

ADV Part II. Using the ADV in the Lab

When configured properly, the ADV can be used in a multitude of laboratory situations to measure velocity quite accurately.

Seeding the flow. As explained above, the ADV sends out acoustic waves that must bounce off of particulate matter in the flow. In the field, water is often dirty enough that adding particles is not necessary (or practical). In the lab, however, water is usually quite clean and requires artificial introduction of particles. This is called seeding. The minimum particle size that Sontek (an ADV manufacturer) recommends is 2 μm . Thus, particles larger than this size that remain in suspension in the water can be used as seeding material. To check if water is properly seeded, the Sontek ADV software interface provides a readout of something called signal-to-noise ratio (SNR). This is an indicator of how well the flow is seeded: the higher the SNR, the better the seeding and the more reliable the velocity measurements. In the laboratory, the minimum SNR at which the ADV should be operated is about 15.

Positioning the ADV. Four acoustic probe tips (one transmitter and three receivers, shown in *Figure 2*) all send and receive acoustic information in a fluid volume below the ADV, referred to as the sampling volume. Because the ADV is inserted into the flow, the sampling volume must be far enough away from the probe tip so as not to disturb the flow and the velocity measurements. Thus, it is located about 7 cm below the probe tip. When positioning the ADV near boundaries, the user must be particularly aware of the sampling volume location.

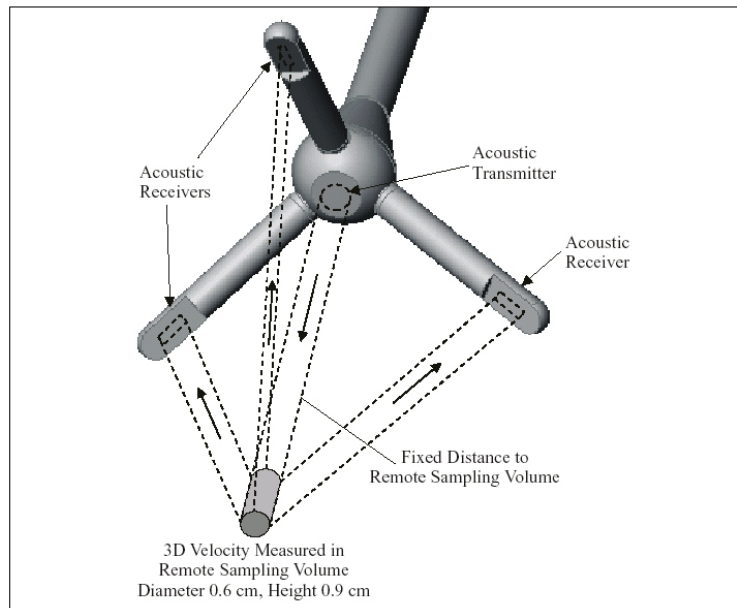


Figure 2: Schematic of ADV probe tip and sampling volume. The distance from the transmitter to the sampling volume in the 10 MHz Sontek ADV is about 7 cm. (Courtesy of Sontek²)

The Sontek ADV software program allows the user to easily check if the sampling volume is too close to the boundary. Using acoustic waves, the ADV directly measures how far away the probe tip and sampling volume are from the bottom boundary. The program displays this in real-time, so the user can make adjustments if there are any conflicts. This is also a reliable way to find the z-coordinate of the sample volume.

Setting parameters. Once the flow is seeded and the ADV positioned, certain parameters about the laboratory setup must be configured in the ADV software:

- **Maximum velocity range:** The selectable values of maximum velocity range from 3 cm/s to 250 cm/s. The user should select the lowest value that adequately encompasses the velocity range. For example, if one expects the measured velocities to be in the range of 4-8 cm/s, the appropriate maximum velocity would be 10 cm/s. Selecting 100 cm/s would not make any sense and would greatly increase the error of the measurement.
- **Sampling rate:** The user sets the sampling rate, which is how often the ADV collects data. The range for this is 0.1-25 samples per second (Hz). Usually, using 25 Hz is the most appropriate value, since it provides the highest temporal resolution.
- **Temperature and Salinity:** The speed of sound is a function of both temperature and salinity. Accordingly, it is important that the user measure these values accurately to better tune velocity measurements.

Uncertainty. As with all measurements, there is some uncertainty associated with velocities measured by the ADV. One primary source of bias comes from inputting salinity and temperature. If these are not accurately measured, or if conditions change while the experiment is being run, the velocity measurements will be biased.

Another source of uncertainty is Doppler noise, which Sontek states is an artifact of acoustic scattering and can be assumed to be purely random. At a sampling rate of 25Hz and an SNR above 15, uncertainty due to Doppler noise can be estimated as 1% of the maximum velocity range.

To evaluate quality of velocity measurements, one of the real-time outputs the ADV provides is a correlation statistic. This is a value ranging from 0% - 100%. The closer the correlation is to 100%, the less noisy and more reliable a velocity measurement is. Sontek recommends 70% as the minimum acceptable correlation. This correlation, when used with SNR, provides an excellent way to gauge the quality of the ADV measurements.