

# **59th Annual International Telemetry Conference (ITC 2024)**

International Telemetry Conference Proceedings  
Volume 59 (2024)

Glendale, Arizona, USA  
21-24 October 2024

ISBN: 979-8-3313-2192-5

**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© (2024) by International Foundation for Telemetry  
All rights reserved.

Printed with permission by Curran Associates, Inc. (2025)

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

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

telemetry@comcast.net  
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  
Web: www.proceedings.com

# TABLE OF CONTENTS

## **SESSION 1 – SPECIAL TOPICS**

|                                                                                                                                                                                                                                                                                           |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| An Empirical Study on the Deployment and Performance of Citizens Broadband Radio Service in 4G LTE Commercial Networks .....                                                                                                                                                              | 1  |
| <i>Jose L. Zapata, Harish Ramchandran</i>                                                                                                                                                                                                                                                 |    |
| Impact of Modeling Parameters on Precision of Aggregate Interference Estimates in the CBRS Band .....                                                                                                                                                                                     | 11 |
| <i>Cameron Patterson</i>                                                                                                                                                                                                                                                                  |    |
| Exploring User Interfaces in Interactive Theme Park Attractions .....                                                                                                                                                                                                                     | 21 |
| <i>Alex Drey, Chayse J. Inniss, David Sepulveda, Grace Godinez, Isabella De Sousa Proulx, Jordan Christian, Lucas Tuan, Lucia Alday, Makena Dundon, Michaelyn Moses, Olivia Dodge, Tanisha Taariq, Travis Reihner, Zackary Tileston, Patrick Lynch, Karson Knudson, Michael Marcellin</i> |    |
| Advantages of a Digital Model for Flight Test Instrumentation .....                                                                                                                                                                                                                       | 31 |
| <i>Troy Troshynski, Cody Raml</i>                                                                                                                                                                                                                                                         |    |

## **SESSION 2 – TIME SPACE POSITIONING INFORMATION**

|                                                                                                                                         |    |
|-----------------------------------------------------------------------------------------------------------------------------------------|----|
| Operational Spectrum Comprehension, Analytics, and Response (OSCAR): Dynamic Spectrum Management Leveraging Range Instrumentation ..... | 41 |
| <i>Andrew Portune, Ryan Tortorich</i>                                                                                                   |    |
| Hybrid Tracking System for GPS Denied Environments (HYTS) Overview .....                                                                | 46 |
| <i>Steven Meyer, Gary Glazner, Alvia Sandberg, Scott Kujiraoka</i>                                                                      |    |
| Deep Learning TSPI from Wave Patterns for Indoor Localization .....                                                                     | 55 |
| <i>Kimberly Tse, Joshua Riojas, Phillip Cannard, Damiano Torre, Andres M. A. Mesa, Ben Abbott</i>                                       |    |
| Frequency Reuse with Waypoints .....                                                                                                    | 65 |
| <i>Phiroz H. Madon</i>                                                                                                                  |    |

## **SESSION 3 – AIRBORNE SENSORS AND DATA ACQUISITION I**

|                                                                                                                                    |     |
|------------------------------------------------------------------------------------------------------------------------------------|-----|
| Reducing Aircraft Downtime for Airborne Instrumentation: 2024 Update .....                                                         | 74  |
| <i>Paul A. Cast, Benjamin Baird</i>                                                                                                |     |
| The Development of a Real-Time Integration Processing Technique for PCM Data Between Asynchronous Master and Slave Telemetry ..... | 82  |
| <i>Dong G. Yun, Min J. Park, Jae T. Yu</i>                                                                                         |     |
| Quantitative Video Scoring in Flight Test .....                                                                                    | 92  |
| <i>Daniel Crump, Brandon Rosso, Rocco Docimo</i>                                                                                   |     |
| Upgrading Flight Test Data Acquisition Systems with New Capabilities While Maintaining Backwards Compatibility .....               | 103 |
| <i>Ben Kupferschmidt</i>                                                                                                           |     |

|                                                                                           |     |
|-------------------------------------------------------------------------------------------|-----|
| Integrating Machine Learning Compute Mechanisms for Unmanned Aerial Vehicle Control ..... | 111 |
| <i>Ahmad Qureshi, Jimmy Payan, Michael Marcellin</i>                                      |     |

## **SESSION 4 – AIRBORNE SENSORS AND DATA ACQUISITION II**

|                                                                                    |     |
|------------------------------------------------------------------------------------|-----|
| Advanced Ring Antenna for Vehicular Communications .....                           | 114 |
| <i>Phil Venezia, Clency Lee-Yow, Maxim Ignatenko</i>                               |     |
| Using Filters to Help Mitigate Near Term Radio Frequency Interference (RFI) .....  | 120 |
| <i>Steven Warner</i>                                                               |     |
| Power Over Ethernet in FTI, Suitability and Challenges .....                       | 127 |
| <i>Patrick Quinn</i>                                                               |     |
| Enhanced Air Delivery Instrumentation .....                                        | 134 |
| <i>Jacob J. Lopez, Michael Diehl, Alvaro Velador, Tab M. Wilcox, Adrian Magana</i> |     |

## **SESSION 5 – ANTENNA & RF SYSTEMS**

|                                                                                                                                                         |     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| A Study on the Improvement of Prediction Accuracy for Receive Signal Strength in Palau Tracking Station Through Analyzing Dynamic Link of KSLV-II ..... | 144 |
| <i>Chunwon Kim, Soonho Kwon, Donghyun Kim, Jeongwoo Han, Taejin Lee, Jina Ma, Nagyun Ahn, Minseok So</i>                                                |     |
| Optimizing Telemetry Links in Mil-Aero Environments .....                                                                                               | 156 |
| <i>Dan Bromley, Will Higham, Jason Le Leivre</i>                                                                                                        |     |
| Aeronautical Mobile Telemetry and Radar Transponders – An Interference Study in C-Band-Part 1 .....                                                     | 166 |
| <i>Trung T. Doan, Kip Temple</i>                                                                                                                        |     |
| Moving Towards an All-Digital Multi-Channel TM Receivers .....                                                                                          | 177 |
| <i>Pierre Bastie</i>                                                                                                                                    |     |

## **SESSION 6 – CHANNEL MODELING & EQUALIZATION**

|                                                                                            |     |
|--------------------------------------------------------------------------------------------|-----|
| Optimizing Wireless Data Transfer of Railway Traction Systems by Defining Conditions ..... | 193 |
| <i>Bekir S. Şahin</i>                                                                      |     |
| Telemetry Spectrum Encroachment Risk Update: Post-WRC-23 and New Domestic Challenges ..... | 200 |
| <i>Tim Chalfant, Guy Williams</i>                                                          |     |
| Assessing Telemetry Receiver Data Quality Metrics using RCC 118-22 Test Procedures .....   | 210 |
| <i>Mark Geoghegan, Sean Wilson, James Uetrecht</i>                                         |     |
| A Novel Carrier Frequency Offset Estimation Scheme for SOQPSK-TG STC Waveform .....        | 222 |
| <i>Oussama A. S. Ali, Alain Thomas, Bertrand Le Gal</i>                                    |     |
| IRIG 106 Chapter 10 Decoder for KSLV-II Telemetry Data Analysis .....                      | 232 |
| <i>Taejin Lee, Chunwon Kim, Jin-A Ma, Soonho Kwon, Dong-Hyun Kim</i>                       |     |

## **SESSION 7 – COMMUNICATION SYSTEMS**

|                                                                                       |     |
|---------------------------------------------------------------------------------------|-----|
| A Survey of Software-Defined Radio Technology for Aeronautical Mobile Telemetry ..... | 240 |
| <i>Joshua Gillis, Travis Berry, Michael Rice</i>                                      |     |
| Satellite 5G Telemetry and Commercial Ecosystem.....                                  | 253 |
| <i>Achilles Kogiantis</i>                                                             |     |
| Embedded Recording in Flight Test Telemetry Receiver .....                            | 260 |
| <i>Florian Sandoz, Gregory Blanc, Maxime Cariou, Philippe Klaeyle</i>                 |     |

## **SESSION 8 – MODULATION & CODING**

|                                                                                                                                                            |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| The Art of Encoding a PCM Telemetry Stream: Interweaving Pre-Recorded and Live<br>Analog/Digital Sensor Data in Gun-Launched Instrumentation Systems ..... | 267 |
| <i>Daniel Salib, Jin H. Choi, Alfred Rotundo</i>                                                                                                           |     |
| Exploring Maximum Bit Rates for Software Defined Radios in Aeronautical Telemetry .....                                                                    | 277 |
| <i>Zachary Hilton, Riley Kirkwood, Michael Rice</i>                                                                                                        |     |
| On the Use of Log a Posteriori Probability Ratios for Diversity Combining .....                                                                            | 288 |
| <i>Michael Rice, Willie Harrison, Erik Perrins</i>                                                                                                         |     |
| Spectrally Efficient LDPC Codes for IRIG-106 Waveforms via Random Puncturing .....                                                                         | 308 |
| <i>Andrew D. Cummins, David G. M. Mitchell, Erik Perrins</i>                                                                                               |     |

## **SESSION 9 – NETWORK TELEMETRY I**

|                                                                                                                                                    |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| JPEG XS Compression for Video Telemetry .....                                                                                                      | 318 |
| <i>Stephen Schaphorst, George Nelson</i>                                                                                                           |     |
| Advancing PortScan Event Detection: Leveraging eXtreme Gradient Boosted Trees with Fast<br>Feature Binning and Unsupervised Learning Features..... | 326 |
| <i>Olanrewaju Bucknor, Arlene Cole-Rhodes, Richard Dean, Farzad Moazzami</i>                                                                       |     |
| Orchestrator and Distributed Integrator (ORDER)– AI/ML Adaptive Orchestration of Range<br>Systems.....                                             | 349 |
| <i>Andrew Portune, Bob Creighton</i>                                                                                                               |     |
| Reinforcement Learning Assisted Decoding .....                                                                                                     | 355 |
| <i>Milad Taghipour, Asit K. Pradhan, Bane Vasic</i>                                                                                                |     |

## **SESSION 10 – NETWORK TELEMETRY II**

|                                                                                       |     |
|---------------------------------------------------------------------------------------|-----|
| Advanced Intrusion Detection in Telemetry Enterprise Networks .....                   | 364 |
| <i>Favour Okonkwo, Richard Dean, Farzad Moazzami</i>                                  |     |
| Building a Physical 1553 Bus Network.....                                             | 374 |
| <i>Otokini George, Perry Jordan, Sterling Holliday, Richard Dean, Farzad Moazzami</i> |     |
| Building a Virtual 1553 Bus Network .....                                             | 383 |
| <i>Perry Jordan, Otokini George, Richard Dean, Farzad Moazzami</i>                    |     |

## **SESSION 11 – RANGE SYSTEMS I**

|                                                                                                        |     |
|--------------------------------------------------------------------------------------------------------|-----|
| A Subsystems Analysis of Two CubeSat Missions.....                                                     | 389 |
| <i>Brody Gatza, Aaron Hastings, Orion Roach, Ethan Wegner, Max Georges, Erik Perrins</i>               |     |
| Adopting Radar-Based SLAM in Autonomous Maritime Vehicles for Robust Environmental Exploration .....   | 405 |
| <i>Baron Young, Maxwell Jung, Cameron Barrett, Wenjin Li, Dhruv Aggarwal, Yogananda Isukapalli</i>     |     |
| A Study on Simulated Launch Flight Test for Telemetry Station using IRIG 106 Chapter 10 Recorder ..... | 415 |
| <i>Soonho Kwon, Taejin Lee, Chunwon Kim, Donghyun Kim, Hanseop Shin</i>                                |     |
| AES and SST Together at Last .....                                                                     | 425 |
| <i>Albert Gabaldon, Jaron Guisa, Jon Morgan</i>                                                        |     |

## **SESSION 12 – RANGE SYSTEMS - II**

|                                                                                                                 |     |
|-----------------------------------------------------------------------------------------------------------------|-----|
| Autonomous Mapping and Navigation for Small-Scale Car Racing.....                                               | 443 |
| <i>Kyle Duval, Will Evers, Ryan Li, Cade Matherly, Maxwell Miguelino, Sean Anderson, Joao Hespanha</i>          |     |
| Ground Based Phased Array Telemetry Antenna (gPATMA) System Integration at the Point Mugu Sea Range (PMSR)..... | 453 |
| <i>Kevin Bossoletti, Brad Follo, Scott Kujiraoka</i>                                                            |     |

## **SESSION 13 – SECURITY AND DATA INTEGRITY I**

|                                                                                                  |     |
|--------------------------------------------------------------------------------------------------|-----|
| Driver Interface using CAN-BUS Communication Protocol to Enhance Driver Awareness and Pace ..... | 467 |
| <i>Thomas Schwab, Gabe Vengas, Michael Marcellin</i>                                             |     |
| Cyber Security Architecture for Networked Telemetry .....                                        | 476 |
| <i>Richard Dean, Wole Akpose, Wondimu Zegeye, Farzad Moazzami</i>                                |     |
| Implementing Procedure Tracking Systems with Computer Vision and Sensors.....                    | 485 |
| <i>Frank Yao, Sophie Guan, Spencer Tang, Anoushka Sawant, Yogananda Isukapalli</i>               |     |
| The Advantages of using a Data Quality Estimate for Antenna Tracking .....                       | 495 |
| <i>John Carlson</i>                                                                              |     |

## **SESSION 14 – SECURITY AND DATA INTEGRITY II**

|                                                                                                                                                            |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Distributed Network mmWave Radar System.....                                                                                                               | 505 |
| <i>Aditya Ramakrishnan, Nitin Indukuri, Qifei Chen, Ryan Baum, Tyler Langowski, Jim Buckwalter, Upamanyu Madhow, Ilan Ben-Yaacov, Yogananda Isukapalli</i> |     |
| Quantifiable Measure for Cyber Security Maturity Model.....                                                                                                | 515 |
| <i>Richard Dean, Wole Akpose, Wondimu Zegeye, Farzad Moazzami</i>                                                                                          |     |
| Cybersecurity Considerations When using Generative AI in Telemetry Post Processing Analysis.....                                                           | 525 |
| <i>Jeff Kalibjian</i>                                                                                                                                      |     |

|                                                                                |     |
|--------------------------------------------------------------------------------|-----|
| Secrecy Codes for Telemetry Links.....                                         | 534 |
| <i>Dallin T. Bowden, Tobias S. Cook, Nathan B. Estoque, Willie K. Harrison</i> |     |

## **SESSION 15 – SENSORS & DATA ACQUISITION I**

|                                                                                                                            |     |
|----------------------------------------------------------------------------------------------------------------------------|-----|
| Design of a Wearable Device with Integrated Biometric and Environmental Sensors.....                                       | 544 |
| <i>Julian Frank, Ben Cruttenden, Brandon Lee, Harshita Gangaswamy, Snehith Nayak, Yogananda Isukapalli</i>                 |     |
| Physical Data Collection and Transpondence System for Beetleweight Combat Robotics Arena using Computer Vision .....       | 554 |
| <i>Wolfgang Roettiger, Michael Marcellin</i>                                                                               |     |
| Digital Spectroscopy of Ionospheric Plasma with Telemetry-Enabled Waves, Instabilities & Noise Spectrometer (WINS).....    | 564 |
| <i>Ahmad Qureshi, Naomi Yescas, Sarina Blanchard, Mihailo Martinović</i>                                                   |     |
| Enhancing F-18 ECS Reliability Through Telemetry: enDAQ Sensors' Role in Predictive Maintenance and Safety Assurance ..... | 569 |
| <i>Dylan Pike, Robert Parent</i>                                                                                           |     |

## **SESSION 16 – SENSORS & DATA ACQUISITION II**

|                                                                                                                                                                                                      |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Utilizing the Digital Thread to Track Test Points in Test and Evaluation. How Far Can We Take the Digital Thread? What is the Limit? .....                                                           | 575 |
| <i>Jil M. Barnum, Pamela Tanck</i>                                                                                                                                                                   |     |
| Enhancing Time Series Analysis in Flight Testing with Real-Time Embedded AI .....                                                                                                                    | 584 |
| <i>G. Guerrero, R. Pelluault, S. Sivakumaran, F. Charaix</i>                                                                                                                                         |     |
| Hardware-Software Co-Design of Integrative Telemetry System for Off-Road Racing Vehicle .....                                                                                                        | 592 |
| <i>Alejandro Romero-Lozano, Dylan Correa, Matthew Larsson, Julian P. Rendon, Michael Byerly, Lily Hall, Bea Goco, Jacob Missbrener, Christian White, Owen Ashbeck, Joseph Lee, Michael Marcellin</i> |     |
| Improving Rotorcraft Flight Tests Safety and Efficiency with Real-Time Wind Mapping .....                                                                                                            | 602 |
| <i>Renaud Urli, Sebastian Schmid, Lilian Rocchi, Gabriel Eket</i>                                                                                                                                    |     |
| Ciphering of Telemetry Over IP Performances on UDP .....                                                                                                                                             | 612 |
| <i>Jean-Guy Pierozak, Cédric Tavernier</i>                                                                                                                                                           |     |

## **SESSION 17 – SOFTWARE SYSTEMS AND TOOLS**

|                                                                                                        |     |
|--------------------------------------------------------------------------------------------------------|-----|
| Next Generation Data Download .....                                                                    | 619 |
| <i>Malcolm Weir</i>                                                                                    |     |
| Informing the Simulation: Bridging the Gap Between Model and Reality in Extended Range Artillery ..... | 629 |
| <i>Avi Soffer, Matthew Hawkswell</i>                                                                   |     |
| Constraints Based Airplane and Data Acquisition System Configuration .....                             | 639 |
| <i>Gopinath Rajagopal</i>                                                                              |     |

|                                                   |     |
|---------------------------------------------------|-----|
| Chapter 7 Packet Telemetry: A Retrospective ..... | 648 |
| <i>Katherine Rodittis, Benjamin Kupferschmidt</i> |     |

## **ADDITIONAL PRESENTATIONS**

|                                                                                                                                                                   |     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Telemetry @ KU .....                                                                                                                                              | 655 |
| <i>Erik Perrins</i>                                                                                                                                               |     |
| Morgan State University: Annual Report - IFT Support Winets Laboratory .....                                                                                      | 664 |
| <i>Farzad Moazzami, Richard Dean, Mulugeta Dugda, Wondimu Zegeye, Arlene Cole-Rhodes</i>                                                                          |     |
| Telemetry and Sensing at UCSB .....                                                                                                                               | 675 |
| <i>Yoga Isukapalli</i>                                                                                                                                            |     |
| Missouri University of Science and Technology - College of Engineering and Computing<br>Department of Electrical and Computer Engineering: Report for CY2023..... | 688 |
| <i>Jonathan Kimball</i>                                                                                                                                           |     |
| Telemetry @ BYU .....                                                                                                                                             | 694 |
| <i>Michael Rice, Willie Harrison</i>                                                                                                                              |     |
| NMSU Report to the IFT Board of Directors - May 2024 .....                                                                                                        | 706 |
| <i>Charles D. Cruesere</i>                                                                                                                                        |     |
| The University of Arizona - Telemetry Activities - 2023-24 .....                                                                                                  | 720 |
| <i>Michael W. Marcellin</i>                                                                                                                                       |     |
| ICTS Report to the IFT.....                                                                                                                                       | 733 |
| <i>Chris Patscheck</i>                                                                                                                                            |     |

## **Author Index**