IAF EARTH OBSERVATION SYMPOSIUM (B1)
IAF EARTH OBSERVATION SYMPOSIUM - Extra Session (8)

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TOWER-CHECK: DESIGNING A REAL-TIME MONITORING ARCHITECTURE FOR HIGH VOLTAGE OVERHEAD POWER LINES USING SAR ON-BOARD PROCESSING TECHNIQUES

Abstract

The escalating frequency of extreme weather events observed over the past few decades, driven by climate change, poses a critical threat to the structural integrity of strategic ground infrastructure, including high voltage overhead power lines. Power outages, caused by a structural failure of the transmission tower or even a loss of the transmission cable, may have a significant economic impact on businesses and households located within the disrupted area. Monitoring high voltage power lines and locating the damage within a few hours after the extreme weather event becomes especially crucial in mountainous regions, where conventional inspection methods such as aerial surveys using airplanes, Unmanned Aerial Vehicles (UAVs) or ground-based personnel, may prove expensive and potentially hazardous.

The privileged viewpoint of a Synthetic Aperture Radar (SAR) satellite platform answers the need to

image visibly damaged power lines even during nighttime and severe weather conditions. However, since data coming from SAR satellites is currently handled within the ground segment, information is not promptly available to the managing authority of the power lines infrastructure, to deploy a maintenance team in a timely manner. To bridge the gap, Planetek Italia S.r.l. together with its commercial partners Geophysical Application Processing S.r.l., Politecnico di Bari and Università degli Studi di Bari, is pioneering an innovative monitoring solution for SAR platforms leveraging Artificial Intelligence and Machine Learning (AI/ML) techniques implemented in the space segment for on-board processing.

The proposed design is targeted to identify precisely located damages on transmission towers by means of on-board SAR high resolution data processing supported by AI/ML algorithms. Specifically, the objective of the AI/ML techniques is to autonomously detect anomalies in power line infrastructures accurately characterized by geometry and exact position, thus delivering an almost instantaneous alert to the final user. A synergy of different approaches is proposed that aim to optimize the computational effort of the on-board computer and the resources needed for downlink operations, thus providing a solution expressly tailored for on-board low power consumption platforms.

This research is supported by the Italian Space Agency (ASI, Agenzia Spaziale Italiana) in the framework of the RESEARCH DAY "GIORNATE DELLA RICERCA ACCADEMICA SPAZIALE" initiative, through contract no. ASI-PKI-2023-5-E.0.