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Unsupervised Fault Detection and Classification in Microwave Links for Opportunistic Weather Detection: Differentiating Weather-Induced and Non-Weather Faults

Wednesday, June 25, 2025 3:15 PM (45 minutes)

Changes in communication signals due to weather conditions are often misclassified as faults, making it challenging to differentiate between meteorological effects and actual network malfunctions, such as physical obstructions (e.g., new construction blocking the signal path) or hardware failures. In this work, we propose an unsupervised learning framework for fault detection and classification in commercial microwave links (CMLs), distinguishing between weather-related and non-weather faults. Our approach is based on an autoencoder (AE) trained on mixed data to establish a reconstruction-based threshold for identifying potential fault regions. We then extract features from the encoder's latent space and combine them with domain-specific spatial and temporal features to enhance characterization. These enriched representations are clustered to capture both localized and regional fault patterns, allowing us to differentiate between faults caused by meteorological events—such as precipitation affecting multiple links simultaneously—and those resulting from structural or equipment-related issues. Beyond improving fault classification accuracy, our method enables opportunistic sensing of weather-induced signal variations, offering a valuable tool for both network maintenance and meteorological monitoring.

Are you an Early Career Scientist ?

Yes

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