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Scarplet: A Python package for topographic template matching and diffusion dating

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Software

- Review
- Repository
- Archive

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Summary

Detection and analysis of landforms is a major problem in geoscience, including identifying and measuring the relative ages of earthquake fault scarps. Inverse methods using the diffusion equation have been applied to relatively date a wide range of landforms, including scarps (Hanks, 2000; Hilley, DeLong, Prentice, Blisniuk, & Arrowsmith, 2010), terraces (Avouac & Peltzer, 1993), and impact craters (Fassett & Thomson, 2014). Size (height) and relative age estimates from these techniques provide important constraints where instrumental or historic data may be sparse: for example, in a fault zone with a limited record of historic seismicity. Similar wavelet-based methods are widely used in geophysics and channel network analysis as feature extraction techniques (Lashermes, Foufoula-Georgiou, & Dietrich, 2007; Passalacqua, Tarolli, & Foufoula-Georgiou, 2010).

The `scarplet` package provides a set of tools for performing feature detection and diffusion dating using user-defined landform templates. The package contains several template functions implemented for vertical scarp dating as well as a crater template and common functions such as the Ricker wavelet. As the template matching approach can exploit simple map-reduce parallelism, it can be efficiently applied to large datasets in a distributed manner.

The core algorithms of `scarplet` use standard signal processing tools in the scientific Python ecosystem, and the `WindowedTemplate` base classes used by these methods are easy to extend. The intent is to provide a quick, scalable option for topographic data analysis and template function prototyping which can be adapted by users familiar with NumPy and SciPy. As availability of digital topographic data from airborne and satellite sources grows, tools like this will help to enable quantitative geomorphology on regional and global scales and complement Python-based modelling packages such as LandLab (Hobley et al., 2017).

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