A Case Study on Avicennia Community for Assessing Structural Variation Assessment Through Scale Profiling Using Laplacian of Gaussian Filter

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Abstract

This study evaluates structural variations in two Avicennia species to assess ecosystem dynamics and resilience to environmental changes using scale-space profiling. Since leaf

thickness and vein patterns are unique to each Avicennia community, an appropriate filtering method is needed for accurate geometric pattern analysis, such as fractal dimension calculation, which depends on precise image boundary identification. Techniques such as vein isolation via Gaussian blur and adaptive thresholding, edge detection using Canny, image scaling, and the Laplacian of Gaussian (LoG) filter are employed. The LoG filter method demonstrates greater accuracy based on Mean Squared Error (MSE), Structural Similarity Index Measure (SSIM), Peak Signal-to-Noise Ratio (PSNR), and Figure of Merit (FoM), the last of which could not be determined due to a rare case of uncertainity. The results indicate that the LoG filter is a preferable choice for assessing structural patterns in Avicennia marina and Avicennia officinalis species. The study evaluates the time efficiency of different image-processing techniques, emphasizing edge detection and vein isolation. The Laplacian of Gaussian (LoG) filter, despite its computational complexity $O(n+m)$, provides superior accuracy. Additionally, the Gaussian pyramid technique is employed for fractal analysis in leaf structures following LoG filtering, aiming to enhance fractal analysis for studying leaf geometric patterns.

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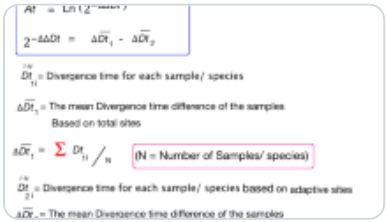

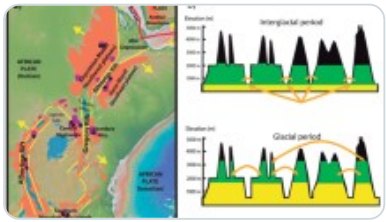

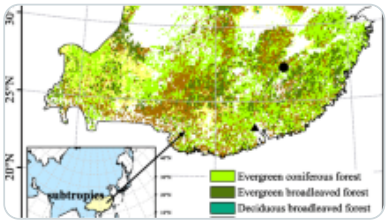

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References

1. Lindeberg T (2009) Scale-space

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2. Fu R (2022) Scale space mining algorithm and application analysis based on computer image processing. In: 2022 second international conference on advanced technologies in intelligent control, environment, computing and communication engineering (ICATIECE). IEEE, pp 1–6

Google Scholar

3. Abbasi S, Mokhtarian F, Kittler J (1999) Curvature scale space image in shape similarity retrieval. Multimedia Syst. 7:467–476

Google Scholar

4. Malik K, Robertson C, Roberts SA, Remmel TK, Long JA (2023) Computer vision models for comparing spatial patterns: understanding spatial scale. Int J Geogr Inf Sci 37(1):1–35

Google Scholar

5. Saito H, Bellan MF, Al-Habshi A, Aizpuru M, Blasco F (2003) Mangrove research and coastal ecosystem studies with SPOT-4 HRVIR and TERRA ASTER in the Arabian Gulf. Int J Remote Sens 24(21):4073–4092

Google Scholar

6. Hu L, Xu N, Liang J, Li Z, Chen L, Zhao F (2020) Advancing the mapping of mangrove forests at national-scale using Sentinel-1 and Sentinel-2 time-series data with Google Earth Engine: a case study in China. Remote Sens 12(19):3120

Google Scholar

7. Kamal M, Phinn S, Johansen K (2013) Assessment of mangrove spatial structure using high-spatial resolution image data. In: 2013 IEEE international geoscience and remote sensing symposium-IGARSS. IEEE, pp 2609–2612

Google Scholar

8. Blasco F, Gauquelin T, Rasolofoharinoro M, Denis J, Aizpuru M, Caldairou V (1998) Recent advances in mangrove studies using remote sensing data. Mar Freshwater Res 49(4):287–296

Google Scholar

9. Suteanu C (2023) Scale, patterns, and fractals. Scale: understanding the environment. Springer International Publishing, Cham, pp 207–252

Google Scholar

10. Karaca Y, Moonis M, Baleanu D (2020) Fractal and multifractional-based predictive optimization model for stroke subtypes' classification. Chaos, Solitons Fractals 136:109820

Google Scholar

11. Clarke J, Barman S, Remagnino P, Bailey K, Kirkup D, Mayo S, Wilkin P (2006) Venation pattern analysis of leaf images. In: Advances in visual computing: second international symposium, ISVC 2006 Lake Tahoe, NV, USA, Proceedings, Part II 2. Springer, Berlin, pp 427–436

Google Scholar

12. Pajor R, Fleming A, Osborne CP, Rolfe SA, Sturrock CJ, Mooney SJ (2013) Seeing space: visualization and quantification of plant leaf structure using X-ray micro-computed tomography: view Point. J Exp Bot 64(2):385–390

Google Scholar

13. Silva PF, Marcal AR, da Silva RMA (2013) Evaluation of features for leaf discrimination. In: International conference image analysis and recognition. Springer, Berlin, pp 197–204

Google Scholar

14. Gwo CY, Wei CH (2013) Plant identification through images: using feature extraction of key points on leaf contours1. Appl Plant Sci 1(11):1200005

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15. Held A, Ticehurst C, Lymburner L, Williams N (2003) High resolution mapping of tropical mangrove ecosystems using hyperspectral and radar remote sensing. Int J Remote Sens 24(13):2739–2759

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