TECHNICAL COURSES

INFLIGHT ICING AND ITS EFFECTS ON AIRCRAFT HANDLING CHARACTERISTICS

May, 2010
Course Director: Mr. Borja Martos
Course Fee: $1899 for full 4-day session or $899 for 2 day lectures only

This course will consist of a ground school covering all pertinent aspects of aircraft icing, and use of two simulation devices to provide practical training and experience with icing effects on aircraft performance and handling. One simulator will allow attendees to plan and conduct typical flight test maneuvers and analyze test results as required by the latest changes in the FAR's and advisory materials. The other, which is NASA's Ice Contamination Flight Training Device (ICEFTD), will provide a unique opportunity for course attendees to experience the effects of icing on aircraft handling qualities in a scenario based pilot training format. Participation in simulator training is limited to 16 students, but an unlimited number of individuals may attend the Tuesday and Wednesday ground school at a reduced fee, and observe the simulation sessions. A combination of guest lecturers and UTSI staff, who are experts in various fields of icing technology, flight testing, and flight operations, will provide a comprehensive curriculum covering the following subject matter:

- Icing Meteorology including Supercooled Large Droplet (SLD) icing
- Ice shape formations and how they relate to the physical properties of icing clouds
- Aerodynamic effects of icing on airfoils
- Practical applications of aircraft stability control and performance to selected icing certification testing
- Flight test results of icing effects on aircraft performance, stability and control, including SLD and Ice Contaminated Tailplane Stall
- Icing related upsets
- Methods and facilities for icing simulation: Codes, wind tunnels, airborne tankers
- FAR 23/25 icing certification requirements including discussion of AC 25-25
- Simulator training to provide practical applications for flight test planning and execution, and for experiencing the unique affects of icing on aircraft handling characteristics

SIMULATOR LABORATORY AND TRAINING

UTSI employs two simulators in order that course attendees have the opportunity to apply themselves to planned exercises in flight test planning, data analysis, and pilot assessment of aircraft handling qualities. UTSI's Flight Research Simulation Laboratory is a PC based system with high fidelity graphics, head down displays, and flight controls. This simulator is programmed with an ice contamination aerodynamic data base from the NASA DH-6 "Twin Otter" icing research aircraft, provided for this course, courtesy of

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Bihrle Applied Research (BAR), Hampton, VA. The simulator model runs in the BAR D-Six® simulation environment and is the same model that drives the NASA ICEFTD, which is described below. Course instructors will guide attendees in developing test plans and performing data analysis in accordance with the latest icing certification rules and related advisory material. The simulator is used to obtain flight data for analysis and presentation of results.

The flight simulations using the NASA ICEFTD provides a unique opportunity for students to experience and understand important flight characteristics related to icing induced handling anomalies. The NASA ICEFTD simulator operates with a full computing aerodynamic data base, derived from extensive wind tunnel testing from a subscale model of the NASA Twin Otter icing research aircraft, and flight test data from the full scale aircraft. Training profiles are structured to provide realistic scenarios where progressively degraded handling characteristics due to various ice formations affect flying qualities. A control loading system provides representative control forces and dynamic feedback, which emulates that of the actual aircraft. Under the guidance of experienced instructors, course attendees practice flight control techniques associated with loss of stability and control effectiveness. A structured one hour training session is provided to all full course attendees.

MATLAB

November 16-19, 2009
Course Director: Dr. Chris Parigger
Course Fee: $499

In a review of Matlab® (commercial, university site license) one finds that Matlab® is highly suitable for numerical computations. Several embedded features are of immanent advantage, e.g., symbolic manipulations, graphing, and so on. In this short course series several aspects of Matlab® applications will be addressed, ranging from start-up, novice-type of sessions to advanced practical sessions. The initial block of 1 to 2 days will cover introduction and standard applications along the following lines: (a) Matlab® session basics, variables, elementary operations, and functions; (b) Vectors and vector operations in Matlab®; (c) Function and vector plotting; (d) Floating-point arithmetic and numerical data types; (e) Basic programming constructs (loops,branching); (f) Matlab® scripts and functions; (g) Comparison with “Octave." Days 3 to 4 will address specific areas of applications, namely, (i) Graphical User Interface (GUI) design. Here, MatLab’s® GUI editor, called GUIDE, will be used. Topics covered ‘keypress,’‘buttondown,’ ‘callbacks,’ and ‘resize’ possibilities; (ii) Classes, including Basic classes structure, Handle versus Nonhandle classes, Property access, Set and Get functions, Simple Parsing, and Controlling GUIs with classes; (iii) Other applications including Anonymous functions and the cellfun() function, Menu building/linking and dynamic menus, Dynamic structures and generating code snippets with xlswrite, Dialog design; (iv) Numerical model applications, viz. example codes typically used in numerical Mathematics; (v) Symbolic computations, (vi) Matlab® toolbox applications; and (vii) Presentation by Mathworks personnel of extensions to Matlab® including Simulink®.

COMBUSTION INSTABILITY: ANALYSIS, DIAGNOSIS, AND CORRECTIVE PROCEDURES

March 2-5, 2010
Course Director: Dr. Gary Flandro
Course Fee: $1,249.00

Despite intensive work spanning five decades, the problem of oscillatory behavior of high-energy propulsion systems and industrial burners is still an important engineering problem. New problems continue to threaten important propulsion development programs such as the NASA Constellation program with its heavy-lift ARES system based on the five-segment version of the Shuttle SRB. Current mathematical and computational tools in widespread use have failed to yield reliable techniques for predicting and especially for controlling such problems. It is imperative that correct procedures be implemented, since combustion instability problems usually appear late in the development cycle resulting in large, unexpected expenditures and delays in schedule. They are too often the reason for propulsion system program cancellation.

New research has resulted in sharpened physical understanding, better diagnostic techniques, and improved predictive computational algorithms. This course will present a detailed and balanced coverage of the theory of combustion instability and the means to implement it in the design process. Emphasis will be on new findings including the effects of vorticity and other flowfield interactions not incorporated in the classical theories and computational tools. These will be discussed in detail along with a full treatment of established viewpoints including effects of flow-turning, velocity coupling, and distributed combustion effects. New techniques will be introduced that greatly improve the modal analysis procedures needed in identifying acoustic mode shapes and frequencies in complex system configurations. Vastly improved nonlinear analytical techniques now allow accurate determination of limit cycle amplitudes giving a much better indication of the threat of instability to the motor system. New improvements also extend the mean flow Mach number range so that problems in supersonic combustion instability can be accommodated. The course also includes comprehensive treatment of vortex shedding, effects of nonlinear interactions, and new methods for controlling combustion instabilities. Applications in solid and liquid rockets, turbojet thrust augmentors, ramjets and scramjets are covered. A multitude of data sets from research and development programs and from current encounters with combustion instability difficulties will be used as case studies. Emphasis is on avoiding instabilities in the design process of a new system and eliminating them in an effective manner if they appear in the development cycle.

Attendees will receive a comprehensive literature package and text material by Culick, Price, Yang, and Flandro covering all aspects of the course. These will be distributed in DVD format. Tables of experimental data and other visual supportive material and viewgraphs will be included. Latest versions of predictive algorithms will be demonstrated.

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HYBRID ROCKET PROPULSION

March 18-19, 2010
Course Director: Dr. Joe Majdalani
Course Fee: $ 1,095.00

The "Hybrid Rocket Propulsion" short course is quintessential for all professionals specializing in chemical propulsion. The mechanisms associated with hybrid combustion and propulsion are diverse and affect our abilities to successfully advance and sustain the development of hybrid technology. It is our penultimate goal to promote the science of hybrid rocketry which is safe enough to be used in academia and the private sector. A historical demonstration of hybrid rocket capability is the 2004 X-prize winner Space Ship One. This course reviews the fundamentals of hybrid rocket propulsion with special emphasis on application based design and system integration, propellant selection, flow field and regression rate modeling, solid fuel pyrolysis, scaling effects, transient behavior, and combustion instability.

FUNDAMENTALS OF SOLID PROPELLANT ROCKET MOTORS

March 29 – April 2, 2010
Course Director: Dr. Gary Flandro
Course Fee: $ 1,575.00

This course is a concise coverage of the fundamental principles of solid rocket motor design and analysis. Attendees will acquire a comprehensive working knowledge of all features that are unique to the operation of a solid rocket motor including: propellant formulations and their characteristics, propellant mixing and casting, CFD simulations of the casting process, propellant burning rate laws, the ignition process, combustion effects, detonation, combustion chamber flow, steady and unsteady flow effects, design of propellant grain geometry, simulation of the burning process, two-phase flow effects involving combustion of metallic additives, nozzle flow and nozzle design, heat conduction effects and material ablation.

A brief introduction of operational problems unique to solid rockets is also presented. The course emphasizes the correct choice and application of analytical and numerical tools in design and in solid rocket development problem solving. Many case studies and examples of successful problem solutions are presented.

DIGITAL SIGNAL PROCESSING FOR INSTRUMENTATION AND DATA ANALYSIS

April 13-15, 2010
Course Director: Drs. Bruce Bomar and Montgomery Smith
Course Fee: $ 1,249.00

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This is a three day course intended for scientists and engineers involved in experimental data acquisition and analysis who wish to become familiar with recently developed methods of signal processing for use in their work. It provides a working knowledge of digital signal processing (DSP) techniques and systems with emphasis on those methods of interest in instrumentation and data analysis. Familiar applications to often-encountered experimental data types are emphasized. Examples of the DSP techniques will be given using the interactive numeric computation software package MATLAB®. Numerous exercises are provided during the course workable in The Student Edition of MATLAB®.

The course begins on day one with an introduction to the fundamental principles of discrete signals and DSP. The concept of frequency analysis of signals is introduced and developed to acquaint the participant with the widespread utility of this technique. Common numerical schemes such as differentiation, integration and smoothing of digitized data are examined in light of this approach. Frequency domain methods are developed further in a session on the discrete Fourier transform, including its computation via the fast Fourier transform (FFT) and its variations.

On the second day, useful techniques for performing spectral analysis of digitized data are covered in the first session. Principles of finite impulse response and infinite impulse response filtering are then addressed, and methods of filter design are presented. The second day concludes with a session where students will use computers to practice using MATLAB® for implementing DSP methods and filter design techniques.

Algorithms for efficiently implementing such filters in software are covered in the first session of day three with examples used to illustrate the fundamental principles. Methods for changing the sample rate of digital signals via interpolation and decimation are then discussed along with practical schemes for A/D and D/A conversion. The course material then moves into the use of high-speed digital signal processor chips for implementing DSP methods. Typical characteristics and architectures of floating-point digital signal processors are examined along with an overview of available personal-computer-based coprocessor cards utilizing these chips. The course considers how DSP methods would be implemented in the C programming language for efficient execution on DSP chips. The course concludes with sessions on finite word length effects and methods for the lossless and lossy compression and restoration of digital data.

AERO-PROPULSION SYSTEMS, TECHNOLOGY TEST AND EVALUATION

May 3-7, 2010
Course Directors: Dr. Stephen Corda and Roger Crawford
Course Fee: $1,575.00

The "Aero-Propulsion" short course has been updated and presented annually since 1964. This is the 59th offering of this unique course, designed to present an overview of aero-propulsion system performance, engine operability, engine technologies, and test and evaluation processes. Current and future air breathing propulsion systems performance and technology status will be presented to engineers, scientists and managers engaged in research, development, maintenance and operation, and test and evaluation. Lecturers from academic, government and industrial organizations who are actively engaged in air breathing propulsion technology will discuss the state-of-the-art and the trends in Aero-Propulsion. The Aero-Propulsion short course was developed with support and sponsorship of the

American Institute of Aeronautics and Astronautics (AIAA) Air Breathing Propulsion Technical Committee (ABPTC), and the Tennessee Section of the AIAA.

LABVIEW FOR AEROSPACE GROUND AND FLIGHT TEST

June 21-25, 2010
Course Director: Mr. John Muratore
Course Fee: $2,195.00

National Instruments' LabVIEW is an extremely powerful computer programming tool for data acquisition, analysis and control applications. LabVIEW has grown quite popular in the aerospace ground and flight test community. The purpose of this course is to teach LabVIEW fundamentals while emphasizing the unique aspects of aerospace ground and flight test problems and how to best utilize LabVIEW to deal with these unique challenges. In this course each student will be at a computer with LabVIEW and access to networked data acquisition equipment and each student will build and test Virtual Instruments (VI's) dealing with typical aerospace data processing problems which include:

- Typical aerospace data types
- How to format and decode telemetry
- How to log and playback test information
- How to decode Global Positioning Satellite (GPS) receiver messages
- Working with typical aerospace sensors and devices
- Unique aerospace data visualization tasks with LabVIEW
- Interfacing to flight simulators via networks
- Networks and Avionics Data buses
- Making sense of test data using statistics, regression analysis and digital filters in LabVIEW
- Using the internet for ground and flight test data distribution

LabVIEW is a registered trademark of National Instruments XPlane is a trademark of Laminar Research

FUNDAMENTALS OF FLIGHT TEST ENGINEERING

July 26 - August 6, 2010
Course Director: Dr. Stephen Corda
Course With Flying: $6,750.00 (6 student limit)
Course Without Flying: $2,750.00

This two week Short Course teaches the Fundamentals of Flight Test Engineering in a comprehensive, exciting format that incorporates academic lectures, an extensive flight simulator session, an on-runway ground exercise, and 8 in-flight laboratory sessions where the students fly as Flight Test Engineers in UTSI Aviation Systems research aircraft. Academics and Flight Test Techniques for Performance, Flying Qualities, and Systems flight testing will be covered, along with Flight Test Instrumentation, Data Acquisition, and System Safety. After taking this course, the student will be well grounded in the fundamentals required for performing the duties of a Flight Test Engineer, including aircraft familiarization, airmanship, test planning, and test reporting.

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