Full Feature Set

Edward Baleni

May 13, 2025

Description	Variable	Description	References
Shape Descriptors	Compactness	$\text{Com} = \frac{CP^2}{4\pi CPA}$	Bribiesca (1997)
	Eccentricity	$\text{Ecc} = \frac{MinAL}{MajAL}$	Zhang and Lu (2004)
	Convexity	$\text{Conv} = \frac{CP}{convexPerimeter}$	Hentschel and Page (2003)
	k-Curvature	$\kappa = \frac{\lvert x'' y' - x' y'' \rvert}{((x')^2 + (y')^2)^{\frac{3}{2}}}$	Young et al. (1974)
	Bending Energy	$E_c = \frac{1}{N} \sum_{p=1}^{N} \kappa(p)^2 \quad \frac{2\pi}{RoG} \leq E_c \leq \infty$	Young et al. (1974)
	Circularity	$\text{Circ} = \frac{4\pi CPA}{CP^2}$	Zdilla et al. (2016)
	Roundness	$\text{Rou} = \frac{4 \cdot CPA}{\pi MajAL^2}$	Hentschel and Page (2003)
	Solidity	$\text{Sol} = \frac{CPA}{convexArea}$	Zdilla et al. (2016)
	Zernike Moments	$Z_{nm} = \frac{n+1}{\pi} \sum_x \sum_y V^*_{nm}(x,y) f(x,y)$	Zhang and Lu (2004)
Haralick Texture Features	Angular Second Moment	$\text{ASM} = \sum_{i,j=0}^{levels-1} P_{i,j}^2$	Haralick et al. (1973)
	Contrast	$\text{Con} = \sum_{i,j=0}^{levels-1} P_{i,j}(i-j)^2$	
	Correlation	$\text{Corr} = \sum_{i,j=0}^{levels-1} P_{i,j} \left[\frac{(i-\mu_i)(j-\mu_j)}{\sqrt{(\sigma_i^2)(\sigma_j^2)}} \right]$	
Aerial Reflectance Bands	Band 2, Blue (0.45-0.51μm)	Blue	-
	Band 3, Green (0.53-0.59μm)	Green	-
	Band 4, Red (0.64-0.67μm)	Red	-
	Band 5, Red Edge (0.68-0.73μm)	Reg	-
	Band 6, Near-Infrared (0.85-0.88μm)	NIR	-
Vegetation Indices	Normalized Difference Vegetation Index	$\text{NDVI} = \frac{\text{NIR}-\text{RED}}{\text{NIR}+\text{RED}}$	Rouse et al. (1974)
	Normalized difference red-edge Index	$\text{NDRE} = \frac{\text{NIR}-\text{REG}}{\text{NIR}+\text{REG}}$	Barnes et al. (2000)
	Green Normalized Difference Vegetation Index	$\text{GNDVI} = \frac{\text{NIR}-\text{GREEN}}{\text{NIR}+\text{GREEN}}$	Buschman and Nagel (1993)
	Soil Adjusted Vegetation Index	$\text{SAVI} = \left(\frac{\text{NIR}-\text{RED}}{\text{NIR}+\text{RED}+L} \right) \cdot (1+L)$	Huete (1988)
	Optimised SAVI	$\text{OSAVI} = 1.16 \cdot \frac{\text{NIR}-\text{RED}}{\text{NIR}+\text{RED}+0.16}$	Rondeaux et al. (1996)
	Enhanced Vegetation Index	$\text{EVI} = 2.5 \cdot \frac{\text{NIR}-\text{RED}}{\text{NIR}+6 \cdot \text{RED}-7.5 \cdot \text{BLUE}+1}$	Huete et al. (2002)
Other Indices	Confidence	Conf	-
	Digital Surface Model	DSM	-

Table 1: Feature set used to perform anomaly detection

References

Barnes, E. M., Clarke, T., Richards, S. E., Colaizzi, P. D., Haberland, J., Kostrzewski, M., Waller, P. M., Choi, C. Y., Riley, E., Thompson, T. L., Lascano, R. J., Li, H., Moran, M. S., Robert, P. C., Rust, R. H., and Larson, W. E. (2000). Coincident detection of crop water stress, nitrogen status and canopy density using ground-based multispectral data. In *5th International Conference on Precision Agriculture*.

Bribiesca, E. (1997). Measuring 2-d shape compactness using the contact perimeter. *Computers & Mathematics with Applications*, 33(11):1–9.

Buschman, C. and Nagel, E. (1993). In vivo spectroscopy and internal optics of leaves as basis for remote sensing of vegetation. *International Journal of Remote Sensing*, 14(4):711–722.

Haralick, R. M., Shanmugam, K., and Dinstein, I. (1973). Textural features for image classification. *IEEE Transactions on Systems, Man, and Cybernetics*, SMC-3(6):610–621.

Hentschel, M. L. and Page, N. W. (2003). Selection of descriptors for particle shape characterization. *Particle & Particle Systems Characterization*, 20(1):25–38.

Huete, A. (1988). A soil-adjusted vegetation index (savi). *Remote Sensing of Environment*, 25(3):295–309.

Huete, A., Didan, K., Miura, T., Rodriguez, E., Gao, X., and Ferreira, L. (2002). Overview of the radiometric and biophysical performance of the modis vegetation indices. *Remote Sensing of Environment*, 83(1):195–213. The Moderate Resolution Imaging Spectroradiometer (MODIS): a new generation of Land Surface Monitoring.

Rondeaux, G., Steven, M., and Baret, F. (1996). Optimization of soil-adjusted vegetation indices. *Remote Sensing of Environment*, 55(2):95–107.

Rouse, J. W., J., Haas, R. H., Schell, J. A., and Deering, D. W. (1974). Monitoring Vegetation Systems in the Great Plains with Erts. In Freden, S. C., Mercanti, E. P., and Becker, M. A., editors, *NASA Special Publication*, volume 351, page 309. NASA. Goddard Space Flight Center 3d ERTS-1 Symp., Vol. 1, Sect. A.

Young, I. T., Walker, J. E., and Bowie, J. E. (1974). An analysis technique for biological shape. i. *Information and Control*, 25(4):357–370.

Zdilla, M. J., Hatfield, S. A., McLean, K. A., Cyrus, L. M., Laslo, J. M., and Lambert, H. W. (2016). Circularity, solidity, axes of a best fit ellipse, aspect ratio, and roundness of the foramen ovale: A morphometric analysis with neurosurgical considerations. *Journal of Craniofacial Surgery*, 27(1).

Zhang, D. and Lu, G. (2004). Review of shape representation and description techniques. *Pattern Recognition*, 37(1):1–19.