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Bathymetry mapping using a GPS-sonar equipped remote control boat: Application in waste stabilisation ponds

Liah Coggins, Anas Ghadouani, and Marco Ghisalberti

School of Civil, Environmental and Mining Engineering, The University of Western Australia, Crawley, Australia (liah.coggins@uwa.edu.au)

Traditionally, bathymetry mapping of ponds, lakes and rivers have used techniques which are low in spatial resolution, sometimes subjective in terms of precision and accuracy, labour intensive, and that require a high level of safety precautions. In waste stabilisation ponds (WSP) in particular, sludge heights, and thus sludge volume, are commonly measured using a sludge judge (a clear plastic pipe with length markings). A remote control boat fitted with a GPS-equipped sonar unit can improve the resolution of depth measurements, and reduce safety and labour requirements.

Sonar devices equipped with GPS technology, also known as fish finders, are readily available and widely used by people in boating. Through the use of GPS technology in conjunction with sonar, the location and depth can be recorded electronically onto a memory card. However, despite its high applicability to the field, this technology has so far been underutilised. In the case of WSP, the sonar can measure the water depth to the top of the sludge layer, which can then be used to develop contour maps of sludge distribution and to determine sludge volume.

The coupling of sonar technology with a remotely operative vehicle has several advantages of traditional measurement techniques, particularly in removing human subjectivity of readings, and the sonar being able to collect more data points in a shorter period of time, and continuously, with a much higher spatial resolution.

The GPS-sonar equipped remote control boat has been tested on in excess of 50 WSP within Western Australia, and has shown a very strong correlation (R^2 = 0.98) between spot readings taken with the sonar compared to a sludge judge. This has shown that the remote control boat with GPS-sonar device is capable of providing sludge bathymetry with greatly increased spatial resolution, while greatly reducing profiling time. Remotely operated vehicles, such as the one built in this study, are useful for not only determining sludge distribution, but also in calculating sludge accumulation rates, and in evaluating pond hydraulic efficiency (e.g., as input bathymetry for computational fluid dynamics models).

This technology is not limited to application for wastewater management, and could potentially have a wider application in the monitoring of other small to medium water bodies, including reservoirs, channels, recreational water bodies, river beds, mine tailings dams and commercial ports.