ADV Part III. Example Velocity Record

A flume experiment is conducted to measure the impact of vegetation on the turbulence of a system. The flow rate and geometry of the flume are known, and the Reynolds number is estimated at about 4000. We want to measure the instantaneous velocity at two points – one upstream of the vegetation and one inside the vegetation – and compare the turbulence intensity at each of those points.

The ADV is set to sample at a rate of 25Hz, so this will provide an essentially instantaneous record of velocity. We take a 5-minute record at each of the points we are interested in. Data is extracted from the binary file using the ‘Getvel’ command. It can then be imported into a spreadsheet. We now have two velocity records, each containing 7500 data points. First, we calculate the average velocity, \( \bar{u} \), simply by taking the average of the 7500 measurements:

\[
\bar{u} = \frac{1}{N} \sum_{i=1}^{N} u_i
\]

where \( N \) is the total number of measurements (in this case 7500), and \( u_i \) is an individual velocity measurement. Next, we calculate \( u_{\text{rms}} \), which is a measure of how much the individual velocity measurements fluctuate from the mean, \( \bar{u} \) (\( u_{\text{rms}} \) is therefore a measurement of turbulence strength).

\[
u_{\text{rms}} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} (u_i - \bar{u})^2}
\]

where \( u_i' = u_i - \bar{u} \)

Now, we can compare the turbulence intensity, \( u_{\text{rms}} / \bar{u} \), at each of the two points to get an idea of how vegetation impacts turbulence in this experiment. A sample graph of an ADV record is shown in Figure 4.

![Sample from ADV Record](image)

**Figure 4:** Sample from an ADV record. This 30-second sample from a real ADV record shows the average velocity and the root-mean-square velocity for this duration.

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