# ITC 2020
# Full Day Short Courses
# Monday, October 26, 2020
# 9:00am-5:00pm

**FULL DAY**     **ADVANCED MODULATION & DEMODULATION TECHNIQUES FOR TELEMETRY**
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.

**FULL DAY**     **BASICS OF AIRCRAFT INSTRUMENTATION**
Instructor:     *Ken Miller, Electronics Engineer, NAWCAD Patuxent River*

This course will describe the data acquisition system design criteria used to meet the customer's data requirements. An example accelerometer measurement is used to illustrate the design process from the sensor to the engineering unit display. The presentation will cover pre-sample filtering, sampling, digital encoding, and the trade-offs to consider when designing an airborne data acquisition system. Recording of data sources and RF telemetry are presented along with measurement uncertainty. Standards and best practices are highlighted throughout.

**FULL DAY**     **BASIC SIGNALS AND MODULATION**
Instructor:     *Steve Horan, NASA Langley Research Center*

This course is directed towards beginning technical personnel or telemetry personnel with limited experience in communications and modulation systems. The course will cover basic concepts necessary to understanding the data communications process within the telemetry system. This will include signal descriptions, the Pulse Code Modulation (PCM) process, concepts of analog and digital modulation and demodulation, and signal bandwidth representations. Emphasis will be on graphical representations with minimal mathematical requirements.

FULL DAY      **FUNDAMENTALS OF MICROWAVES AND RF**
Instructor:      *Mark McWhorter, Lumistar, Inc.*

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.


FULL DAY      **iNET TELEMETRIC NETWORKS**
Instructor:      *Thomas Grace, NAVAIR Patuxent River & Ben Abbott, SwRI*

This course introduces participants to telemetric networks as applicable to the integrated Network Enhanced Telemetry (iNET) project. Participants will 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) based demonstration system will be presented illustrating the test article network, radio access network, range operations network, mission control network, system management operations, and telemetric applications. The presentation will include current performance and capabilities of developmentally flight tested capabilities. 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.


FULL DAY      **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.

FULL DAY     **IRIG 106-17 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 the 2017 release of the IRIG 106, Chapter 7, Packet Telemetry Downlink Standard. It will also focus on the implementation of airborne and ground system hardware and methods to handle IRIG 106, Chapter 7, Packet Telemetry data. The presentation will address the implementation of special features necessary to support legacy RF Transmission, data recording, RF Receiving, Ground Reproduction, and Chapter 10 data processing methods.

FULL DAY     **PRINCIPLES AND IMPLEMENTATION OF THE IRIG 106 CHAPTER 10/11 DIGITAL RECORDING STANDARD**
Instructor:     *Mark Buckley, Telspan Data*

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.

FULL DAY     **TELEMETRY FOR HIGH-LATENCY, ERROR-PRONE NETWORKS**
Instructor:     *Robert Ritter, IMI/RT Logic*

Global telemetry networks present many challenges with high-latency and error-prone transport conditions. This tutorial will present detailed information on packet-based telemetry standards that are designed to operate reliably in such conditions, with emphasis on RF systems, Forward Error Correction, delivery assurance, efficient packet structures in asymmetric links, Internet Protocol considerations, security, interoperability and more. With practical applications for ground, sea, air and space telemetry systems, much of the emphasis will be on Consultative Committee for Space Data Systems (CCSDS) standards, and how those standards (and select elements) can be considered for more broad telemetry applications. This course provides a protocol stack depiction of these concepts with reference to the common OSI stack. Students should have a general technical competency and understanding of communications theory, protocols and systems.

FULL DAY    **TELEMETRY OVER IP**
Instructor:    *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. The three key RCC IRIG standards for TMoIP are described: IRIG 218, IRIG 106 Chapter 10 over UDP, and iNET. Interactive and scripted setup, configuration, status, and diagnostics approaches are presented. Advanced topics include minimizing latency, handling poor-quality WAN networks, inter-vendor interoperability, one-to-many and mesh networks, configurable quality-of-service, time/data correlation, future-proofing, and security.

FULL DAY    **VIDEO AND VIDEO COMPRESSION**
Instructor:    *Gary Thom, Delta Information Systems, Inc.*

With the growing complexity of flight test programs and the improved efficiency of compression algorithms, video is an ever increasing component of flight test data collection. This course will provide a basic understanding of video interfaces, signals, formats, resolutions and frame rates. Building on those basics the course will then present a high level description of how video compression works and the trade-offs that can be made when selecting and implementing video compression components. An overview of various video compression algorithms will be provided, highlighting the differences between the algorithms. We will examine the effects of video compression on video quality and investigate some of the causes and corrections for quality problems. Finally, there will be a brief overview of audio compression.