NORTEK

PRODUCT SELECTION GUIDE

2016 - 2017

NORTEK

TRUE INNOVATION MAKES A DIFFERENCE

THE DOPPLER PRINCIPLE

Nortek instruments measure the velocity of water by utilizing a physical principle called the Doppler Effect. The Doppler Effect is the change in frequency of an acoustic wave when a sound source moves with respect to an observer.

Nortek instruments use the Doppler effect by transmitting acoustic pulses that propagate at slanted angles through the water column. Along the way, the emitted sound pulse is reflected from small suspended particles. If the scattering particle has a velocity in the direction of the acoustic beam, a Doppler shift will be observed by the instrument as it detects the backscattered signal.

Current profilers measure Doppler shift in multiple depth cells. Each cell represents the average velocity within the user-specified cell. The instrument uses speed of sound to compute the position of all cells and map them to vertical position. Using information from three (or more) beams and their geometry, the three dimensional velocities are determined, in a coordinate system selected by the user. Available options are beam coordinates, XYZ or ENU (East, North, Up).

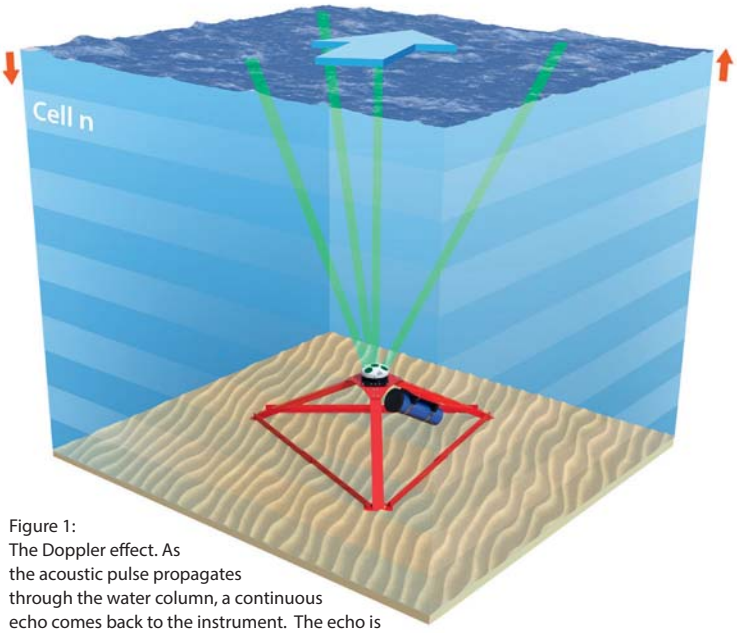
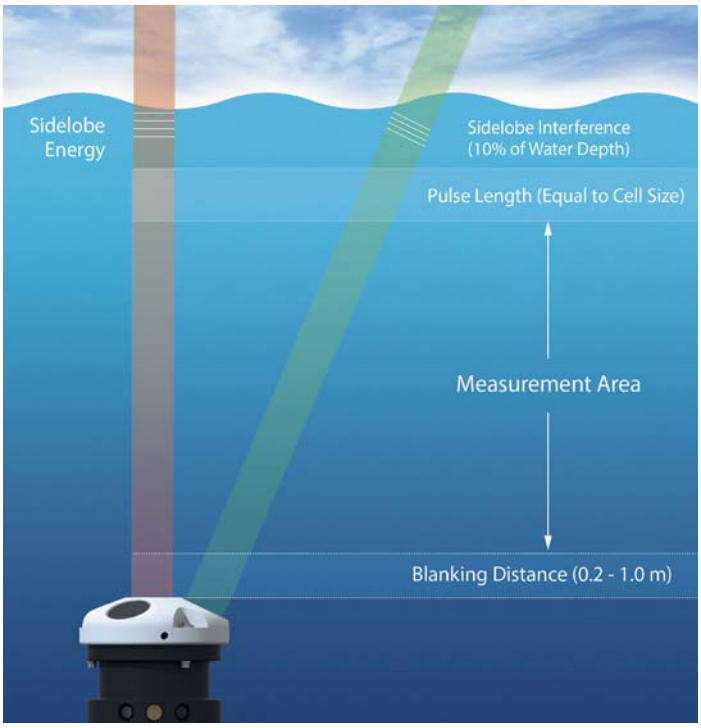


Figure 1:
The Doppler effect. As the acoustic pulse propagates through the water column, a continuous echo comes back to the instrument. The echo is processed for Doppler shift and the current velocity can be calculated for multiple levels or depth cells.



The profiling range and spatial resolution is primarily a function of the acoustic frequency. Instruments using a low frequency have longer range than instruments using higher frequency, while the latter has better spatial resolution. Acoustic instruments require free sight into the water column since obstructions will reduce the profiling range and may interfere with the measurements to a degree that makes the data unusable. Clear water with very little suspended material gives little scattering and reduces the profiling range, while areas rich in particles give a stronger echo and longer profiling range.

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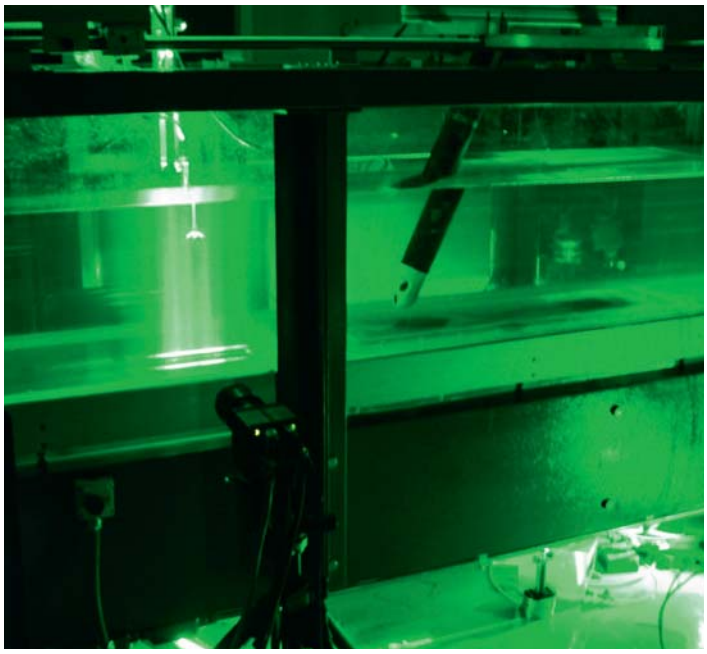
Figure 2: Overview of the measurement area from an up-looking instrument.

Some instruments, such as the Aquadopp, Aquadopp Profiler, and AWAC, work by sending single, unmodulated pings into the water. This is a robust yet flexible method and can therefore be used in a large number of settings.

Broadband instruments (Signature Series) provide faster and more accurate data. Nortek Broadband instruments transmit a frequency modulated pulse.

Pulse coherent instruments, such as the HR Aquadopp Profiler, Vector, and Vectrino, utilize a pair of acoustic pulses with a known separation to determine a Doppler shift. This is a robust yet flexible method and can, therefore, be used in a large number of settings.

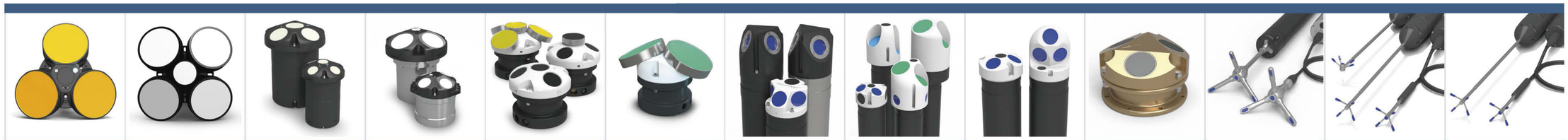


Measuring velocities close to a boundary is difficult due to an interference phenomenon known as the sidelobe effect. The acoustic beams focus most of the energy in the center of the beams, but a small amount leaks out in other directions and reaches the boundary before the main pulse traverses the water column.

Because sound reflects much stronger from the surface-air boundary than from the water, low energy signals that travel straight to the surface can produce sufficient echo to contaminate the desired signal from the water. This type of interference may affect 5-10% of the end of the velocity profile depending on the seastate, the seabottom and the slant angle (Figure 2).

The Acoustic Surface Tracking (AST) is different from the velocity measurements and uses echo-ranging to detect the sea surface with a vertical transducer. It can detect wave motion from 1Hz and slower. This information can be used to derive high quality wave parameters such as signifcant wave height, peak wave period, wave direction, etc.

PRODUCT OVERVIEW



Product Family	Signature55	Signature 250	Signature 1000/500	DVL	AWAC	AWAC 2D	Aquadopp	Aquadopp Profiler	Aquadopp HR Profiler	Vessel Mounted	Vector	Vectrino Lab/Field	Vectrino Profiler
	Long range current profiler	Profiler for medium range current, waves and ice measurements	Advanced current profiling and turbulence system	Underwater Navigation	Wave and current profiler with AST	Horizontal current profiler for cross channel measurements	Single-point current meter	Multi-purpose current profiler and PUV wave measurements	High-resolution short-range current profiler	Vessel-mounted current profiler for survey vessels	Stand-alone high-resolution single point velocimeter	Online High-resolution single point velocimeter	Online High resolution profiling velocimeter
Application													
Oil and Gas Surveys	●	●			●		●	●					
Vessel Surveys				●						●			
Renewable Energy			●		●	●	●	●					
Oceanographic Research	●	●	●		●		●	●	●		●	●	●
Natural Resource Management					●	●		●			●		
Aquaculture					●		●	●			●		
Ports and Harbors					●	●		●					
MetOcean Engineering	●	●			●	●	●	●	●		●		
Online Monitoring	●	●			●	●	●	●					
Laboratory												●	●
Navigation				●									
Product Specifications													
Transducer Frequency (kHz)	75/55 Dual Frequency	250 (500kHz opt. 5th transducer)	500/1000	500/1000	1000/600/400	400	2000	2000/1000 /600/400	2000/1000	1000/600/400	6000	10000	10000
Measurement Range (m)	10-1000+	200	50/20	50/180	0.5-100	130	0.35-5	0.2-90	0.05-6	0.5-100	0.15	0.05	0.03-0.07
Sampling Rate - Typical (Maximum)	1-60 min (1 Hz)	1 Hz	4/8 (8/16) Hz	8 Hz	1-60 min (4 Hz)	1 Hz	1-60 min (4 Hz)	1-60 min (1 Hz)	1 min (8 Hz)	60 s (1 Hz)	1 s (64 Hz) (fixed)	25 Hz/200 Hz ("plus" firmware)	100 Hz
Cell Size—Typical (Minimum) (m)	15 (5)	8(1)	1/0.5 (0.5/0.2)	1/0.5 (0.5/0.2)	1 (0.25)	5 (1)	N/A (single cell)	1 (0.2)	0.05 (0.007)	1 (0.5)	N/A (single point)	N/A (single point)	2 (1) mm
Typical / Maximum Deployment Life	3 months > 5 years	3 months > 5years	3 months > 5 years	Online	3 months > 2 years	Real Time	6-12 month / > 5 years	30-60 days / > 1 years	5-10 days / > 6 month	Real Time	Real Time / > 2 years	Real Time	Real Time
Maximum Installation Depth (m)	1500	300	300	4000/1000	300	300	300/3000/6000	300	300	30	300	50	50
Standard Sensors , # of Beams	Temp/Press/HPR/3	Temp/Press/HPR/4	Temp/Press/HPR/5	4	Temp/Press/HPR/4	Temp/Press/HPR/2	Temp/Press/HPR/3	Temp/Press/HPR/3	Temp/Press/HPR/3	Temp/3	Temp/Press/HPR	Temp	Temp
Available Upgrades	64 GB recorder.	5th beam, Waves, Ice, 64 GB recorder	Vertical beam velocities. Waves, Ice (Sig500 only). 64 GB recorder.	Custom Integration	Analog inputs, platform head, internal wave calculations. Metal connector.	AOS, Metal Connectors, 4GB recorder	AOS, Analog inputs, Li Ion batteries, custom transducer head geometry, IMM	AOS, Analog inputs, Li Ion bat-teries, side-look-ing head, Z-Cell, 6000m housing	Analog inputs, Li Ion batteries, 4 GB recorder	Bronze housing	IMU , Analog inputs, Li Ion bat-teries, cable probe, 4000m housing, 16 GB recorder	Vectrino+ firmware, sidelooking probe, flexible cable plobe	Flexible cable probe
Method of Deployment													
Bottom Mount	●	●	●		●		●	●	●		●		
Moving Vessel				●						●			
Mooring Line	●				●		●	●					
Fixed Structure	●	●	●		●	●	●	●	●		●		
Laboratory Flume									●			●	●

ABOUT NORTEK

Nortek is an international instrumentation company that provide ocean and laboratory systems to scientists and engineers in more than 80 countries. The core products are based on the acoustic Doppler principle and measure water movement in its different forms. Product development and production take place just outside Oslo, Norway. Eight international subsidiaries provide direct contact with our worldwide customer base. The company is privately held, has about 100 employees, and annual revenue in excess of $25 mill.

Nortek's roots are in the scientific community that pioneered the use of acoustic Doppler technology to measure ocean currents in the early 1980s. Nortek was formed in 1996, initially under a cooperative agreement with Sontek Inc., and in 2001 launched the first hardware products developed in-house.

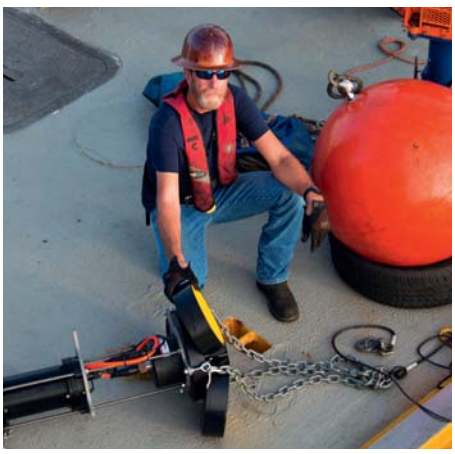
From 2008-2013, the company expanded primarily to provide local services and into sectors outside acoustic instrumentation. In 2014, Nortek launched the new AD2CP hardware platform, allowing engineers unprecedented flexibility in new applications and product development.

Nortek runs multiple outreach programs to promote ocean science within the community. The Nortek Student Equipment Grant program is a 10-year old tradition allowing graduate students to compete for instrumentation loans and travel grant, which support their research.

Bringing science to high-speed yachting, Nortek collaborated with team PUMA in the 2012 edition of the Volvo Ocean Race to develop a leeway sensor and successfully collected ocean currents around the entire world.

The engine that drives Nortek is its multi-talented, global team, each authorities in their field. At the core is a world-class design and development group with expertise in acoustics, electrical and mechanical engineering, physics, and oceanography. Through their ingenuity and ability to handle complex structures, Nortek provides a functionality and reliability level that is unmatched within the industry. Build-to-order manufacturing takes place in a single-floor environment that is actively using its ISO certification to improve processes and reliability. Calibration functions are all automated and delivery times are the best in the industry.

The Nortek customer experience is exceptionally enhanced through interaction with a lean production and operations team that has direct access to the development engineers.



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