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Thermal 3D Modeling of Geothermal Area Using Terrestrial Photogrammetry

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Photogrammetry and computer vision, sciences producing high accuracy 3D models from digital images based on projective geometry. 3D models can also be produced using thermal camera images using photogrammetry and computer vision techniques. Thermal images are capable of displaying hotspots on geothermal areas as a heat source in details. In the research, Tuzla geothermal area in Çanakkale province of Turkey is inspected using imaging techniques of terrestrial photogrammetry. Both a digital camera Canon EOS 650D and an infrared camera Optris PI 450 are used to obtain images of the thermal site. Calibration parameters (focal length, principle point, distortion coefficients) of thermal and digital cameras are determined using the calibration test field at the laboratory before the field work. In order to provide the georeferencing and the robustness of the 3D model, aluminum discs having diameter of 30 centimeters as ground control points (GCPs) are set to the geothermal area appropriately before imaging. Aluminum targets are chosen as the GCP because they are determined on the image depending on the contrast reflectance rate of the aluminum. Using GNSS RTK receivers supplying ± 1 cm accuracy positioning, GCPs are measured so as to implement photogrammetric process successfully with thermal images. Numerous corresponding points are detected on the overlapped images with image matching techniques. Later on, bundle block adjustment is applied to calculate the revised interior orientation parameters of camera and exterior orientation parameters of camera positions. The 3D model showing details of the surface temperatures of the geothermal area are produced with multi view stereo (MVS) technique. The technique is able to produce 3D representation (point cloud, mesh and textured surface) of the field from both the thermal and digital images. The research presents that photogrammetric evaluation of thermal images is a noteworthy method to obtain a quick-accurate 3D geometric temperature model of the geothermal areas.

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