RD Instruments
Acoustic Doppler Solutions

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Subject: RDI's 4-Beam Solution vs. 3-beam systems

Introduction

Accuracy and dependability are crucial elements to a successful ADCP deployment. RDI's 4-beam transducer is a proven workhorse, reliably providing data for installations around the world.

RDI's 4-beam system is more reliable, produces higher quality data, and delivers improved accuracy, when compared with a 3-beam system.

Benefits of a 4th Beam

- Reliability
- Quality
- Accuracy

Reliability

If an instrument can't provide data, then that instrument is not worth deploying. Three dimensional motion measurement requires a *minimum* of three beams. If any one beam fails to provide data, then three-dimensional measurements cannot be made.

A four-beam ADCP, however, provides a redundant beam, meaning three dimensional measurements can be made even when one beam is blocked, degraded by obstructions, or simply is not functioning. This is especially useful when working near underwater structures where it may be necessary to turn off an obstructed beam.

Quality

RDI's four-beam ADCP incorporates a unique data quality measure called *Error Velocity*, something not possible with three-beam systems.

Three dimensional velocity calculations assume that the beams are all seeing the same flow field. *Error Velocity* evaluates how well this assumption is being met, providing a quantitative base for QA/QC at each depth layer of each ping.

Important advantages of *Error Velocity* (*EV*):

- *EV* is a more sensitive data quality measure than is echo intensity.
- *EV* provides an independent measure for evaluating data quality during analysis, peer review, or in a court of law.
- *EV* helps reduce noise in average values by screening for non-uniformity caused by fish,

turbulence, or eddy variability.

- *EV* helps reduce data bias by detecting consistent obstructions from solid scatterers (structures, vessels, mooring lines, buoys, suspended instruments, etc.).

- *EV* provides a quick and independent way to screen horizontal flow variance. *Note: the USGS has recently mandated that their field technicians reject all ADCP measurements with single-ping error velocities greater than 1.5 ft/s.*

Error Velocity cannot be calculated with a three-beam system when computing three-dimensional velocities.

Accuracy
RDI's four-beam system has 25% less variance than a three-beam system. This produces data with lower standard deviation, allowing for improved navigation and finer along-track resolution.

Summary
A four-beam ADCP improves reliability by providing redundant data and allowing measurements to be made near structures that may obstruct a beam. It improves data quality by delivering an independent measure known as *Error Velocity*. And, it improves accuracy by reducing variance in the data.