The Landslide4Sense Competition 2022

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Recent advances in computer vision and the high availability of Earth Observation (EO) imaging have enabled the generation of information about natural hazards. Detecting areas affected by natural hazards is of obvious immediate importance. The EO images are the main source of spatial information from hazard impacts in remote and large-scale areas. Modern deep learning methods have recently automated EO image processing to produce applicable high-level information. In particular, these methods are preferred over longstanding physics-based conventional solutions for detecting the natural hazard of landslides. The updated knowledge of ground surface deformations caused by landslides developed from EO images and machine learning provides a critical landslide inventory, essential for a better understanding of landslides, identifying triggers, and identifying prone areas.

A special session of the CDCEO'22 workshop (https://www.iarai.ac.at/cdceo22/) presents findings from the first globally distributed, multi-sensor landslide detection competition, named as Landslide4Sense (https://www.iarai.ac.at/landslide4sense/). The aim of the competition is to promote innovative algorithms for automatic landslide detection using remote sensing images around the globe, and to provide objective and fair comparisons among different methods. For this goal, the images are collected from diverse geographical regions offering a unique benchmark dataset [1], which is an essential resource for conducting interdisciplinary research in remote sensing, computer vision, and machine learning. The Landslide4Sense data consist of the training, validation, and test sets, containing 3799, 245, and 800 image patches, respectively. Each image patch is a composite of 14 bands that include:

- Multispectral data from Sentinel-2: B1, B2, B3, B4, B5, B6, B7, B8, B9, B10, B11, B12.
- Slope data from ALOS PALSAR: B13
- Digital elevation model (DEM) from ALOS PALSAR: B14

All bands in the competition dataset are resized to the resolution of 10m per pixel (see Fig. 1). The image patches have the size of 128 × 128 pixels and are labeled in a pixel-wise manner.

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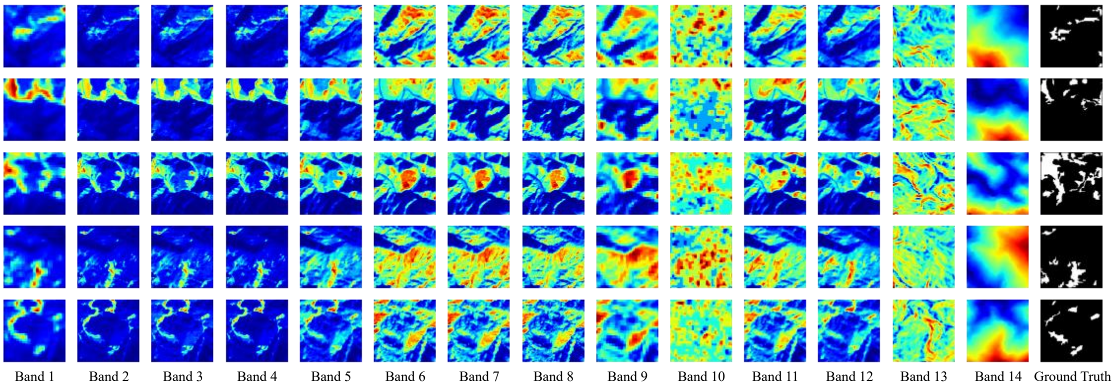

Figure 1: Illustration of each single layer in the 128 × 128 window size patches of the collected landslide data set. Bands 1–12 belong to the multi-spectral data from Sentinel-2 and bands 13–14 are slope and DEM data from ALOS PALSAR. The patches in the last column are corresponding labels.

The competition ranking is based on a quantitative accuracy metric (F1 score) computed with respect to undisclosed test samples. One special prize was also considered for the creative and innovative solution in landslide detection according to the evaluation of the Landslide4Sense scientific committee.

A total of 7775 landslide detection results were submitted to the Landslide4Sense competition website by 439 unique users within 85 teams https://www.iarai.ac.at/landslide4sense/challenge/. There were a total of 219 landslide detection results submitted by 29 teams during the test phase, with a maximum of ten submissions per team allowed. The competitors were from 37 different countries or regions around the world, such as mainland China, Hong Kong, the USA, Germany, Austria, Japan, Canada, and Australia. This competition had four winning teams. The first three winning teams achieved the highest F1 scores on the test phase. One more team was selected for the special prize for their creative and innovative solution in landslide detection according to the evaluation of the Landslide4Sense scientific committee. The Landslide4Sense competition outcome paper describes the innovative algorithms for automatic landslide detection introduced by these winning teams (https://arxiv.org/abs/2209.02556) [2]. Data is available at *Future Development Leaderboard* for ongoing evaluation at https://www.iarai.ac.at/landslide4sense/challenge/, and anyone is invited to submit more landslide detection results to check the accuracy of their methods against those of others.

References

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