Research. Transfer. Sustainabilty.

Autonomous sensor system for monitoring and management of waterways

RiverCloud – Development of an autonomous and networked UAV/USV tandem system for the collection and provision of high-resolution data for water management and the expansion and maintenance of waterways

Based on previous projects, including the BMBF project RiverView®, an autonomous and networked tandem system consisting of an unmanned aerial vehicle (UAV) and an unmanned surface vehicle (USV) was developed in the BMDV-funded RiverCloud project under the leadership of the Geodetic Institute of RWTH Aachen University (gia). The overall system combines the strengths of a measuring drone with those of an unmanned measuring boat for recording high-resolution spatial and temporal river data, so that waterways and traffic structures, as well as the river environment with floodplains and oxbow lakes, can be surveyed and managed holistically.

As part of the project consortium, FiW initially developed a concept for USV inspections and contributed to the evaluation and testing of the individual components and the overall system. In cooperation with FiW, gia and the manufacturer of the USV, a Sonic2020 multibeam echo sounder (MBES) from R2SONIC, Inc. and water sound velocity sensors for echo sounder-based bathymetric surveys were procured and tested in application and system integration.

In addition to accompanying the data collection, workflows were developed to derive water quality and water morphological parameters as well as vegetation analyses using semantic image segmentation. Results show that deep artificial neural networks (ANN) are a suitable approach for semantic image segmentation and analysis of river environments. Transfer learning, a machine learning technique that allows a model trained for one task to be reused for another task, was successfully applied so that the dataset of 502 annotated images of riverbanks

is sufficient to distinguish between river structure classes and vegetation types. The chosen deep learning model, Deeplab version 3, and the three different architectures Mobilenet version 2, Xception 65 and Xception 71, successfully recognize objects and patterns at pixel level in images of different sizes. Another goal was to explore the possibilities of integrating these deep ANNs into the decision-making process for water management issues and, in cooperation with the BfG, to support the determination of water and vegetation structure.

The tandem system, consisting of UAV and USV, was initially developed as an exclusively unmanned system as part of the project. The sensors and other hardware components such as measuring computers can, in principle, be transferred to other carrier platforms. The transfer of the measurement technology into water management practice took place in various formats such as workshops and a hackathon. FiW conducted consortium-wide workshops in which a technical manual was developed. The technical manual is intended to give users the opportunity to look at individual components in isolation and apply them to new issues or projects. FiW was responsible for editing, layout and coordinating the content of the technical manual, which is available for download on the RiverCloud and FiW websites.

Project overview

PROJECT TITLE

RiverCloud – Development of an autonomous and networked UAV/USV tandem system for the collection and provision of high-resolution data for water management and the expansion and maintenance of waterways

PROJECT PERIOD

06/2020 – 11/2023

PROJECT PARTNERS

RWTH Aachen University, Geodätisches Institut (gia), IAV GmbH Ingenieurgesellschaft Auto und Verkehr; Orthodrone GmbH; Bundesanstalt für Gewässerkunde (BfG); Bundesanstalt für Wasserbau (BAW)

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STATUS

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