Vegetation Measurement along the Line Corrider using Satellite Imagery

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ABSTRACT

This study explores the feasibility of using satellite imagery for vegetation measurement along a linear corridor. The research employs remote sensing techniques to analyse satellite data, focusing on vegetation indices such as NDVI(Normalized Difference Vegetation Index) and EVI (Enhanced Vegetation Index). The methodology involves

preprocessing of satellite imagery, including radiometric and atmospheric corrections, followed by vegetation index calculation and interpretation. Additionally, ground truth data collected through field surveys are used for validation and calibration. The results demonstrate the potential of satellite imagery for accurately assessing vegetation characteristics along linear corridors, offering valuable insights for environmental monitoring, land management, and infrastructure planning.

Keywords: Satellite Imagery, Linear Corridor, Vegetation Indices, Normalized Difference Vegetation Index, Enhanced Vegetation Index

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INTRODUCTION

Monitoring of electrical transmission towers (TTs) is required to maintain the integrity of power lines.One major challenge is monitoring vegetation encroachment that can cause power interruption. Most of the current monitoring techniques use unmanned aerial vehicles (UAV) and airborne photography as an observation medium.However, these methods are expensive and not practical for monitoring wide areas.In this paper, we introduced a new method for monitoring the power line corridor from satellite imagery.

RELATED WORK

There are several related works on vegetation measurement along line corridors using satellite imagery.Some key areas of research include Vegetation Index Analysis:Many studies focus on using vegetation indices derived from satellite imagery, such as the Normalized Difference Vegetation Index (NDVI) or Enhanced Vegetation Index (EVI), to quantify vegetation health and density along line corridors.Change Detection Researchers often employ satellite imagery to monitor changes in vegetation cover over time along line corridors, such as deforestation, reforestation, or changes due to infrastructure development.Machine Learning and Remote Sensing Recent advancements in machine learning techniques applied to remote sensing data have enabled more accurate and automated methods for vegetation measurement along line corridors, including species classification

and biomass estimation. LiDAR Integration: Some studies combine satellite imagery with LiDAR (Light Detection and Ranging) data to improve the accuracy of vegetation measurements, especially for three-dimensional assessments of canopy structure and biomass estimation.Urban Greenery Assessment: In urban areas, researchers use satellite imagery to assess the distribution and health of vegetation along transportation corridors, such as roads and railways, to understand the urban heat island effect and improve urban green infrastructure planning.These related works contribute to a better understanding of vegetation dynamics along line corridors and inform various applications, including environmental biodiversity conservation, and land management.

UNMANNED AERIAL VEHICLES

Before deploying UAVs, careful planning is necessary. This involves identifying the specific line corridors to be monitored and coordinating flight schedules with satellite overpasses to ensure timely data collection.Satellite Imagery Acquisition: Satellite imagery provides a broad overview of the entire corridor and its surroundings. High-resolution satellite imagery can be obtained from various sources, such as commercial satellite providers like DigitalGlobe or government agencies like NASA and ESA. This imagery serves as the foundation for understanding the general vegetation patterns and land use within the corridor.UAV Deployment: UAVs are then deployed to capture detailed imagery and data at a much higher resolution compared to satellite imagery. These UAVs are equipped with specialized sensors such as multispectral, hyperspectral, LiDAR, or RGB cameras, depending on the specific requirements of the vegetation monitoring task.Data Collection and Analysis: As the UAV flies along the corridor, it collects imagery and data on vegetation characteristics such as health, density, height, and encroachment onto the infrastructure. The sensors onboard the UAV capture data across different spectral bands, allowing for the identification of vegetation stress, disease, or other anomalies.Image Processing and Integration: Once the UAV mission is completed, the collected imagery and data are processed using specialized software tools. This involves stitching together the individual images to create a seamless mosaic of the corridor, as well as extracting relevant vegetation indices and metrics from the data.Data Fusion with Satellite Imagery: The high-resolution UAV data are then fused or integrated with the broader-scale satellite imagery to provide a comprehensive understanding of vegetation dynamics along the corridor. This integration allows for the identification of localized vegetation changes that may not be discernible from satellite imagery alone.Vegetation Monitoring and Management: The combined dataset enables vegetation monitoring and management activities along the line corridor. This includes identifying areas of vegetation encroachment or risk to infrastructure, prioritizing maintenance interventions, and optimizing vegetation management strategies to ensure the reliability and safety of the corridor.Continuous Monitoring and Feedback: UAV flights and satellite imagery acquisition can be scheduled at regular intervals to enable continuous monitoring of vegetation dynamics over time. Feedback from monitoring activities can inform adaptive management strategies and help in assessing the effectiveness of vegetation management interventions.Overall, the integration of UAVs with satellite imagery enhances the efficiency and effectiveness of vegetation monitoring along line corridors, leading to improved infrastructure resilience and reduced risks of vegetation-related disruptions.

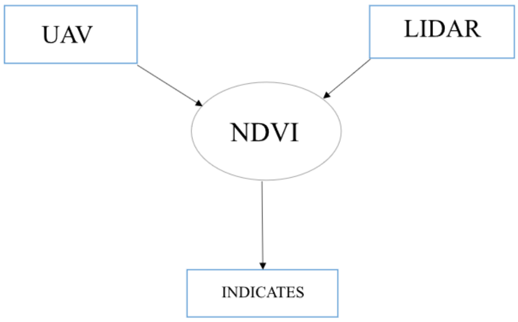
NDVI SYSTEM

Normalized Difference Vegetation Index (NDVI) holds significant importance for vegetation measurement along linear corridors using satellite imagery. Quantitative Vegetation Assessment: NDVI is a widely used vegetation index derived from satellite imagery. It provides a quantitative measure of vegetation greenness and health along linear corridors, indicating the presence and vigor of vegetation cover.Indicator of Vegetation Density: NDVI values range from -1 to 1, with higher values indicating denser and healthier vegetation. Along linear corridors, NDVI helps quantify variations in vegetation density, identifying areas of dense vegetation, sparse vegetation, and vegetation-free zones.Temporal Monitoring: NDVI can be computed from satellite imagery captured at different time points, allowing for temporal monitoring of vegetation dynamics along corridors. Changes in NDVI over time indicate seasonal variations, vegetation growth patterns, and responses to disturbances.Corridor Impact Assessment: NDVI serves as a valuable tool for assessing the impact of corridor infrastructure, such as roads, railways, and power lines, on adjacent vegetation. By comparing NDVI values inside and outside the corridor, researchers can evaluate vegetation health and fragmentation.Integration with GIS: NDVI data can be integrated into Geographic Information Systems (GIS) for spatial analysis and visualization. GIS platforms enable researchers to overlay NDVI maps with other spatial data, such as land use, elevation, and infrastructure, enhancing the understanding of corridor vegetation dynamics.Management Decision Support: NDVI data derived from satellite imagery provides actionable insights for vegetation management and conservation along corridors. It informs decisions regarding habitat restoration, vegetation maintenance, and land use planning to promote ecological balance and corridor sustainability.

LIDAR SYSTEM

LiDAR(Light Detection and Ranging) technology uses laser pulses emitted from aircraft or satellites to measure the distance to the Earth's surface. It provides highly accurate elevation data, generating a detailed 3D representation of the terrain and vegetation structure.In the context of vegetation measurement along line corridors, LiDAR can precisely capture the height, density, and spatial distribution of vegetation. Satellite imagery offers a broader perspective, covering large areas with varying spatial and spectral resolutions.It provides a continuous record of vegetation conditions over time, allowing for trend analysis and change detection. While satellite images may lack the fine-scale detail of LiDAR, they offer the advantage of frequent and consistent monitoring over extensive regions.Integration of LiDAR and Satellite Data: Combining LiDAR data with satellite imagery enhances the understanding of vegetation dynamics along line corridors. LiDAR-derived vegetation metrics, such as canopy height and density, can be integrated with satellite images to improve classification and mapping accuracy.By fusing the strengths of both data sources, such as the detailed structural information from

LiDAR and the broad coverage from satellites, comprehensive assessments of vegetation health and changes can be obtained.



Applications:Vegetation management along line corridors, such as power lines, pipelines, or railways, benefits from accurate and up-to-date information on vegetation structure and encroachment. Monitoring vegetation dynamics helps identify potential hazards, such as trees encroaching on power lines, and supports proactive maintenance planning.Environmental impact assessments and habitat monitoring can also benefit from the combined use of LiDAR and satellite data for vegetation characterization.Challenges and Considerations:Data processing and integration require specialized techniques to align and combine LiDAR and satellite datasets effectively. Cost and accessibility may be limiting factors, as LiDAR data acquisition can be expensive, while satellite imagery often comes with associated costs.Interpretation of integrated data requires expertise in remote sensing, ecology, and geospatial analysis to extract meaningful information for vegetation management purposes.Overall, leveraging both LiDAR and satellite data offers a powerful approach for vegetation measurement along line corridors, enabling informed decision-making and proactive management strategies.

CONCLUSION

Using satellite imagery for vegetation measurement along a line corridor offers numerous advantages, including wide coverage, cost-effectiveness, and the ability to monitor changes over time. By analyzing vegetation indices derived from satellite data, such as NDVI, researchers can accurately assess vegetation health, density, and distribution along the corridor. This information is invaluable for various applications, including ecological monitoring, land management, and infrastructure planning. However, it's essential to consider factors like image resolution, atmospheric conditions, and data processing techniques to ensure accurate and reliable results. Overall, satellite imagery provides a powerful tool for monitoring vegetation along line corridors, aiding in informed decision-making and sustainable management practices.

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