GSAW 2022 Tutorial M:

A Machine Learning Solution for Satellite Health and Safety Monitoring

Overview:
This tutorial presents the basic concepts and challenges associated with applying machine learning solution for satellite health and safety monitoring [1,2]. Unlike the tutorials on ML applications for space missions presented previously that focused on satellite instrument data, this tutorial will present the ML solution for satellite health and safety telemetry data, which includes:

- How to perform data training for telemetry data with different data patterns and complexity.
- How to measure data pattern changes quantitatively.
- How to define a ML representation characterizing patterns of correlations in multiple datasets with data pattern changes. Different events or anomalies have different patterns of correlations.
- How to detect anomalies in satellite telemetry data with clustering algorithms based on patterns of correlations among telemetry datasets.
- This will be illustrated by using specific examples.

Reference:
1. Zhenping Li, "A Machine Learning Solution for Satellite Health and Safety Monitoring", accepted for publication on Journal of Satellite Operations & Communicator.
2. Zhenping Li, "A Hybrid Machine Learning Approach to Anomaly Detections in Satellite Telemetry Data"25th Annual Ground System Architecture Workshop (GSAW), Los Angeles, February, 2021.
   https://gsaw.org/wp-content/uploads/2021/02/2021-P-014-Li.pdf

Instructor:
Zhenping Li, ASRC Federal

Biography:
Zhenping Li: Received his Ph.D in Physics from The University of Tennessee in 1992, and a Master's degree in computer science from Johns Hopkins University in 2003. He joined ASRC Federal in 2013. He has more than 20 years' experience in aerospace industry. His recent focus areas are algorithm development for satellite instrument data processing and the application of machine learning algorithms in support of satellite operations.

Description of Intended Students and Prerequisites:
The target audiences are systems engineers and software developers who are interested in the telemetry data modeling and anomaly detections in satellite health and safety telemetry. Satellite engineers who manage and monitor satellite and its instrument health and safety. The knowledge of satellite operations is very helpful, and basic knowledge of the machine learning is needed.

What can Attendees Expect to Learn:
The attendees will learn the machine learning solution for satellite health and safety monitoring, which provides new engineering analysis approach for normal satellite events and anomalies.

Attendees specifically will learn
- How to perform data training for telemetry data that are diverse in data patterns and highly complex.
- Engineering analysis based on outputs of machine learning analysis of telemetry data.
- Graphic plots of the ML representation that provides signatures of normal operation events and characteristics of anomalies.
- How anomalies are detected and characterized based on patterns of correlations among datasets.