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| Supervisor's Department | Geography |
| Project Title | Shape stability of phenomena as assessed from multi-scale vertical profile UAV imagery |

Description of Research Project (1500 characters maximum)

Natural phenomena exhibit different emergent characteristics when viewed, represented, or interpreted at different spatial scales. This premise has spurred decades of research into multi-scalar analyses of phenomena and the intent of isolating the most informative or important scales for specific ecological phenomena or processes. Until now, access to multiple scales of data pertaining to a specific location or phenomenon has required cobbling together data from many different sensors, cameras, or tools, each with slightly varying optics, sensitivities, or design characteristics. Perhaps even more worrying are the time lags among the varied acquisitions that make it difficult to attribute measurable differences to scale, rather than time or sensor differences.

The proposed project controls for the data acquisition platform and timing by using digital imagery obtained from Tetracam Snap multispectral camera mounted to a quadcopter unmanned aerial vehicle (UAV). The UAV is flown vertically upwards and images are acquired at intervals of altitude above the phenomena of interest. Since the camera, its characteristics, and timing are consistent, only the rising altitude changes the spatial resolution of each pixel, thus mimicking a multiple scale dataset. Our goal is to extract and observe individual features from these vertical profiles (e.g., shrubs) and track how their size, complexity, heterogeneity, and specifically shape vary with changing spatial resolution.

Undergraduate Student Responsibilities (1500 characters maximum)

The successful candidate will organize a series of UAV image archives that exist as vertical profiles, initially by developing a consistent and scalable naming nomenclature. The images within each vertical profile require georegistration to a control layer such that the same features will align across all layers in the profile, but at changing spatial resolution (this is an onerous and difficult task requiring precision and patience). The images will then be classified to permit the identification of individual features within each image and then be cropped into individual feature profiles that characterize that feature along a continuum of spatial resolutions. Summaries of the features (particularly their shapes) will be require the use of using existing software tools. Every step of the process needs documentation in words and with figures as necessary. Results are to be summarized in appropriate tabular form that will permit pivoting to isolate and emphasize specific aspects of the numeric results. The various profiles will be compared and clustered (with the help of the supervisor) to identify stability and variability of features to scale changes. A technical paper will be prepared along with a conference presentation jointly with the supervisor.

Qualifications Required (750 characters maximum)

The qualified applicant must have familiarity with Geographic Information Systems (GIS) and remote sensing tools to manipulate digital imagery (e.g., ArcGIS, QGIS, Geomatica Focus). Experience with Microsoft Excel is required for organizing and summarizing numeric results; the ability to do this using R would be preferred but is not mandatory. Competency, or the willingness to learn the use of Pivot Tables is necessary and the attention to detail is an absolute requirement. Clear documentation of work is required. The results of this study will hinge on the precision of the georegistration of images and their processing for shape analysis. Basic statistical knowledge is an asset.
