Wake Removal for Sidescan

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Side-scan sonar is used to obtain high resolution images of the bottom. However, these images may be obscured by the presence of boat wakes because side-scan sonar beams are wide, picking up backscatter simultaneously from the bottom and wake. Wakes are particularly bothersome for surveys conducted in busy waterways and harbors because the abundance of wakes makes obtaining a clear image of the bottom difficult and time consuming. Locations of interest might have to be surveyed a number of times, waiting for opportunities between wakes. Other interfering signals that obscure bottom images are those from water column targets and surface bounce multi-path. Fig. 1 shows a side-scan image recorded near the port of Vancouver, Canada. Present in this image is a wake (mid-image), that obscures part of the bottom image, along with a number of water column targets. The water column targets are seals, but because of the lack of depth information in the image, these targets may be interpreted as being part of the bottom unless the area is surveyed again and they have moved.

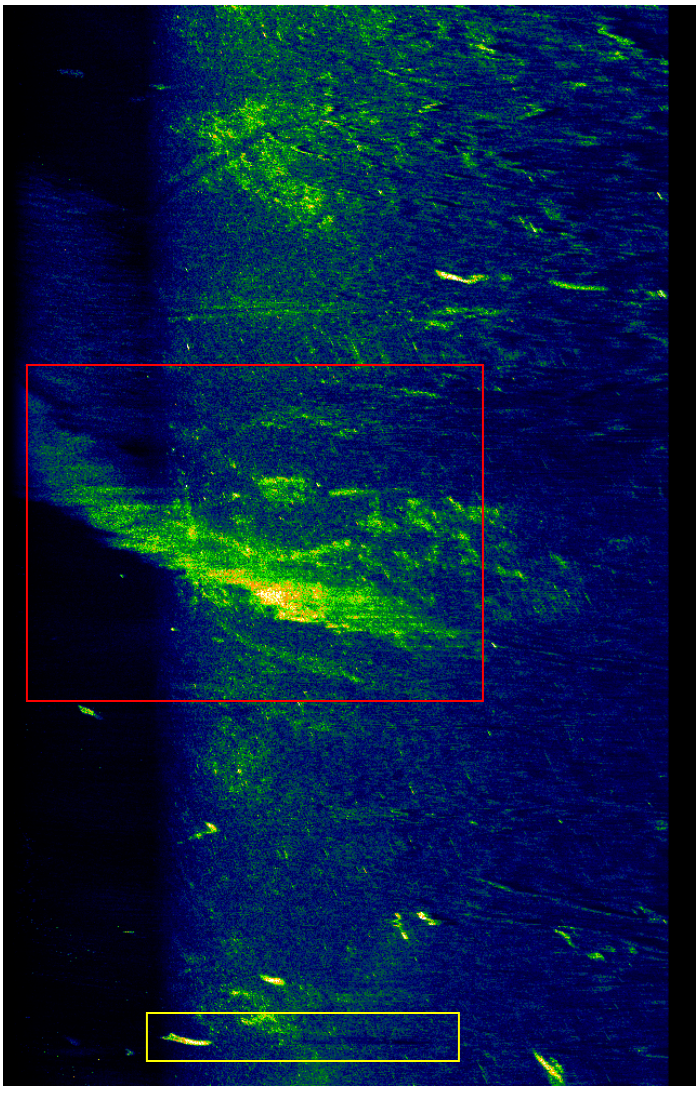


Fig. 1 This is a standard side-scan image of a bottom that is relatively flat at a depth of 30 m. The maximum range is 120 m and the transducer is moving up the left side of the image. There are some anchor scars, isolated targets, and a boat wake that obscures the bottom. The red box shows the area of the boat wake. The yellow box shows an isolated water column target plus its shadow. There are other isolated water column targets but from this image we don't know which ones they are. Also, it would be good if we could see what is underneath the boat wake.

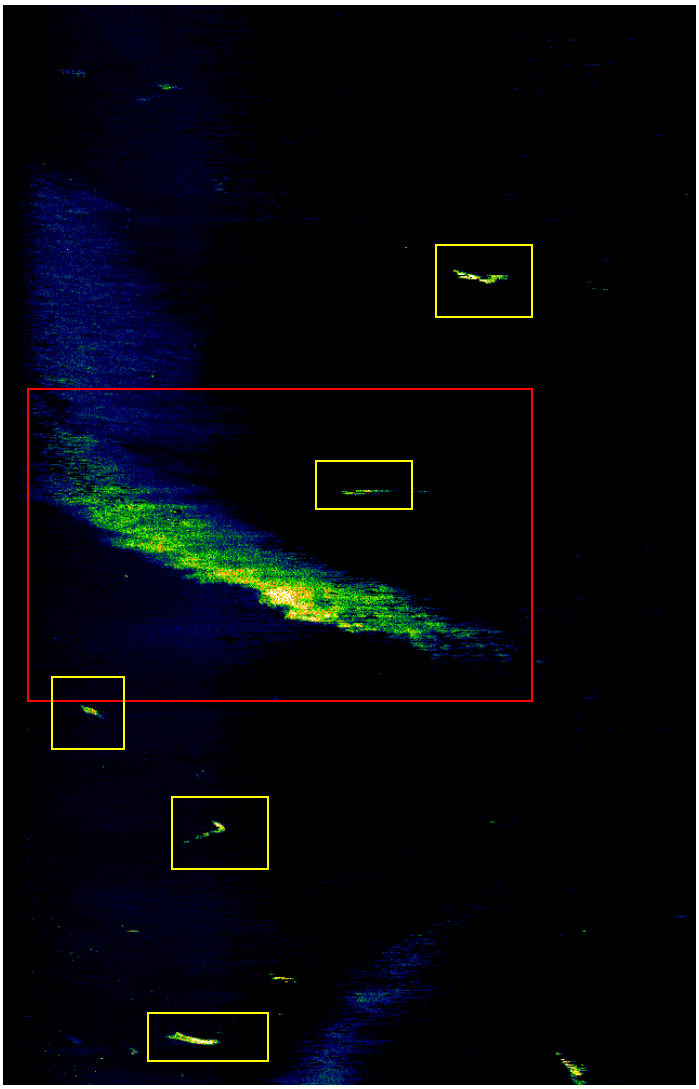


Fig. 2 This is the standard side-scan image as shown in Fig. 1 but with the bottom removed. The yellow boxes show the positions of typical water column targets (probably seals), and the red box shows the boat wake. There also seems to be a small wake at the bottom of the figure. Hence this technology can also be used to locate off-bottom targets that are being obscured by the bottom backscatter.

First, this document describes how AADB (angle of arrival directed beamforming) applied within the context of multi-angle swath bathymetry (MASB) side-scan sonar can be employed to obtain clear side-scan images of the bottom in the presence of wakes and other interfering signals. Typically, MASB sonar is used to build a 3D image of the bottom with the same pixel resolution as high resolution side-scan sonars (see 3D sidescan project). However, it may be desirable in some situations to employ MASB sonar coupled with AADB to produce high resolution side-scan images, free of wake and other interferers, for comparison with previous side-scan or perhaps future side-scan records. Specifically, it may be advantageous to employ an MASB sonar with AADB in high traffic areas so that surveys do not have to be repeated due to the presence of wakes that obscure the bottom image. For this application of AADB, the location of the bottom is estimated and then a beam is steered along the bottom corresponding to the propagation of the acoustic pulse. The spatial resolution of the beam is sufficient to eliminate wakes, surface bounce multi-path and some water column targets.

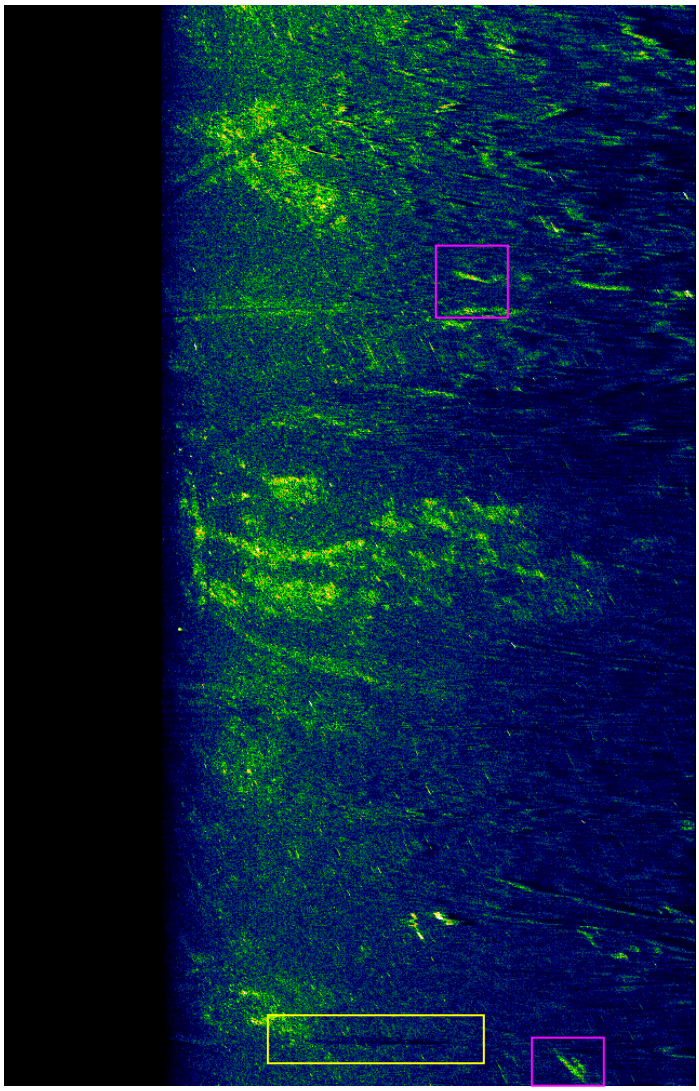
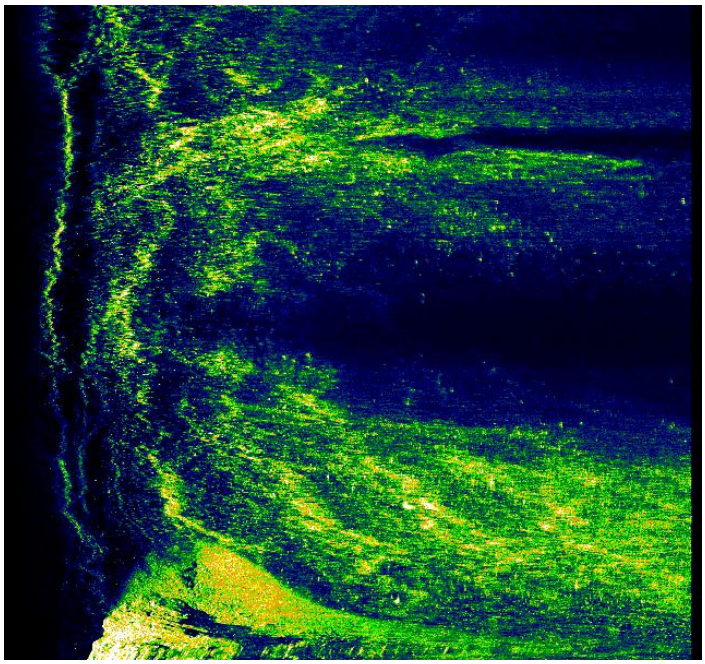
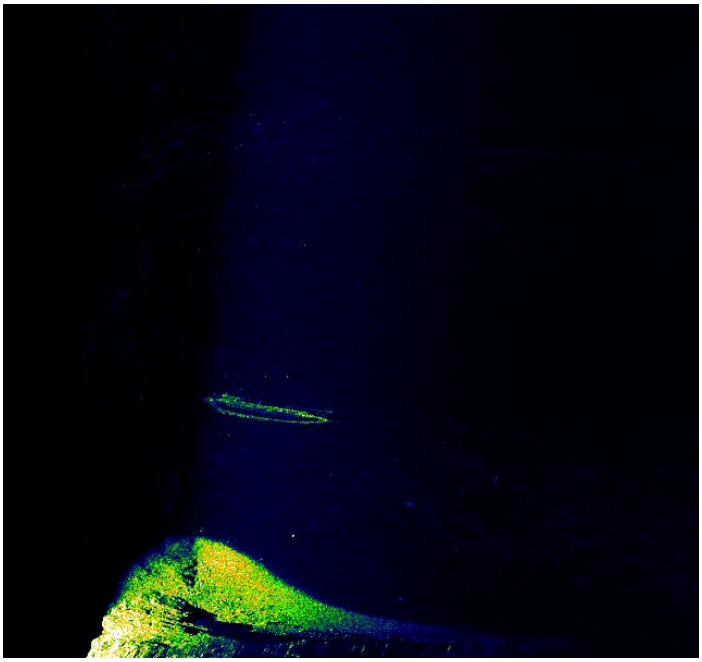


Fig. 3 This is the standard side-scan image as shown in Fig. 1 but with the water column targets and wake removed. The shadow of the water column target in Fig. 1 is still visible (yellow box) because it is impossible to get signals from an area of the bottom where there is a shadow. A couple of water column targets are still somewhat evident (pink boxes) because they are not separated enough from the bottom for the beam associated with only 6 elements to get an independent measure of signal intensity at that range. However, the wake is completely gone and so the bottom is no longer obscured and is shown as it truly is.

Second, the results employing an alternative to MASB type processing are shown below. It is possible to clean up sidescan sonar images without using the processing associated with MASB sonar. This methodology is not as good at removing water column targets but nevertheless is very good at removing wakes. In the sidescan images shown below a small wreck was being surveyed. After crossing over the wreck a number of the times the boat's own wake was interfering with the bottom image as can be seen by the figure on the left where it is almost impossible to see the wreck. The image on the right is the result of being cleaned up by our wake remove scheme that does not use MASB type processing. As can be seen the, wake has been completely remove and the wreck is clearly visible.





Commercialization

We are looking for partners who would like to commercialize this wake removal sonar technology.