UAS bathymetry observations

A New Tool for Water Resources Engineering

Summary:

We have developed a new drone-tethered sonar payload, which can measure water depth at high accuracy in rivers, streams, lakes and wetlands. The tethered payload was designed for standard UAV platforms. Bathymetry (elevation of the bottom of the watercourse above mean sea level) can be estimated by subtracting the observed water depth from the water surface elevation measured by the WSE payload.

The bathymetry drone payload

The payload:

The payload consists of a differential global navigation satellite system (GNSS) unit and a tethered sonar. The GNSS unit records the exact position of the UAV platform, while the sonar measures water depth. However, due to the tethered system, the position of the sonar might differ from the position of the UAV by up to a couple of meters. Thus, when accurate sonar positioning is required, the system includes additional components: i) an Inertial Measurement Unit (IMU), ii) an RGB camera, and iii) the WSE payload. Combining the observations of these systems (i.e. by optical tracking of the sonar), the horizontal and vertical offset between the sonar and the UAV can be estimated.

Accuracy of bathymetric measurements	Ca. 3 cm
Recommended flight height	Max 5 m
Recommended flight speed	0.2 m/s
Minimum depth	15 cm
Maximum depth	100 m
Sonar ranger frequency	675 kHz
Beam divergence	7°
Survey time for 10 meters	ca. 5 min
Processing time for 1 river section	ca. 20 min

UAV-borne water depth surveys: Technical specifications

Note: Other UAS bathymetry solutions are also currently under development, e.g. Ground Penetrating Radar (GPR). Unlike the tethered sonar solution, the GPR solution provides entirely contactless bathymetry measurements.

Applications:

The drone payload can be used to efficiently map water depth along rivers and streams and over wetlands and lakes. Applications include:

- River shape control and maintenance - the geometry and the elevation of the riverbed should be monitored to control the riverbed shape and ensure adequate maintenance
- Hydrodynamic modelling –cross section geometries are primary inputs in hydrodynamic models.
- River discharge estimation – Water depth is required to estimate river discharge.
- Sedimentation processes- Monitoring of temporal changes in bathymetry of lakes and rivers is important to estimate sedimentation processes

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