Geophysical Research Abstracts
Vol. 19, EGU2017-3129, 2017
EGU General Assembly 2017

Hydraulic risk assessment of bridges using UAV photogrammetry

Jürgen Hackl, Bryan T. Adey, Michał Woźniak, and Oliver Schümperlin
Institute of Construction and Infrastructure Management, Swiss Federal Institute of Technology (ETH), Zürich, Switzerland

Road networks are essential for economic growth and development. Of the objects within a road network, bridges are of special interest, because their failure often results in relatively large interruptions to how the network is used, their replacement costs are generally large, and it usually takes a considerable amount of time to restore them once they have failed. Of the different types of bridges, bridges in mountainous regions are of special interest because their failure could cause severe societal consequences, for example, if it renders an area inaccessible. One of the main causes of the failure of bridges in mountainous regions is the occurrence of a hydraulic event, for example, flood waters above a certain level, scour below a certain depth or debris build up beyond a certain level.

An assessment of risk related to a bridge in a mountainous region is challenging. The probability of occurrence of these events, and the resulting consequences, depend greatly on the characteristics (e.g. slope, soil, vegetation, precipitation, . . .) of the specific regions where the bridges are located. An indication of the effect of these characteristics can be seen in the sediment deposition during floods in mountain catchments. Additionally, there is often no, or no recent, topological information that can be used to develop terrain models to be used for realistic water flow simulations in mountain regions, and most hydrology and hydraulic models have been developed for lower gradient rivers and can often not be directly used to model water flow in mountain rivers.

In an effort to improve the assessment of risk related to bridges in mountainous regions, using the setting for risk assessments established by Hackl et al. (2015) and Adey et al. (2016), an investigation was undertaken to determine whether *unmanned aerial vehicles* (UAVs) and photogrammetry could be used to generate the topological information required to run realistic water flow simulations. The process investigated includes:

- the use of geo-referenced images, taken by an UAV,
- the exportation of these images into a photogrammetric software,
- the creation of a 3D mesh of the terrain from these images,
- the conversion of the 3D mesh to a computational mesh,
- the use of the computational mesh to build a hydrodynamic model, and
- the use of the hydrodynamic model to run flow simulations.

The process was used to estimate the complex water flow near a single span concrete bridge in the Canton of Grisons, Switzerland. The hydraulic events (abutment scour and overflow) predicted by the developed model were compared with with historical observations from a recent flood event in the region.

The hydraulic events predicted by the developed model correspond with historical observations, indicating that the topological information collected in this way is sufficiently accurate to be used to simulate complex flow situations, which can be used in bridge risk assessments.

Hackl, J., Adey, B.T., Heitzler, M., and Iosifescu Enescu, I. (2015). “An Overarching Risk Assessment Process to Evaluate the Risks Associated with Infrastructure Networks due to Natural Hazards.” *International Journal of Performability Engineering*, 11(2), 153–168.

Adey, B.T., Hackl, J., Lam, J.C., van Gelder, P., Prak, P., van Erp, N., Heitzler, M., Iosifescu Enescu, I., and Hurni, L. (2016). “Ensuring acceptable levels of infrastructure related risks due to natural hazards with emphasis on conducting stress tests.” *1st International Symposium on Infrastructure Asset Management (SIAM2016)*, K. Kobayashi, ed., Kyoto, Japan, 19–29 (Jan).