Unpaved forest road quality assessment using airborne lidar data

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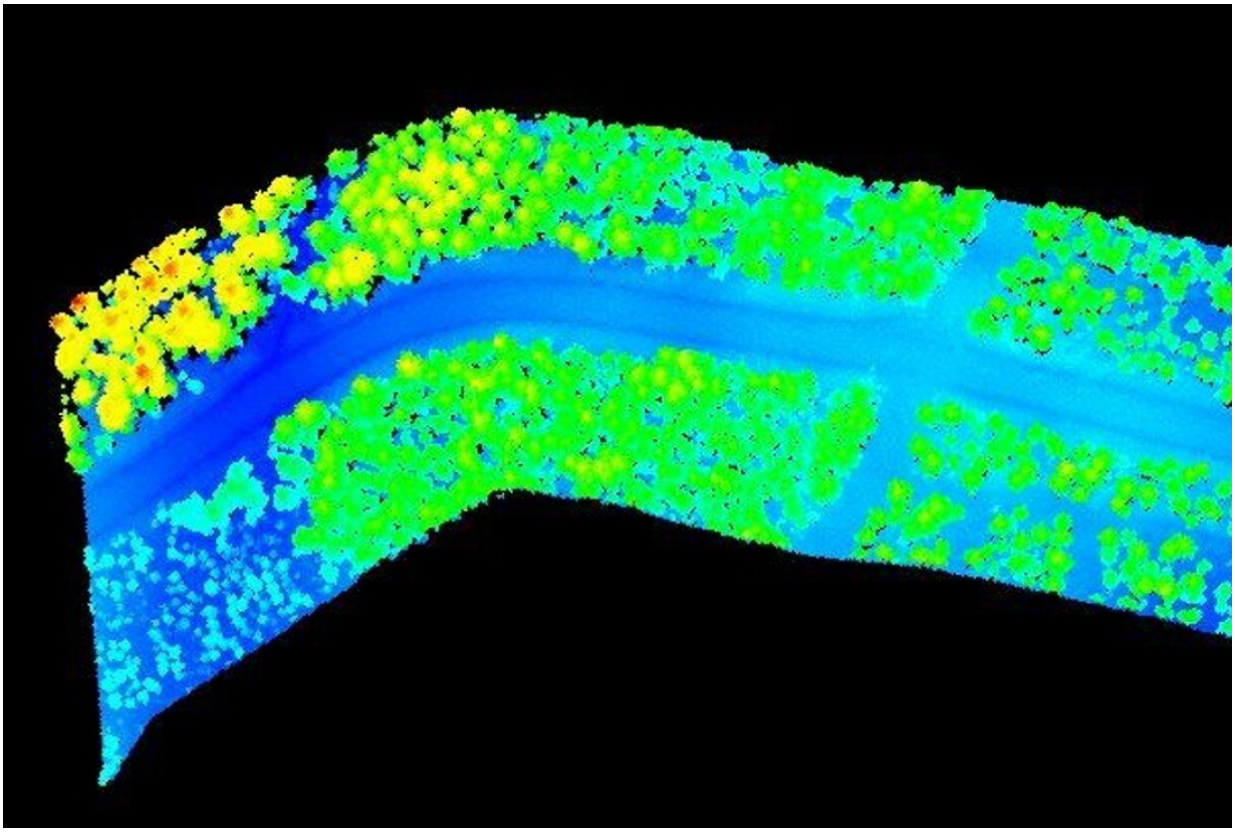

Credit: University of Eastern Finland

Forest road quality control is a time-consuming task, but it can help reduce road management costs and allocate resources to the most urgent renovation needs. While in Finland the aging forest road network

requires extent maintenance in the upcoming year, in Canada one of the biggest challenges to assess the existing road network system before building new forest roads.

Although bearing capacity cannot be assessed without field measurements, other trafficability criteria can be derived and assessed from remote sensing data. The road quality properties assessed here include the vegetation cover, ditch system and road surface conditions. Both in Finland and in Canada the research made use of the same ALS dataset as had been acquired for forest inventory purposes. The quickly developing technology enables new tools, such as airborne laser scanning to use for unpaved forest road quality assessments, and this thesis presents methods how this can be carried out. The laser scanning data is usually collected when forest management plans are prepared and road quality maps can be byproducts that forest managers could receive alongside an ALS-based forest inventory. Also, depending on the future cost structure, drone-based data collection systems might also provide a feasible alternative source of data for these techniques,

The low and high pulse density ALS data were first processed and digital elevation model created at several resolutions from 0.2 m to 1 m and different interpolation methods were also compared in this. The work focuses on road quality properties such as surface flatness, surface wear quality, road structure, ditch quality, road drying properties and water accumulation, and also the vegetation cover on and beside the road.

The roads were divided into three categories using the Metsäteho forest road quality assessment system, and active and deactivated road status was assessed on Vancouver Island, Canada. Linear discriminant analysis was used to find the best predictors of the road quality classes, the result being validated using confusion matrices and kappa values. A combination of surface indices, the topographic wetness index and soil information provided high precision information about unpaved forest

road quality. Simultaneously, the indices individually showed promising results when applied to high pulse density data. The classification based on vegetation growth and the presence of a ditch system and its status gave reliably results as well.

The findings indicate that the use or airborne laser scanning data can help forest managers gain more information about the quality and status of forest roads in remote areas without spending extra resources (time, transportation costs, personnel) on checking the road network manually, although cannot yet replace field visits, it opens up possibilities for further research and offer the option of combining these novel approaches with other road assessments.

The doctoral dissertation of MSc Katalin Waga, titled "Unpaved forest road quality assessment using airborne LiDAR data," will be examined at the Faculty of Science and Forestry on the 4th of June at 12 noon online.

More information: Katalin Waga, Unpaved forest road quality assessment using airborne LiDAR data, *Dissertationes Forestales* (2021). DOI: 10.14214/df.316

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