University of Central Florida

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New Velocimeters Provide Improved Sensing Capabilities in Aquatic Environments

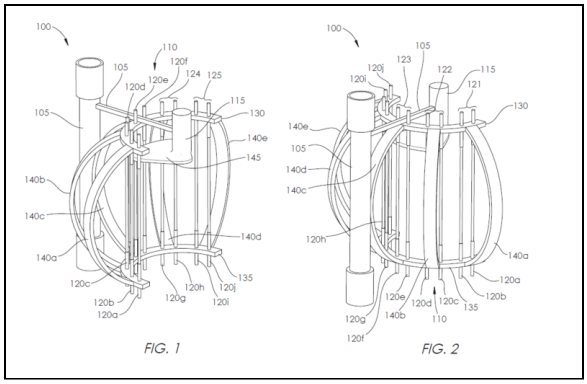

Fig. 1 And Fig. 2 Perspective Views Of An Arc-type APTV

Introducing the Automatic Pulse Tracer Velocimeter (Cross-type and Arc-type)

Measuring low flow regime water velocities is challenging, but important for investigating the fate and transport of nutrients and contaminants in heterogeneous aquatic environments. Similarly, monitoring of groundwater is important for understanding solute transport processes including; pollutant fate and transport mechanisms, detection of leaks from groundwater storage containers, and development of early warning systems for flooding and bank stability. However, real-time measurement of water velocity and direction in such aquatic environments are difficult due to technological limitations, budget constraints, environmental conditions, location or time, and labor constraints. Researchers at the University of Central Florida have developed two novel devices: Cross-type automatic pulse tracer velocimeter (Cross-type APTV) and Arc-type automatic pulse tracer velocimeter (Arc-type APTV), which assist in measurement of velocity and direction of water in both wells and wetland environments. These devices are cost-efficient, have improved accuracy, are easy to use, and are equipped with wireless communication units. The Cross-type Automatic Pulse Tracer Velocimeter (APTV) is the first device of its kind, designed to measure low flow regime water velocities (0.2–5.0 cm/sec) in heterogeneous aquatic environments. It is the only device that can both measure velocity and dispersion coefficients within a small time scale. The Arc-type APTV is a new, cost-effective device designed to measure low velocity flow rates in wetlands, and was shown to operate within 10 percent accuracy for both velocity magnitude and directional measurements when compared to Acoustic Doppler Velocimeter (ADV) technology. It has better accuracy and resolution for direction measurement than the Cross-type APTV. However, the Cross-type APTV can measure flow velocity as low as 0.2 cm/sec against 0.5 cm/sec of the Arc-type APTV. Unlike Acoustic Doppler Current Profilers (ADCPs), both APTV types are better suited for horizontal profiling in shallow water conditions in densely vegetated environments and are deployed in the field with the inclusion of wireless units that can send and receive data remotely from a personal computer. Wireless communication enable real-time acquisition and analysis of data, and it greatly reduces maintenance and communication cost. For groundwater monitoring, the Arc-type APTV is modified into a probe for measurements of centimeter-scale velocity-magnitude, flow direction, hydraulic conductivity, and dispersion coefficient. The measurement are carried out by coupling the probe with a PVC pipe and inserting it into a pre-drilled well.

Technical Details

The Arc-type and Cross-type devices operates by emitting small pulses of saline (NaCl) solution into the water column. Conductivity measurements are made by use of pairs of stripped copper wires set up immediately downstream of the

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injection point arranged in an arc pattern, or, for the Cross-type, with four detector wire pairs arranged in a cross configuration to measure low velocity ranges with straight flow conditions. By measuring the change in conductivity with time, a tracer pulse curve is generated which can be used to derive velocity magnitude, direction, as well as dispersion in water column. Using calibration curves, velocity measurements are adjusted to within 10 percent accuracy of ADV meters.

Benefits

- Easy to use
- Cost-efficient
- Enable frequent measurements
- Improved accuracy
- Can be integrated with existing devices to provide additional sensing capabilities

Applications

- Non-cohesive, small diameter grained aquifers
- Wells
- Wetland systems
- Stormwater ponds
- Estuaries and bays
- Flow monitoring stations
- Groundwater monitoring

Additional Technology numbers: 33168

Technology #33297

• US Patent Pending

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