Monday, October 21st

NOTE: Short courses are a separate fee from the Conference.
Full-day course $600

9:00-5:00 ADVANCED MODULATION AND DEMODULATION TECHNIQUES
Instructor: *Terry Hill, Quasonix, LLC*

Explores modulation techniques currently employed or proposed for telemetry. Material covers the legacy PCM/FM waveform, SOQPSK, and Multi-h CPM. Demodulation techniques for these waveforms are also addressed with particular emphasis on synchronization techniques and performance.

9:00-5:00 BASICS OF AIRCRAFT INSTRUMENTATION
Instructor: *Bruce Johnson, Aircraft Instrumentation Division Chief Engineer, NAWCAD*

This course will cover a wide variety of topics related to Aircraft Instrumentation. Data, Acquisition, Telemetry, Instrumentation System Block Diagram, Standards, Data Requirements, Transducers Specifications, Video, Avionics Busses (e.g. 1553, ARINC-429, Ethernet etc.), using requirements to configure an Analog Data Channel, creating a PCM map to obtain a sample rate, telemetry bandwidth, record time, GPS, audio, Telemetry Attributes Transfer Standard (TMATS), and measurement uncertainty - interpreting the results. This is great introduction for new hires or a refresher for current employees.

9:00-5:00 FUNDAMENTALS OF MICROWAVE AND RF IN AERONAUTICAL TELEMETRY SYSTEMS
Instructor: *Mark McWhorter, Lumistar*

This course begins with an overview of electromagnetic theory and the many common uses of RF microwaves today. Concepts such as the frequency spectrum, basic physics of electro-magnetic wave reflection and propagation, standing waves, power density, phase and polarity are discussed. The second section discusses RF microwave components typically found in telemetry systems, touching on design and applications. Consideration of antennas, transmissions lines, couplers/splitters/combiners, hybrids, RF amplifiers, VCOs, isolators, attenuators, modulators, etc. is given. Concepts such as intermodulation, dynamic range and linearity are introduced. The final section of the course addresses the application of an end-to-end digital telemetry transceiving system. A typical airborne to ground station radio link is presented with emphasis placed on RF-centric issues impacting radio link performance.

9:00-5:00 INTRODUCTION TO ANALYZING ETHERNET DATA
Instructor: *Paul Ferrill, Avionics Test and Analysis Corporation*

With the proliferation of Ethernet as a data transport on multiple commercial and military aircraft and weapon systems it is becoming even more important to get a basic understanding of how to analyze Ethernet data. This course will start with an introduction to the OSI model and lay out the

basics that make up Ethernet traffic. Then we'll look at the open source Wireshark program and go through a crash course in using it to examine different types of Ethernet traffic. We'll also examine wireless traffic and how it differs from traditional wired Ethernet. Finally, we'll look at using the Python programming language along with several libraries to actually analyze and decode data embedded in Ethernet traffic.

9:00-5:00 INTRODUCTION TO SATELLITE COMMUNICATIONS AND TELEMETRY STANDARDS

Instructor: *Robert Ritter, IMI Technology*

The Introduction to Satellite Communications short course provides an overview of the theories and international standards for various means of space communications. It includes descriptions of practical applications for high-latency and error-prone links, describes the RF link characteristics, modulation schemes, various forms of error detection, correction and compression, practical mechanisms for data networking in space, considerations for IP, concerns over security, new applications of short and medium distance links, and interoperability interests between civil and defense systems. Questions related to new standards proposed for user interfaces are also explored. Optical communications and the new proposed Unified Space Link Protocols will also be introduced as the path forward for the international standards body, CCSDS (the Consultative Committee for Space Data Systems).

9:00-5:00 IRIG CHAPTER 7 PACKET TELEMETRY DOWNLINK BASIS AND IMPLEMENTATION FUNDAMENTALS

Instructor: *Johnny Pappas, Safran Data Systems, Inc.*

This course will focus on presenting information to establish a basic understanding of IRIG 106, Chapter 7, Packet Telemetry Downlink Standard. It will also focus on the implementation of airborne and ground system hardware, what to consider for use cases using Chapter 7 Packet TM and methods to handle Chapter 7, Packet Telemetry data on the ground. The class will address how to multiplex packet telemetry into your existig IRIG Chapter 4 PCM legacy stream. Other subjects such as latency, compatibility with Test Range Instrumentation System compatibility such as RF Transmission, data recording, RF Receiving, Ground Reproduction, and Chapter 10 data processing methods.

9:00-5:00 IRIG 106 CHAPTER 10/11 DIGITAL RECORDING STANDARDS

Instructor: *Mark Buckley, Telspan Data and Alfredo Berard, 96 RANSS/RNRE*

This course will present an in-depth look at the latest IRIG 106 Chapter 10/11 Digital Recording Standards. Each section within the standard will be covered along with implementation, compliancy, interoperability, data processing and validation methods. Lessons learned and insight into development and applications of recorders/reproducers, test equipment and processing software throughout the test and operational communities will also be presented. A review of emerging implementations and the next release of the standard will also be conducted.

1:00-5:00 TELEMETRY FUNDAMENTALS: A JOURNEY FROM SENSOR TO DISPLAY
Instructor: *Gary Thom, Delta Information Systems, Inc.*

This course is ½ day $450

Dive into the fascinating world of telemetry with this introductory course. Gain a high-level understanding of key concepts and components, starting with onboard vehicle systems such as sensors, signal conditioning, modulation, and transmission. Transition to ground-based operations, exploring receivers, data distribution, decommutation, processing, and display. Discover additional topics like IRIG 106 Ch 10 and 11 recording and distribution formats, along with IRIG 106 Chapter 7 packet data over PCM. Get ready to unlock the secrets of telemetry!

9:00-5:00 TELEMETRY OVER IP
Instructors: *Mark Roseberry, NetAcquire Corporation*

This course begins by introducing the capability of transporting PCM telemetry over an IP network (TMoIP), including discussion of the benefits and limitations of this technology. Essential network topics are covered including the OSI network model and associated TMoIP network protocols. Three key RCC IRIG standards for TMoIP are described: IRIG 218, IRIG 106 Chapter 10 over UDP, and TmNS. Interactive and scripted setup, configuration, status, and diagnostics approaches are presented. Advanced topics include minimizing latency, handling poor-quality WAN networks, inter-vendor interoperability, reliability and redundancy, one-to-many and mesh networks, configurable quality-of-service, and time/data correlation. The course ends with an overview of current and future trends in IP convergence and cloud-based architectures.

9:00-5:00 TmNS TELEMETRY NETWORKS
Instructors: *Thomas Grace, NAVAIR Patuxent River & Todd Newton, SwRI*

This course introduces participants to telemetric networks to gain an understanding of telemetric networking principles, applicable networking technologies, trade-offs in applying networks to telemetry, and end-to-end telemetric applications. Specifically, the RCC Telemetry Network Standard (TmNS) and its application will be presented illustrating the test article network, radio access network, range operations network, mission control network, system management operations, and telemetric applications. Sprinkled throughout the course are selected networking technology topics to help aid in the networking discussions. This course is intended for anyone who needs an introduction to TmNS technologies and system capabilities. It will be useful for participants to have a basic knowledge of networking concepts. This short course is particularly beneficial for persons responsible for or involved in flight test instrumentation and telemetry systems.