SibFU Researchers Developing Neural Network to Detect Coniferous Trees Pests with Drone Photos at Early Stages

Siberian Federal University researchers are working on an AI system which can automatically detect various damages to conifers using data collected from drones shot images. The latest neural system architecture is capable of prompt classification of tree damage stages all by itself.

"*In our opinion, this research is relevant and topical. Siberian taiga is of paramount importance for the global climate. Although forests are considered as a renewable resource, in some parts of the world, their degradation rate is too high, and the damage cannot be compensated by restoration. In addition to fires, attacks of bark beetles often lead to weakening and death of trees. Usually spruce dies within 2–4 years from the first expansion of the beetle. Therefore, we should perform monitoring of the insect invasion as early as possible, literally at the first sign of damage to the trees. We need to achieve the most accurate assessment of the forest condition in order to take further action. In fact, we need to make a decision relying on a small amount of data as it is hard to detect when the beetle expands up to a dozen of trees, especially with low-quality photos made by a drone. We hope to resolve the situation with smart convolutional self-learning neural network*", said **Ms Anastasia Safonova**, head of the Laboratory of Deep Learning, Siberian Federal University.

The research fellow noted that they would train the neural network using with both data set without an increase and artificially increased data set. The developed graphical user interface of the software will facilitate the interaction with the system and the analysis of the results of detecting stages of tree damage.

"*As a result, we developed a software detecting and classifying various categories of tree damage in the images of ultra-high spatial resolution. The system will be able to display marks showing damaged trees and immediately classify the damage*", added **Ms Safonova**.

The researchers call their software innovative: the system automatically draws the boundaries of objects which display the marks, detects damaged trees and their damage class. There are no counterparts to this neural network architecture in Russia at the moment.

"*Our product has only up to 6 convolution layers, it is lightweight and highly accurate at a lower computational cost (recognition accuracy is more than 5% higher compared to the conventional methods). I should note that our system is tuned for specific tasks such as detecting and classifying tree damage according to images from drones. I'm talking mainly about conifers and their issues*", added **Ms Safonova**.

The structure of the algorithm developed by the researchers from Krasnoyarsk looks the following way:

the image in RGB model is sequentially converted into a palette of grey shades; the “grey” image is blurred with a Gaussian filter to reduce noise. Then the software prepares a black-and-white image with structured contours of all elements to distinguish the outlines of the individual crowns of the trees so that they won’t look like a single object. Finally, the network detects suspicious-looking areas of the image and classifies them. The researchers note that the developed product works with the accuracy of up to 97%, the network learning speed is up to 30 iterations, and the classification speed is up to 30 seconds per one image.

The scholars have already tested the algorithms and architecture of the convolutional neural network using the drone footage for 2016 and 2018 from test areas of Stolby Nature Reserve (https://www.mdpi.com/2072-4292/11/6/643, http://news.sfu-kras.ru/node/21588).

The developed product could be widely used by research departments of institutes and enterprises working with forest resources and ecosystems, in regional forest protection services and forest management services. Also, the software can be installed to forestry and agriculture monitoring systems and ground control stations to monitor plant communities online.

This project is among the winners of the UMNIK contest for young researchers working on commercial research and engineering projects within the national program Digital Economy of the Russian Federation 2019.

24 july 2020