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Landslide fissures and fractures mapping and classification from UAV imagery

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Mapping landslide fissures and fractures are essential in understanding the landslide dynamics and evolution across space and time. In the current study, a particular focus on detecting, mapping, and classifying the fissures and fractures located along the landslide bodies and in their vicinity has been given. The depth, direction and width of each fissure and fracture are related to the stress and strain imposed on the landslide body. Moreover, the spatial distribution of these can indicate areas where the landslide can extend, mainly if they are located in the upper part of the main landslide scarp. Even though the fissures and fractures leave a distinct pattern on the landslide body when they are fresh or when there is a high contrast between the bare soil and the surrounding vegetation, these patterns are gradually diminished by time, making their detection difficult. The problem of landslide cracks mapping in various environmental conditions and having different ages was tackled in the current study by using very high spatial resolution UAV aerial imagery and derived products in conjunction with deep learning models. Several flights using DJI Phantom 4 RTK were performed in the Romanian Subcarpathians in areas with both recent and old landslide occurrences. The sampling dataset was collected with Esri ArcGIS Pro on products obtained by the fusion of orthoimages with terrain parameters. The dataset was fed into a Mask RCNN deep learning model with a Resnet152 architecture and trained for 50 epochs. The training and validation reached accuracies of 0.77 and 0.70, estimated from the Intersect over Union metric. No significant differences were recorded between the detection on only orthoimages and the detection on products obtained from the fusion of orthoimages with other terrain parameters. A slight decrease in the validation accuracy was observed when the images were collected on older landslides compared to recent landslides. Overall, the detection of fissures and fractures using deep learning and UAV aerial imagery proved reliable if the UAV flights are flown quickly after the landslide occurrence or after recent rainfalls.

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