Advanced Extraction and Analysis of Topographic Features from High-Resolution DEMs

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SUMMARY

The Surveyor-General of Victoria serves as the primary government authority on land surveying and cadastre in the state. The Surveyor-General oversees the Surveyor-General Victoria (SGV) division within Land Use Victoria. A key operational unit within SGV is the Land Reform Projects (LRP) team, which is responsible for investigating land tenure and parcel definition matters. The LRP team provides surveying services to support legislative processes involved in government land reform projects. LRP's services include establishing accurate cadastral boundaries and dealing with other land related matters such as legal access, lease and licenses and updating land status in line with the future land use. Determining topographic features such as ridges and watercourses play an important role in establishing cadastral boundaries. In regions where field surveys are impractical or time-consuming, or where existing datasets for topographic features are unreliable, the analysis of high-resolution Digital Elevation Models (DEMs) and aerial imagery offers a highly effective alternative for extracting and analysing topographic structures. This paper presents an enhanced method for extracting channel networks and ridgelines from DEMs, leveraging advanced hydrological algorithms designed for topographic feature detection. These algorithms help identify flow patterns and elevations, enabling the accurate delineation of key topographic features such as ridges and watercourses, which are critical for cadastral boundary definitions. To refine the accuracy of the extracted features, advanced smoothing and simplification techniques are applied to the raw data. These methods smooth sharp bends and remove redundant points in the topographic features while preserving the essential structure of watercourses and ridges. The simplification thresholds are carefully calibrated against manually extracted watercourses from a test region to ensure the reliability of the results. One of the challenges in this approach is the potential similarity between roads and topographic features, as both can exhibit linear patterns that may be difficult to differentiate. To address this, similarity measures, such as Fréchet distance, are used to distinguish between roads and the topographic features. By quantifying the similarity of shapes, these measures

help ensure that roads are correctly separated from watercourses and ridgelines. The results demonstrate a strong alignment between the extracted watercourses and ridgelines and the features visible in recent high-resolution imagery. This method significantly reduces the need for time-consuming manual extraction and provides an improvement over existing datasets derived from lower-resolution DEMs, offering a more reliable and efficient solution for delineating topographic features in cadastral applications.