensive use of VBA is the key to unlocking all the features of Excel, and moving away from attempting to program on worksheets.

Those who attend this intensive hands-on workshop experience a dramatic change in their use of Excel and VBA. Benefits include increased productivity, automation of tedious tasks, increased use of XLToolboxes and Add-ins, development of re-usable functions, forms and templates, improved documentation and configuration management, and improved team interaction and parameter sharing.

Course Materials



Each participant receives a 3-volume set of workshop notes which include all the PowerPoint slides used during the workshop for concept discussion and setting up of workshop exercises. The CD-ROM contains an electronic version of the course notes; the course examples; engineering case studies;

and many SpreadsheetWorld Engineering XLToolboxes including **XL QuikPlot**, **XL Numerical Methods**, **XL Simulation**, **XL Thermal-Fluids**, **XL Heat Transfer**, **XL GasDynamics**, geometric modeling add-in, and data analysis add-in. It also includes the new and popular **Units Converter PowerBook** which brings a comprehensive capability of unit conversion as well as extensive engineering constant reference. Workshop attendees receive free updates on all included software for 5 years. Participants also receive 30-day demo copies of other selected XLToolboxes including **XL Eigenvalues**, **XLProPlot**, **XL Linear** and **Roark for Excel**. Participants also receive a copy of the course textbook *Computational VBA*, which is written by the course instructors.

The participants in this workshop will learn how to :

- Define the mission and process flows
- Define system physical object structure
- Create engineering information tables
- Develop re-useable system functional models
- Monitor the impact of key design and process variables
- Monitor performance and constraint functions
- Deal with implicit relationships using Goal Seeker
- Develop and use VBA Add-Ins for rapid modeling
- Use XLToolboxes to support modeling
- Solve systems of equality and inequality rules
- Dynamic system simulation
- Do system optimization using Solver
- Monitor System Requirements using Solver
- Setup system sensitivity maps about a design point
- Do dynamic system simulation in the optimization loop
- Setup Configuration Trade-Study Matrix
- Use Userforms for man-in-the-loop design and analysis
- Develop graphic user interfaces for systems design
- Setup system modeling for integrated design teams
- Use Fortran and C modules from Excel
- Use MATLAB models in Excel

For a complete outline go to:
www.peinternational.com/576



Professional Education International

Spreadsheet Aided Engineering

Key Workshop Topics of this hands-on engineering workshop include:

- The Excel/VBA Platform
- Structured Spreadsheets and Documentation
- Visual Basic for Applications (VBA)
- Building Engineering Function Libraries
- Object Oriented Programming
- Userforms & ActiveX for Project Control
- System Optimization & Rules Solving
- Numerical Methods for System Modeling
- Data & Data Analysis and Graphing
- Interfacing VBA & FORTRAN-DLLs

Call PEI today for details about this exciting workshop! See back page for schedule of offerings.



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Spreadsheet Aided Engineering On-Site Sponsor Members

The following organizations have sponsored on-site offerings of Spreadsheet Aided Engineering at their facility. Many of the organizations below sponsor these workshops on an on-going basis and comment on how their engineers benefit immediately by methods taught in SpreadsheetWorld hands-on workshops.

- NASA
Dryden Test Flight Center
Glenn Research Center
Goddard Space Flight Center
Jet Propulsion Lab
Johnson Space Center
Marshall Space Flight Center
• United Technologies
East Hartford, CT
• US Army Tank Command
Warren, MI
• General Motors
Milford, MI
Pontiac, MI
• Hamilton Sundstrand
Rockford, IL
Windsor Locks, CT
• U.S. Air Force
Arnold AFB
Edwards AFB
Eglin AFB
Rocket Research Lab
• National Security Agency
Hanover, MD
• Pratt & Whitney
West Palm Beach, FL
• L.A. Water District
Los Angeles, CA
• U.S. Navy
Indianapolis, IN
Patuxent River, MD
NRL-Washington, DC
• L3 Ocean Systems
Sylmar, CA
• Booz-Allen Hamilton
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• Honda R&D
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• ERDC
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Houston, TX
• Ricardo
Detroit, MI

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Table with 3 columns: Course, Date, City/Number, Fee, Time, Units. Rows include Avionics & Weapons System Flight Test, Spreadsheet Aided Engineering (June 19-23, 2006), and Spreadsheet Aided Engineering (July 31-August 4, 2006).

Course Fee and Payment: Avionics & Weapons System Flight Test: \$1,995/student; Spreadsheet Aided Engineering: \$2,495/student (\$1,995 for on-site members).

Discounts:

Group: Available when registered as a group and requested in advance: 3-5=10%, 6-10=20%, 11+=30%.

Full-time Faculty, Graduate Students and Small Business: 50%

Alumni Refresher (Spreadsheet Aided Engineering Only): \$500 (Complimentary if you bring a full paying associate and assist during the help sessions)

Refunds: The course fee (less a \$50 processing fee) will be refunded if cancellation is received at least one week prior to the first day of the course. Substitutions may be made at any time.

Other Upcoming public courses selected from our library of over 300 on-site engineering courses:

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Table with 3 columns: Course Name, Date, Location. Includes Spreadsheet Aided Engineering (06/12-06/16, 2006), Spreadsheet Aided Data Plotting & Analysis, Avionics & Weapons System Flight Test, Design & Development of Auto A/C Systems, Design & Development of Auto Engine Cooling Systems, Explosives Technology and Modeling, Fundamentals of Systems Engineering with Exercises.