2pUWa5. Flow noise measurements at strong tidal current area in Uldolmok Waterway

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Flow noise is a kind of hydrodynamic noise, which is created by turbulent flow in the boundary layer around the hydrophone. Although the turbulent pressure is not a true acoustic noise in that its influence decreases rapidly with distance, it acts as a self-noise source. In general, since the spectrum level of flow noise has been reported to increase rapidly with the increment of flow speed, it is possible to monitor the current velocity from the flow noise measurements. Uldolmok waterway in Korea is one of the locations where currents are very strong, with maximum speed of about 5 m/s. The measurements of flow noise were conducted in Uldolmok waterway using two different shapes of hydrophone. In this talk, the flow noise spectra for various flow speeds will be presented for the frequency range of 20-100 Hz, and the comparison of spectra between two different-shape hydrophones will be given.

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INTRODUCTION

Flow noise is known to affect the performance of hydrophones deployed in the ocean. In general, the speed of ocean current is reported to be typically 0.1 to 0.3 m/s, and these low-velocity currents can even cause flow noise [1]. The Uldolmok strait is a sea passage between the Jindo Island (off the south-western tip of the Korea peninsula) and mainland, which is famous for its strong tidal current with maximum speed of about 6 m/s at the narrowest part of the channel. The length of Uldolmok strait is about 15 km, the water depth is about 15–20 m, and its width is in range of approximately 1–2 km, with the narrowest width of about 250 m [2]. The flow noise in the frequency range of 20 to 100 Hz was received by two different types of hydrophone, and the flow noise levels as a function of current speed were analyzed in the range of current speed between 1.0 and 3.0 m/s.

FIELD MEASUREMENTS AND ANALYSIS

The Korea Institute of Ocean Science and Technology (KIOST) has been operating the tidal current pilot power plant in the Uldolmok strait. Acoustic measurements were made on June 6, 2012 at a site 400 m away from the KIOST power plant (34°33.875′ N, 126°18.556′ E). Two different size omni-directional cylindrical hydrophones (RESON TC – 4014 and 4032) and acoustic Doppler current meter (NORTEK, Aquadopp P20763) were deployed at a depth of 20 m from a small boat which was tied up with a rope to the power plant to prevent from getting swept away by the strong current (Fig. 1). Acoustic signals received by the hydrophones were digitized at a sampling rate of 100 kHz and saved. At the same time, current speed data were saved every 1 second using self-recording system. The flow noise level was estimated from the power spectral density analysis (in dB re 1 μPa²/Hz in a 1 Hz band) to investigate the correlation with the current speed.

![Diagram](Image)

FIGURE 1. Experimental geometry for measurements of flow noise and current speed.
RESULT AND DISCUSSION

Figure 2 shows the comparisons of the flow noise level to the speed of flow. Blue line shows the fluctuation of current speed (m/s) with time, Red and black dots indicate flow noise spectrum levels at 100 Hz acquired by the TC- 4014 and TC-4032 hydrophones, respectively. The current speed fluctuates with a period of approximately 10 minutes and it is known to be due to the vortex in the Uldolmok passage [2]. The average current speed was 2.2 m/s with a range between about 1 m/s and 3 m/s during 90 minutes.

There is a close correlation between current speed and flow noise levels. However, the flow noise spectrum levels measured by hydrophone TC – 4014 (diameter 1.6 cm) is approximately 15 dB higher than those measured by TC – 4032 (diameter 2.4 cm). The change of flow noise level with respect to the shape and surface area of hydrophone were reported by several literatures [1, 3-4]. In general, the flow noise level increases as flow speed increases and as hydrophone diameter and frequency decrease.

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REFERENCES