

# **58th Annual International Telemetering Conference (ITC 2023)**

International Telemetering Conference Proceedings Volume 58  
(2023)

Las Vegas, Nevada, USA  
23-26 October 2023

Part 1 of 2

ISBN: 979-8-3313-0054-8

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571



**Some format issues inherent in the e-media version may also appear in this print version.**

Copyright© (2023) by International Foundation for Telemetering  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2024)

For permission requests, please contact International Foundation for Telemetering  
at the address below.

International Foundation for Telemetering  
5665 Oberlin Drive, Suite 200  
San Diego, California, USA  
92121

[telemetry@comcast.net](mailto:telemetry@comcast.net)  
[www.telemetry.org](http://www.telemetry.org)

**Additional copies of this publication are available from:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: 845-758-0400  
Fax: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

## PART 1

### SESSION 1 – AIRBORNE SENSORS AND DATA ACQUISITION I

Continuously Swept Laser-Based Fiber Bragg Grating Data Acquisition System Capable of Operating in Extreme Environments .....	1
<i>Hon Chan, Jonathan Lopez-Zepeda, Francisco Pena, Allen Parker</i>	
How to Reconcile COTS Components and Tailored Future-Proof Data Acquisition System in Flight Test Instrumentation? .....	11
<i>Ghislain Guerrero, Valentin Belaud, Remy Pelluault, Quentin Lecoq</i>	
User Friendly Edge Computing in FTI Networks .....	21
<i>Diarmuid Collins</i>	
Reducing Aircraft Downtime for Airborne Instrumentation.....	29
<i>Benjamin Baird, Paul Cast, Anthony Portella</i>	
Space Telemetry Devices – Surviving and Measuring High Level Shocks.....	37
<i>Stephen Curran</i>	

### SESSION 2 – NETWORK TELEMETRY I

An End-to-End TmNS System with MDL .....	46
<i>Benjamin Kupferschmidt, Thomas Grace</i>	
Data on Demand: Using TmNS to Request Recorded Data that Was Not Telemetered .....	60
<i>Benjamin Kupferschmidt, Rocco Docimo</i>	
Encryption of Packet Telemetry: A Risk Analysis.....	68
<i>Jean-Guy Pierozak, Cedric Tavernier</i>	
Ethernet via Bidirectional Packet Based Telemetry – Frequency Division Duplex (FDD) vs. Time Division Duplex (TDD).....	74
<i>Sean Wilson, Ray O'Connell</i>	
Implementation of a Drone-Based Information Gathering System .....	84
<i>Tianrui Hu, Yifan Pan, Anshuman Dash, Matthew Tran, Zhiwen Wu, Yogananda Isukapalli, Phil Tokumaru</i>	
Switched Telemetry System (SwTS) Standard for Bidirectional Telemetry Interoperability .....	94
<i>Ray O'Connell, Sean Wilson, Michael Rauf</i>	

### SESSION 3 – RANGE SYSTEMS

A Helping Hand - Challenges of a Single Range Over-The-Horizon Support .....	104
<i>Steve C. Warner</i>	

Telemetry Quality & Efficiency Improvement by Multi-Location Ground Stations Centrally Controlled.....	109
<i>Philippe Klaeyle, Marc Seznec</i>	
Automated Data Check and Calibration System using Matrix Switch Prototype with Small Change of Line-Resistance .....	121
<i>Nahyeok Lee, Jieun Kim, Chaemin Lim, Seongjong Kim, Youngsik Kim, Woonmoon Lee, Wonju Yoon, Seongmin Noh</i>	
Unique Telemetry Requirements for a Hypersonic Telemetry System.....	131
<i>Paul Cook, Ben Kupferschmidt</i>	
Updated Status on the Ground Based Phased Array Telemetry Antenna (gPATMA) System .....	136
<i>Scott Kujiraoka, Kevin Bossoletti, Brad Follo</i>	
VLAB – Enhanced Video and Data Pre-Processing .....	140
<i>Simon Hardt, Marc Faber</i>	

#### **SESSION 4 – SPECTRUM MANAGEMENT**

Geolocation System Fundamentals .....	147
<i>Jim Wargo</i>	
Harvesting Fallow Spectrum in Aeronautical Mobile Telemetry .....	159
<i>Mark Wigent</i>	
Towards Building a Common Operating Picture for Risk Informed Spectrum Management .....	164
<i>Sastry Komppella, Bryan George, Marc Siriratsivawong, Joseph Molnar, Eric Makara</i>	
Spectrum Usage Measurement and Deconfliction – An Update.....	170
<i>Phiroz H. Madon</i>	
Telemetry Spectrum Reallocation Risk Update: An Update on Threats to Telemetry Spectrum.....	180
<i>Tim Chalfant, Guy Williams</i>	

#### **SESSION 5 – COMMUNICATION SYSTEMS**

A Comparison of Two Software Defined Radios for Aeronautical Telemetry.....	186
<i>Michael Rice, Hyrum Croft, Joshua Gillis, Zach Hilton, Riley Kirkwood, Preston Walker, Philip Lundrigan, Willie K. Harrison</i>	
Cloud Computing for Aeronautical Telemetry: A Brave New World or Pandora's Box? .....	196
<i>Michael Rice, Elise Hopkins</i>	
KUbeSat Ground Station: Revision and Future Expansion .....	203
<i>Brody Gatza, Zach Rhodes, Ethan Wegner, Ryan Biven, Joshua Lee, William Whitehead, Brian Kaplinger, Erik Perrins, Mark Ewing</i>	
Satellite Side Data Collection and Transmission for a Cube Satellite Mission .....	210
<i>Daniel Owen, Brody Gatza, Ethan Wegner, Aaron Hastings, Joshua Lee, Brian Kaplinger, Erik Perrins, Mark Ewing</i>	
Analysis of a Telemetry System for a Level 3 Rocket.....	220
<i>Aidan Rice, Michael Rice</i>	

MOSAIC Amphibious Test Range Development and Deployment.....	227
<i>Joshua Goins, William Debbaneh</i>	

## **SESSION 6 – AIRBORNE SENSORS AND DATA ACQUISITION II**

Ethernet Based Wireless Rotor Transmission.....	241
<i>Rocco Docimo, Mike Barfield</i>	
Advanced Calibration Method for Improving Mesurement Accuracy .....	250
<i>Nelson Leite, Lucas Sousa, Bruno Silva</i>	
In Flight Optical Fiber Measurements on Flight Test Aircraft.....	260
<i>David Cumer, Laetitia Mennebeuf, Benjamin Mouchet, Karounen Veerabadran, Laurent Malar</i>	
Remote Sensing of Aircraft Landing Gear Metallic Linkage Interfaces using Eddy Current Sensors .....	271
<i>John Vinella, Jason Chippy</i>	
Light FTI System – The First Truly Light Wireless System for Flight Test Instrumentation .....	280
<i>Renaud Urli, David Cumer, Ligang Huang</i>	

## **SESSION 7 – NETWORK TELEMETRY II**

An Enhanced TmNS Data Request Protocol that Includes Chapter 10 Recorder Support .....	292
<i>Carl Reinwald</i>	
Association Rule Learning Anomaly Event Dependency Prediction and Classification.....	302
<i>Olanrewaju Bucknor, Farzad Moazzami, Richard Dean</i>	
Emulation of the 1553 Telemetry Bus in a Physical and Virtual Environment .....	311
<i>Perry Jordan, Richard Dean, Farzad Moazzami</i>	
Prototype MIL-STD-1553 Network Design for Cyber Testbed using Microcontrollers .....	318
<i>Robel Yacob, Richard Dean</i>	
Networked Telemetry Testbed – Attacks and Defenses.....	326
<i>Favour Okonkwo, Richard Dean, Farzad Moazzami</i>	
The Hitchhiker’s Guide to MDL .....	331
<i>Sydney Whittington</i>	

## **SESSION 8 – TIME, SPACE POSITIONING INFORMATION**

Joint Advanced Missile Instrumentation (JAMI) Software Ground Segment Module.....	341
<i>Steven J. Meyer</i>	
High-Accuracy Time Space Position Information (TSPI) – Field Test Resluts.....	348
<i>Benjamin Kupferschmidt, Rocco Docimo</i>	
Real-Time Multi-Lateration using Millimeter Wave Radar.....	358
<i>Alex Dinkelacker, Owen Convery, Jackie Chen, Nihal Singh, Philippe Rerolle, James Buckwalter, Upamanyu Madhow, Ilan Ben-Yaacov, Luke Theogarajan, Tyler Susko</i>	

Reinforcement Learning Assisted Tuned Controller for Suspended Payloads using Unmanned Aerial Vehicles (UAVs) .....	366
<i>Onyekachi A. Okoye, Ben Abbott, Nicole Webb</i>	
Utilizing GPS to Locate Gun Launched Telemeters.....	376
<i>Sarah Fontana, Daniel Salib</i>	
Overcoming Challenges in Synchronizing IRIG-B to Non-GPS Telemetry Systems .....	385
<i>Jin H. Choi, Daniel Salib</i>	

## **SESSION 9 – CHANNEL MODELING AND EQUALIZATION**

Best Source Selector Versus Diversity Combiner.....	395
<i>John Carlson</i>	
Comparative Analysis of Studies on Performance Improvement Techniques for Aeronautical Channels .....	405
<i>Tasmeer Alam, Richard Dean, Farzad Moazzami</i>	
Artificially Noise-Injected Low-Density Parity-Check Codes for the Gaussian Wiretap Channel .....	413
<i>M. Munibun Billah, Willie Harrison</i>	
Generalization Bounds for Neural Normalized Min-Sum Decoders .....	423
<i>Sudarshan Adiga, Ravi Tandon, Bane Vasic, Tamal Bose</i>	
To Bit Sync or Not to Bit Sync? Why This is a Question.....	433
<i>Michael Rice</i>	

## **PART 2**

### **SESSION 10 – SENSORS & DATA ACQUISITION I**

Implementation of a Proprietary Embedded Real-Time Telemetry Protocol for Off-Road Racing Vehicle.....	446
<i>Alejandro Romero-Lozano, Oliver Sjostrom, Michael Byerly, Henry Overbeck, Man Doan, Joseph Lee, Ahmed Eladawy, Soltane Loudhabachi, Haseeb Irfan, Michael Marcellin</i>	
Real-Time 3D Visualization: Wirelessly Controlled LED Matrix .....	456
<i>Anna Koh, Eric Hsieh, Ryan Chau, Sachen Sampath, Christine Wan, Yogananda Isukapalli</i>	
Use of Telemetry to Track Ride Systems.....	466
<i>Alex Drey, Alyssa La Fountain, Anthony Rascon, Chayse J. Inniss, Jordan Christian, Lucas Tuan, Olivia Dodge, Zackary Tileston, Karson Knudson, Nicholas Silverston, Michael Marcellin</i>	
Telemetry and Data Logging System for the Wildcat Formula Racing Car .....	476
<i>Nick Smith, Christian Copic, Shayan Afzal, Michael Marcellin</i>	
Use of Telemetry in Battlebots .....	485
<i>Nicholas Sivertson, Yousuf Choudhary, Aleksander Hurworth, Karson Knudson, Mathias Ramirez, Alex Wait, Michael Marcellin</i>	
Remote Power System Monitoring and Management of a Teleoperated Mars Rover .....	495
<i>Alex Wortmann, Garrett McEntire, Tyler Lunyou, Jorge Noriegapereira, Kurt Kosbar</i>	

## **SESSION 11 – NETWORK TELEMETRY III**

Enhancing Network Stability and Performance with Per-VLAN Spanning Tree and Trunk Load Balancing for Wired and Wireless Robotics Applications .....	503
<i>Clayton Cowen, Brady Tappel, Kurt Kosbar</i>	
How Can Telemetry Data Be Meaningfully Reduced and What is the Benefit of Reconfiguration on the Fly? .....	513
<i>Bernd Dippold, Colin Douglas</i>	
Implementation of a Network-Based Instrumentation Data System for a Flight Test Air Vehicle .....	518
<i>Philip Ellerbrock</i>	
Overview of Flight Tests using iNET RF Network .....	528
<i>Takeshi Honda, Katsuhiko Abe, Daiki Aoyama, Kiminori Mizutani, Sei Ito</i>	

## **SESSION 12 – CELLULAR TELEMETRY**

Strategy for the Application of Cellular Wireless Technology for AMT .....	538
<i>Charles Havasy, Charles Bartlett, Peter Weed, Hans Miller</i>	
Incorporating 5G Data Feeds into the Modern Control Room .....	553
<i>Mark Wigent</i>	
Using 5G's Non-3GPP Inter-Working Function to Support Heterogeneous Networking in Aeronautical Mobile Telemetry .....	556
<i>M. Steele, C. Teague, I. Chen</i>	

## **SESSION 13 – SOFTWARE SYSTEMS AND TOOLS**

Advances in Developing a Unified Post-Flight Analysis System.....	564
<i>Dale Jones</i>	
Autonomous Miniature Car for Room Exploration and Object Search.....	577
<i>Tyler Hattori, Xuanni Huo, Parker Napier, Sabrina Maldonado, Wyatt Swist, Sean Anderson, Joao Hespanha</i>	
Shape Detection in an Image using Parallelized Traditional Image Analysis Techniques.....	587
<i>Alan Cornidez, Ruben Gutierrez, Michael W. Marcellin</i>	

## **SESSION 14 – SENSORS AND DATA ACQUISITION II**

Cost-Effective UV Fluorescence Spectrometer for Life Detection .....	597
<i>Aster G. Davidson, Drew G. Wellen, Jesse P. Deuel, Maxwell J. Ryan, Kurt Kosbar, Melanie Mormile</i>	
Diverse Control Scheme Selection for a Teleoperated Robotic Arm.....	607
<i>Malacki Ehlers, Grant Brinker, Brady Davis, Ethan Medrow, Kurt Kosbar</i>	
Compression of Diffusion Weighted Magnetic Resonance Images using JPEG2000 .....	617
<i>Alexis Boone, Ali Bilgin, Michael W. Marcellin</i>	

StressVision: Non-Invasive Stress Detection from Thermal Videos .....	627
<i>Calvin Xia, Vikram Bhagavatula, Jason Moraes, William Peng, Ryan Murakawa-Rubin, Tom Bullock, Satish Kumar, B. S. Manjuanath</i>	

Ultraviolet Pulse Position Modulation in the Presence of Scattering Losses .....	640
<i>Deva Borah, David Voelz</i>	

## **SESSION 15 – SECURITY AND DATA INTEGRITY**

Adaptive Linear Secrecy Codes with Feedback .....	648
<i>David Hunn, Willie K. Harrison</i>	

Commercial AES256 Block Encryption Applied to Streaming Telemetry – Methodology and Results .....	658
<i>Scott Wolfson, Jonathan Wright</i>	

Data at Rest Innovation with Turnstile .....	665
<i>Malcolm Weir</i>	

Network Telemetry Security Strategy and Design.....	675
<i>Moses Odejobi, Farzad Moazzami, Richard Dean, Mulugeta Dugda, Wondimu Zegeye</i>	

Security Considerations When Performing Telemetry Post-Processing and Analysis in Cloud Environments.....	685
<i>Jeff Kalibjian</i>	

Security Requirements Comparison: Industrial Control Systems vs. IT Systems in Telemetry Networks .....	692
<i>Hassan Shuaibu, Farzad Moazzami</i>	

## **SESSION 16 – ANTENNA AND RF SYSTEMS**

Competing Radio Frequency Mitigation .....	701
<i>Michael Diehl, Tab Wilcox, Alvaro Velador, Jacob Lopez</i>	

Determining Antenna Performance via Comparative Methods .....	717
<i>Frank Cruz, Mark Radke</i>	

Implementation of AESA Technology for High-Target Dynamic Telemetry Ground Antennas.....	727
<i>A. Lohou, A. Robert, G. Kipfer, B. Lesur, P.-M. Bastie</i>	

Meaningful G/T Measurements –Made at Night.....	733
<i>Terry Hill, Jim McCurdy</i>	

Utilizing the SatNOGS Network at Brigham Young University .....	742
<i>Tyler Nielsen, Ryan Sawyer, David Long</i>	

Virtual RF Test Range .....	748
<i>Jason Lucas, Jamie Bergin, Greg Carter</i>	

## **SESSION 17 – SOFTWARE AND SYSTEM TOOLS II**

AITA. Automatic Manoeuvre Detection Based on Wavelets.....	752
<i>Pedro R. Alvarez, Francisca C. Herrero</i>	

The Telemetry Applications of TENA, JMTC, and Big Data Analytics ..... 764  
*Gene Hudgins, Juana Secondine*

CHEETAS & Safari Update ..... 773  
*Thomas Treakle, Christopher Moyer*

## **SESSION 18 – MODULATION AND CODING**

Data Quality Metric (DQM) – How Accurate Does It Need to Be? ..... 787  
*Mark Geoghegan*

LDPC Codes for IRIG-106 Waveforms: Part I – Code Design ..... 799  
*Erik Perrins*

LDPC Codes for IRIG-106 Waveforms: Part II – Receiver Design ..... 811  
*Erik Perrins*

On the Use of Bit Error Rate Testers to Test the Data Quality Metric ..... 822  
*Michael Rice, Gary Sheets, Todd Gross, Chris Gembarowski, Ashley Weis*

## **ADDITIONAL PRESENTATIONS**

Telemetering @ BYU ..... 836  
*Michael Rice, Willie Harrison*

Telemetry @ KU ..... 848  
*Erik Perrins*

Morgan State University: Annual Report - IFT Support WiNetS Laboratory ..... 856  
*Farzad Moazzami*

Telemetry Learning Center: Missouri S & T ..... 866  
*N/A*

NMSU Report to the IFT Board of Directors - April 2023 ..... 893  
*Charles D. Creusere*

Telemetry and Sensing at UCSB ..... 908  
*Yoga Isukapalli*

Telemetering Activities - 2022-23 ..... 920  
*Michael W. Marcellin*

Spring 2023 IFT Board Report ..... 933  
*N/A*

ICTS Report to the IFT ..... 937  
*Raymond Faulstich*

## **Author Index**