Glossary

Acoustic beam: A beam of acoustic energy with a specific spread and typically a fixed acoustic frequency.

ADCP: Acoustic Doppler current profiler - The acronym is used to identify any type of instrument that obtains profiles of water velocity by transmitting sound of known frequency into the water and measuring the Doppler shift of reflections from scatterers, which are assumed to be passively moving with the water. Now generally used, this designation originates from a TRDI trademark while ADP (Acoustic Doppler Profiler) is the trademark used by Sontek.

Ambiguity Resolution: A method to count the number of wavelengths included between two points where phase is measured, thereby removing the ambiguity associated with measuring only phase.

Ambiguity Velocity: The maximum allowable radial motion for phase measurements to be unambiguous, corresponding to a maximum observable velocity, beyond which ambiguity resolution is required.

Ambiguity: ADCPs determine the radial motion between a source and scatterer by measuring the phase change of the reflected signal. Because phase is periodic, this solution is multi-valued.

Backscatter: 1) The portion of a sound wave that is reflected by scattering particles directly back toward the source. 2) A qualitative measurement of scattering particle concentration. Backscatter is the intensity of returned energy normalized for sound absorption, beam spreading, water temperature, etc. and provides means of tracking relative concentration of scattering particles.

Beam check: A method of evaluating the return-signal strength of transmitted acoustic pulses.

Beam Coordinates: Profile data is reported as referenced along each beam (i.e. no coordinate transformation is performed upon the raw data).

Bin (Depth Cell): Discrete segments of the vertical water column to which an average water velocity generated by the ADCP processes is assigned. The graph of each Depth Cell velocity as a function of depth provides an estimate of the velocity profile for the Ensemble location.

Blanking Distance: The distance from the transducer face within which no velocity measurements are made and that corresponds to electronics and transducer recovery time after a ping is transmitted.

Bottom Track: A special ping transmitted to measure the Doppler shift of the signal return from the bottom. If the bottom is not moving, this measurement is a very accurate measurement of the ADCP. For ADCPs, this velocity is typically used to extract the true water velocity profile from the measured velocity profile (by removing the vehicle motion from the measurements).

Boundary: A surface or object that causes a strong return signal from transmitted acoustic pulses.

Broadband ADCP: An ADCP that uses broadband processing.

Broadband Processing: Use of coded pulses to make multiple measurements of phase with a single ping, and thereby greatly increase the precision of the measurement.

Correlation: A key quality control parameter, this is essentially a measurement of how much the particle distribution has changed between phase measurements. The less the distribution has changed, the higher the correlation, and the more precise the velocity measurement.

Counts: Raw signal amplitude values that have not been normalized. Values often range from 0 to 255.

Depth Cell (Bin): Discrete segments of the vertical water column to which an average water velocity generated by the ADCP processes is assigned. The graph of each Depth Cell velocity as a function of depth provides an estimate of the velocity profile for the Ensemble location.

Distance Made Good: When collecting data with an ADCP, this is a measure of the straight line distance between the current position of the ADCP and the starting point (i.e. variations in course track are removed).

Doppler Shift: Named for Johann Doppler (1803-1853), the German physicist who first predicted it: it is the change in apparent frequency of a wave as observer and source move toward or away from each other.

Earth Coordinates: Profile data is reported in an orthogonal coordinate frame as referenced to the Earth (East, North and Up).

Echo Intensity: Echo intensity is a measure of the signal strength intensity returned to the transducer. High echo intensity can show solid targets (e.g. a boundary, obstruction or fish), while low echo intensity can show insufficient scattering particles or the limits of profiling range for the environment.

Ensemble (Sample): A group of measurements (pings) considered together. An ensemble is usually the average of the individual measurements, and has a higher precision than any individual measurement.

Error Velocity: A key quality control parameter that derives from the four beam geometry of an ADCP. Each pair of opposing beams provides one measurement of the vertical velocity and one component of the horizontal velocity, so there are actually two independent measurements of vertical velocity that can be compared. If the flow field is homogeneous, the difference between these vertical velocities will average to zero. To put the error velocity on a more intuitive footing, it is scaled to be comparable to the variance in the horizontal velocity. In a nutshell, the error velocity can be treated as an indication of the standard deviation of the horizontal velocity measurements.

Extrapolation: Method used to estimate the unmeasured areas on the top and bottom of the cross section where an ADCP cannot measure. The default method fits a power curve with a 1/6 exponent through the measured data and extends the fit to the surface and to a velocity of zero at the streambed. Other methods (constant, no slip, and varying power exponents) allow optimization of the extrapolation for the river conditions.

Frequency: The number of wave crests passing a given point per unit time.

Gage height: The gage height of a stream or lake is the height of the water surface above an established datum plane. Gage height and stage are often used interchangeably; however, gage height is more appropriate when used to indicate a reading on a gage.

GGA: A data string output from a GPS receiver that includes time, latitude, longitude, fix quality, number of satellites, HDOP, altitude and other parameters.

Global Positioning System (GPS): Satellite-based navigation aid for precise measurement of location. When the bottom is out of range or moving, calculating the distance between GPS position fixes and dividing by the time between those fixes can be used to measure the ADCP velocity. DGPS refers to a positioning solution to which a Differential correction is applied.

Heading: Heading of an ADCP indicates its relative direction against the north.

Instrument noise level: A combined value of environmental and electronic noise level near which a reflected or returned acoustic signal cannot be detected by the instrument electronics.

Lag: A time delay between pulses or pings.

Length: Sum of all distances measured between the start of the first ensemble and that of the last ensemble.

Main Beam: The primary beam of acoustic energy transmitted by a transducer. Transducers emit sidelobes of acoustic energy at various angles not coincident with the main beam.

Moving Bed (Bottom): Some rivers carry such a heavy sediment load that they do not have a clearly identifiable bottom. In essence, the bottom sediment keeps getting thicker and slower with depth. In such environments it is not uncommon for bottom tracking measurements to lock onto a sediment layer that is still moving, resulting in a bias to the bottom tracking velocity.

Narrowband ADCP: An ADCP that uses narrowband processing.

Narrowband Processing: Uses a single pulse per ping to measure velocity. The lack of coding in the pulse makes a narrowband measurement much less precise, but it allows profiling over a longer range. Narrowband processing generally requires much larger ensembles to get a precise measurement.

Noise: Refers to the error associated with velocity measurements and base levels are determined by the unit and the ping type being utilized. “Noisy” velocity data would have a relatively large random error.

Phase Change (Shift): A phase change represents the amount a wave has shifted horizontally from the original wave, and is measured in degrees, where a complete cycle is 360 degrees. This horizontal shift represents a shift in time.

Phase: An engineering measure of the propagation delay caused by radial motion between scattering particles and source. Phase is ambiguous in that it is cyclical (e.g. 10 degrees is the same phase as 370 degrees).

Phased Array Transducer: A single, flat, multi-element transducer that uses a Teledyne RDI proprietary technique to simultaneously form all four beams.

Ping: The entirety of the sound generated by an ADCP transducer for a single measurement cycle. A broadband ping contains a coded series of pulses and lags, while a narrowband ping contains a single pulse.

Pitch: Pitch of an ADCP involves rotation or tilting of the ADCP from front to back.

Profile: A series of regularly spaced depth cells in which the ADCP measures velocity along with several quality control parameters.

Pulse Coherent: A method for computing water velocity in an ADCP that sends a first coded pulse, listens and collects returning data, then transmits a second coded pulse and again listens and collects returning data. The time separation between the two pulse and phase measurement are used to compute water speed.

Pulse Incoherent: An ADCP that transmits one pulse into the water per measurement (ping). The Doppler shift is computed as the reflected pulse is received. This method is ultilized in narrowband ADCPs and have a higher random error.

Pulse: A sound wave generated by a transducer.

Radial Velocity: The speed of an object parallel to the line of sight. As far as ADCPs are concerned, the radial velocity represents the component of the scattering particles velocity that is parallel to the main beam of acoustic energy.

Regatta: Measurement campaign producing simultaneous discharge observations from many ADCP at once, for the purpose of comparing the performance of these instruments and their configuration.

Relative Velocity: Includes the speed of the water moving by the ADCP and the speed of the ADCP itself. To compute the water velocity, the ADCP, or boat, speed must be subtracted from the relative velocity.

Ringing: After transmission the ADCP electronics, transducer and immediate surrounding equipment (particularly in vessel mounted ADCPs) all require some finite time to dampen the transmit energy, during which time any signal return from scattering particles will be contaminated.

Roll: Roll of an ADCP involves rotation of the ADCP from side to side.

RTK: Real Time Kinematic. As the highest level of accuracy for GPS positioning, it requires a nearby, stationary GPS receiver (called a base) and a radio link to the receiver on the ADCP (called the rover). The base provides information relative to local errors to the rover which can then filter them out of the solution.

Sample (Ensemble): A group of measurements (pings) considered together. An ensemble is usually the average of the individual measurements, and has a higher precision than any individual measurement.

Scatterers: Small particles such as suspended sediment or organic matter that spread and reflect acoustic energy transmitted by hydroacoustic instruments.

Ship Coordinates: Profile data is reported in an orthogonal coordinate frame as referenced to the ship (if beam 3 is forward then ship coordinates are the same as instrument coordinates).

Ship-Track: Trajectory of the ADCP on the horizontal plane and calculated against the bed based on bottom tracking or GPS.

Shore Distance: Distance perpendicular from the shore to the start or end ensemble.

Side Lobe: A beam of acoustic energy emitted by a transducer having lower power than the main beam and at an angle other than the main beam of transmitted energy. Side lobes are considered imperfections of the main beams.

Sidelobe Contamination: ADCP transducer beams are angled relative to the vertical, which means that the distance from the river bed directly to the ADCP is typically shorter than along the beams. Because most river beds will reflect stronger energy than the scattering particles, side lobe energy can travel the shorter path directly to the instrument and thereby include the “velocity” of the boundary within the water velocity measurements. This potential for interference depends on the beam quality and angle.

Signal-to-noise ratio (SNR): Often defined as the strength of a returned acoustic signal divided by the ambient acoustic/electronic noise as measured by an acoustic Doppler velocity meter. The SNR is used to assess the amplitude (strength) of the received acoustic energy used to measure velocity.

Stage: The stage of a stream or lake is the height of the water surface above an established datum plane. Stage and the term “gage height” are often used interchangeably.

Transducer: A device to convert electrical energy into sound waves, and vice versa.

Transect: A single pass across a river cross section, beginning and ending as close to each bank as possible, while still collecting valid data. A transect is not necessarily a straight line from one bank to the other, but rather an arbitrary surface depending on the path of the ADCP. Transects consist of multiple ensembles, each with depth, distance and velocity data, allowing the ADCP’s software to compute discharge.

Update Rate: The time between ensembles or samples.

VTG: A data string output from a GPS receiver that includes information on the ADCP heading and ground speed.

Water Mode: Applicable to TRDI StreamPro and Rio Grande ADCPs, a water mode is a set configuration of ADCP pings, which can be changed for different river conditions.

Wave Crest: The section of a wave that rises above the undisturbed position. Wave crests correspond to areas of high pressure in the water.

Wave Trough: The section of a wave that falls below the undisturbed position. Wave troughs correspond to areas of low pressure in the water.

References:

TRDI Library and Reference Center Glossary: http://www.rdinstruments.com/glossary.aspx

Techniques and Methods 3-A22; Measuring Discharge with Acoustic Doppler Current Profilers from a Moving Boat: http://pubs.usgs.gov/tm/3a22/

Teledyne RD Instruments, 1996, Principals of operation—A practical primer for broadband acoustic Doppler current nprofilers (2d ed.): San Diego, CA, Teledyne RD Instruments,51 p.

Techniques and Methods 3-A23; Computing Discharge Using the Index Velocity Method

Le Coz J., Pierrefeu G., Saysset G., Brochot J.-F., Marchand P. (2008) Mesures hydrologiques par profileur Doppler (aDcp) – Guide pratique, Editions QUAE. 192 p