ITC 2020
Half Day Short Courses
Thursday, October 29, 2020
1:00pm-5:00pm

HALF DAY **A Basic Overview of Telemetry**
Instructor: *Gary Thom, Delta Information Systems, Inc.*

This course provides a very high level introduction of basic telemetry concepts and components. The course begins with onboard vehicle under test discussing sensors, signal conditioning, commutation, modulation and transmission. It continues on the ground with receivers, data distribution, decommutation, processing and display. The course includes additional concepts like IRIG 106 Chapter 10 and 11 recording and distribution formats as well as IRIG 106 Chapter 7 packet data over PCM.

HALF 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.

HALF DAY **Digital Signal Processing to Improve Telemetry Links**
Instructor: *Terry Hill, Quasonix*

This course provides both theory and practice in the use of DSP in telemetry, including Diversity Combining, Best Source Selection (BSS), Data Quality Metric (DQM), Best Channel Selection (BCS), Adaptive Equalization and performance metrics, Space-Time Coding (STC), and Low Density Parity Check (LDPC) Forward Error Correction (FEC). Includes field test data showing the results when all these technologies are employed concurrently.

HALF 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.

HALF DAY **Intro to Machine Learning and Data Analytics Applications using Python Programming**
Instructor: *William (Bill) Schneider, Dell EMC*

Machine learning has become an indispensable tool for processing the large and complex data structures being collected by modern sensor and data acquisition systems at every Test Range. This course will cover the fundamentals of data manipulation, visualization, and machine learning with open source tool python in the context of typical time series data acquisition applications. Public data sets will be used for illustration and demonstration activity. Basic knowledge of programming in any language is assumed, but not necessarily advanced knowledge of python.

HALF DAY **Phased Array Systems for TM Applications**
Instructor: *Michael Pace, Applied Technology Associates*

The student will be exposed to modern phased array design concepts and trades as they relate to telemetry systems. With a focus on new system designs, the course will cover analog beamforming, digital beamforming, and adaptive beamforming techniques along with the associated pros and cons for each technique. Common interfaces to existing range infrastructure will be discussed to further enhance market entry of the technology across test and evaluation (T&E) ranges. While the technology is applicable to space-based deployment environments; this course will focus on ground, surface, and airborne platform applications. The course is intended to spark excitement and intrigue for entry-level to mid-level engineering students and professionals. At the conclusion of the course, the student will be equipped with an understanding of this technology and how it can be applied to meet future telemetry requirements.

HALF DAY **Sensors- Principles of Digital Acquisition Systems**
Instructor: *Steve Pruitt, Diversified Technical Systems, Inc.*

This course provides an overview of the fundamentals of collecting data in flight test, from the physics of what is being measured through analog to digital conversion. Topics include: sensor theory, common sensors and limitations, shunt and empirical checks, data acquisition system features and functions, anti-alias filtering, sampling error, analog considerations of channel to channel time synchronization, grounding and shielding, and specifying a complete system. Compared to others, this course is more "analog" in nature, focusing on the physical measurement before data is formatted and streamed.

HALF 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 implementations 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. Applications will be presented for ground, sea, air and space telemetry systems. This course provides a protocol stack depiction of Consultative Committee for Space Data Systems (CCSDS) standards that are shared in the range and space communities. Students should have a general technical competency and understanding of communications theory, protocols and systems.

HALF DAY **Telemetry over IP**
Instructor: *Mark Roseberry, NetAcquire*

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. 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. Familiarity with basic networking and serial PCM telemetry concepts is presumed.