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First steps toward automatic patterns recognition from sequences of a restored river corridor photographs

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Obtaining information about river morphology and riparian vegetation patterns by means of photographic techniques is a challenging task with promising applications in the field of river hydraulic engineering and restoration. For instance, such a tool would speed up the post- processing phase of aerial images that is needed to calibrate both hydraulics and ecosystem models. Recognizing patterns automatically is relatively easy in the presence of well-defined objects and contrasting background colors, but this operation becomes rather difficult for open air or environmental photographs (e.g. of river corridors) where a multitude of colors, shadows, reflections and changing light conditions typically characterize the images.

In this work an attempt is made in this direction and we begin with the already challenging task of recognizing water and non-water classes from digital photographs under changing light and surface albedo. Such conditions are typically due to either diurnal variability or bad weather conditions (e.g., like fog or snow). We use aerial photographs of the restored corridor of River Thur at Niederneunforn (Switzerland), which is currently monitored with high-resolution digital cameras as a task of the research project RECORD. Images of the river reach are taken from the top of two observation towers installed on the river levee and shots are frequency-dependent on current flow conditions.

The approach we present here consists of masking the images by ignoring the irrelevant parts like mountains and sky, for instance. Next, features are defined which describe properties of the image or the image content, like e.g. color values, gradients of neighboring pixels, or application specific information like a probability distribution of a pixel being water derived from the digital elevation model. The investigated features can be classified according to two orthogonal dimensions: i) Pixel based features and features derived from a group of pixels and ii) Time variant (derived from a time series of images) and time invariant features (derived from a single image).

All collected features will be used in a supervised learning algorithm, which calculates the probability that a specific pixel belongs to the water class. This learning will need a training set of images to calculate the relation between the feature space and the two classes and to suggest how important a feature is for the classification. Time variant features (such as color values of water due to changing light conditions) require instead continues adaptation of the classifier to the most relevant selected feature in order to address the observation of highly variable condition/quality of the images and to adapt to changes in the environment. The evaluation of the proposed approach is done by classifying a test set having similar characteristic as the training set but being independent of it. In summary, our procedure is promising and its usefulness will be tested further on a longer data record or on photographs from different locations.