Development of an RFID Tracking System for Coarse Sediment Transport in a Flume Setting

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Understanding how sediment moves through a fluvial system has important implications for the study of river systems, sediment flux, and flood events. Over the past decade, RFID (radio frequency identification) technology has emerged as a useful method for tracking the movement and transport of coarse sediment clasts. This approach has been used to measure the transport of large clasts in mid-sized streams, ephemeral channels, and laboratory flume settings. However, this research utilized finite transport of sediment and focused on accurately determining clast location, instead of measuring total flux over longer, uninterrupted intervals.

In this study, artificial, course grained clasts were seeded with 12 mm RFID tags in order to test the feasibility of an RFID tracking system in a continuous racetrack flume setting. Using an existing loop antenna to measure baseline results, detection success was studied while varying antenna range and orientation, bead quantity and spacing, and flow speed. These results suggested that an RFID tracking system was feasible for this flume application, with a loop antenna located 20 cm beneath the flume. Using these baseline results, a loop antenna was designed, constructed, and tested to further optimize the detection rate. Finally, a MATLAB computational model was developed to predict the impact of tag interference and entrapment on measured sediment flux and quantify the performance of the system under extended intervals.

The ability to accurately measure bedload flux in this flume system allows for several potential applications for the tracking system, including testing for bedload transport variation with changing bedform type, discharge, and channel size. Furthermore, with an improved data management system, sediment flux can be tracked over extended periods with limited human oversight.