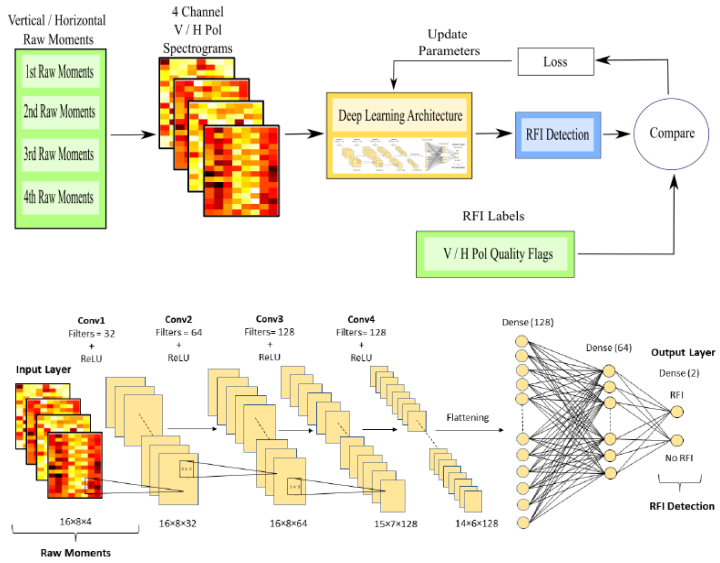
Radio Frequency Interference Detection for SMAP Using Convolutional Neural Networks

Problem: Radio frequency interference (RFI) poses a significant challenge for remote sensing technologies like NASA's SMAP satellite, impacting climate studies and soil moisture estimation. Developing effective and robust detection methods using deep learning is crucial to enhance data accuracy and support environmental monitoring efforts globally.



Flowchart of the learning based RFI detection algorithm and CNN architecture

Finding: This study utilizes four raw moments time-frequency spectrograms from SMAP level 1A and level 1B data products to detect various types of RFI globally. A deep learning model built on a convolutional neural network extracts features, with extensive cross-validation across diverse regions and time frames confirming the model's robustness and adaptability.

Impact: This study advances RFI detection in SMAP by introducing a deep learning framework achieving 99.99% accuracy. Utilizing SMAP data for dynamic labeling enhances efficiency. The research lays a foundation for improved RFI mitigation techniques, ensuring reliable measurements in a crowded radio frequency environment.

A. M. Alam, M. Kurum and A. C. Gurbuz, "Radio Frequency Interference Detection for SMAP Radiometer Using Convolutional Neural Networks," in *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol. 15, pp. 10099-10112, 2022

Microwave Radiometer Calibration Using Deep Learning With 2-D Spectral Features

Problem: Accurate calibration of microwave radiometers is essential for reliable geophysical data retrieval. Traditional calibration methods may introduce measurement uncertainty due to thermal fluctuations and aging. This study proposes a deep learning (DL) method that improves calibration efficiency by reducing reliance on reference data and utilizing 2-d spectral features directly.

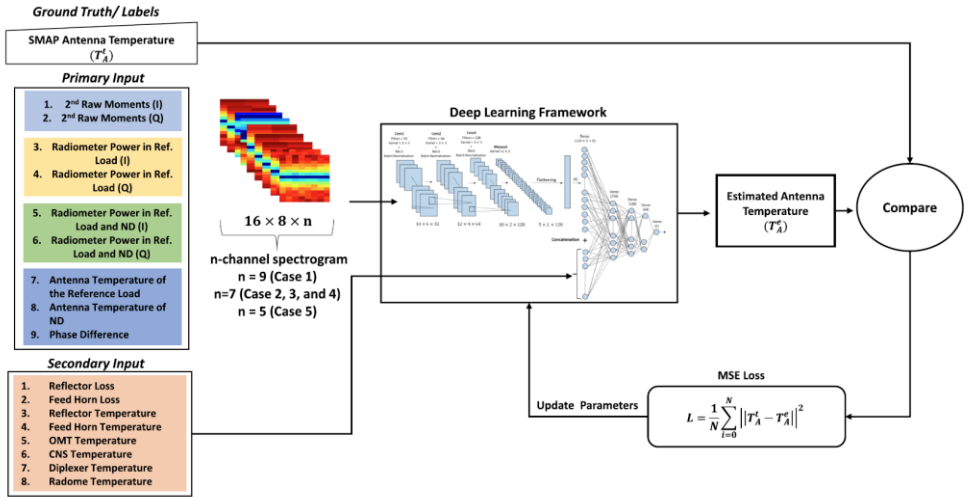


Figure: Training of DL-based architecture to estimate antenna temperature.

Finding: The DL-based calibration method employs convolutional neural networks to analyze 2-D spectral features and leveraging ancillary data like internal thermistor temperature for accurate antenna temperature estimation. This approach reduces reliance on reference information, allowing for more frequent measurements and improved robustness against gain fluctuations across different time frames.

Impact: This work enhances radiometer calibration by using DL to reduce dependence on reference sources, enabling more accurate and frequent measurements despite environmental noise and gain fluctuations. The approach may improve spatial and temporal data quality, supporting more reliable Earth observation and extending radiometer operational life.

A. M. Alam, M. Kurum, M. Ogut and A. C. Gurbuz, "Microwave Radiometer Calibration Using Deep Learning With Reduced Reference Information and 2-D Spectral Features," in *IEEE Journal of Selected Topics in Applied Earth Obs. and Remote Sensing*, vol. 17, pp. 748-765, 2024,