P1.1.2.1 ALFA Debris Modeling, Detection & Mitigation Subtask
Demonstration of an autonomous power and control system for operating multiple acoustic and/or visual instruments unattended for tracking debris.

Summary of efforts to detect woody debris in riverine environments using active acoustics

Field testing of a dual sonar system for detecting woody debris in natural settings was conducted at the Tanana River Test Site (TRTS) in Nenana, AK between 8/26 and 9/23 2015. The TRTS is approximately 65 miles south of Fairbanks and is well suited for testing hydrokinetic energy generation technologies and environmental monitoring technologies such as the dual sonar system used here in realistic settings. Beginning in 2014, Oceana Energy Inc. in collaboration with the Alaska Hydrokinetic Energy Research Center (aka NNMREC-UAF) tested their hydrokinetic energy turbine at the site. Prior to this, the site was used for environmental monitoring studies (Seitz et al. 2011, Bradley et al. 2015) as well as for demonstrating hydrokinetic energy infrastructure (Johnson et al. 2015).

During Fall 2015, the TRTS was the site of the fieldwork for the Debris Modeling, Detection & Mitigation subtask of the DOE funded, OSU led ALFA project. For periods where video or other observational records of debris are available, the sonar data was post processed for evidence that the sonars unambiguously captured the subsurface expression of visually identified debris targets. Sonar data was post processed using the Echoview software package. In addition to naturally occurring debris, compliant targets (e.g. a Tungsten carbide sonar calibration sphere, weighted ABS plastic tubes and submerged buoys) were used to verify the sonars were operating effectively and were capturing the expected field of view. Dr. John Horne, an acoustics expert from the University of Washington was on site for the final two days of field tests of the system.

An imaging sonar (a Teledyne Blueview 900 kHz multibeam sonar) and a split beam sonar (a 120 kHz Simrad EK60) were used to conduct the tests. Imaging sonars are also known as acoustic cameras. Similar to a camera, under ideal conditions imaging sonars such as the UAF owned Blueview produce easily recognizable and detailed images of underwater objects. However, the higher frequency of the Blueview sonar used mean its range is limited to <15 m in turbid environments such as the Tanana River. In contrast, a 120 kHz split beam in similar conditions can capture targets at ranges exceeding 40 m. The down side is that interpreting split beam data is more difficult than for an imaging sonar. The goal was to evaluate whether this combination of complimentary sonars is an effective means of capturing passing debris in order to allow operators with minimal experience interpreting sonar backscatter data to characterize subsurface debris prior to the deployment of any hydrokinetic energy technologies.

Video data of the river surface collected using the Video Debris Observation System is also available for several days when the sonars were operating. A manual debris count was performed using images collected by the VDOS to produce debris statistics; debris counts were conducted for the following dates and times: 8/26/15 13:07-15:20, 8/27/15

11:00-14:36, and 9/14/15 13:30-17:00. These times correspond to the times when the VDOS and ALFA sonars were running at the same time. Debris was classified by size into three categories, small, medium and large. Small debris is anything that could be removed from the river by hand and lifted over one's head. Medium sized debris is anything that is too large to lift over ones head, but too small to ride down the river. Large sized debris is anything that was large enough to comfortably support a person (e.g. Bradley et al., 2005). Debris was also classified by location in the river looking downstream with the river divided into two segments; Middle Channel, from the tip of the debris diverter to ~30' river left of the diverter and Left Channel, from ~30' river left of the diverter to the river left shore. River right is not included in this study since the sonars were positioned in mid-river, looking to the river left shore, with no sonar coverage of river right. The majority of debris on this section of river flows river left of the debris diverter and barge.

Overall, results of the tests were mixed. At times, video images clearly show debris passing through the sonar fields of view while the sonars appear to show no clear signal. At other times, the sonars appear to capture debris passing by. At this time, we do not have enough information to determine the reasons for the success or failure of the sonars to track debris since there is no information on how the characteristics of the debris vary between captures (e.g. how waterlogged the debris may be). Results are summarized in a 3 pdf presentations included with the MHKDR submission. Results of the VDOS analysis are included in a pdf presentation accompanying this report. Raw sonar data files (.son files from the Blueview and .raw files from the Simrad) from the deployment are included with the MHKDR submission as well.

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