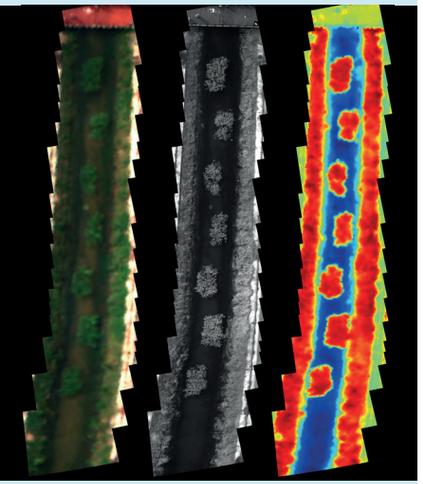
Contact

ellis.penning@deltares.nl
T +31(0) 6 2387 8545

eertwegh@knowh2o.nl

Drones monitoring vegetation in watercourses



Images from drone flight showing a pseudo-real colour image (left), a black & white image (centre) and the NDVI index for vegetation biomass (right)

The seasonal development of vegetation in streams and rivers has two contrasting effects. On the one hand, this is a natural feature of flowing waters and it is valuable because it delivers ecological services and provides habitats for organisms. On the other hand, vegetation obstructs water flows, and dense vegetation patches exacerbate the flood risk upstream. Regional water authorities usually have limited information and knowledge about the vegetation present in their watercourses. An innovative monitoring technique was developed that uses a full-spectrum camera on a drone. The technique was tested in the River Experiment Center of the South Korean Institute for Civil Engineering and Building Technology (KICT) in Andong and in two Dutch streams.

Flow obstruction by vegetation can be reduced by mowing or dredging the vegetation. Currently, decisions about where and how much vegetation must be removed are often based on expert judgement during field assessments by individual persons, and there are no objective quantifying methods. In theory, methods are required to determine thresholds for acceptable levels of biomass in streams. Discharge and water levels need to be taken into account: when water levels upstream increase beyond a given point with a given discharge, overall roughness in the channel will increase too much as a result of vegetation development.

The aim of this project is to develop new techniques for determining where the true obstacles are located in a stream and which types of vegetation cause obstructions. The techniques should also identify the ecological value of the vegetation, and all the results should be obtained in a uniform and quantified way. The true obstructions in the stream are defined by a hydraulic roughness coefficient that is derived from spatial data on vegetation, biovolume and species characteristics. The ecological values of the stream vegetation can be retained as much as possible by removing the true obstructions only and leaving the other vegetation intact.

First flights with the full-spectrum camera at KICT (South Korea)

New Unmanned Aerial Vehicles (UAVs), better known as 'drones', and new cameras capable of capturing the full spectrum between 450-950 nm can be used to automatically monitor large stretches of brooks, channels, and rivers. The full-spectrum images are converted into maps of vegetation cover, biomass and species composition. The information can be obtained quickly using the full-spectrum camera and automated flight paths. Automatic processing ensures that the data are interpreted objectively.

The first tests in the Korean outdoor, unscaled test river channel with patchy vegetation showed that the full-spectrum camera detects the patches very well. The patches can be recognised by eye in the pseudo-real colour images and the black and white images. The measured spectrum is converted to parameters such as the NDVI index for vegetation biomass. The red patches in this image are the vegetation patches. The next step will be to upscale the method and establish a practical approach for the reliable mapping of vegetation for the purposes of both flood risk management and the assessment of ecological values in line with the EU Water Framework Directive (WFD) objectives for entire stream stretches.

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First tests with the full-spectrum camera on the Linge (Rivierenland Water Authority)

Further reading:
Van den Eertwegh & Penning (eds) (2017). TKI-Dotter project. Towards coupled risk-based aquatic vegetation management and EU WFD targets. KnowH2O report 2017-001. Berg en Dal, The Netherlands.