Instrumentation available in the Hydro Lab

Aug 2026

Force Measurement

Block Gages

Variable reluctance / Linear Variable Differential
Accuracy - .25% FS
Waterproof
Single Axis
Very Robust

4 Inch
Wt- 10.25#

Sizes:
10 lb
25 lb
50lb
250 lb
500 lb

2 Inch
Wt- 1.25#

Sizes:
5 lb
10 lb
50lb
200 lb

ATI 6 Axis Load Cells

Strain Gage
Accuracy - .25% FS
Waterproof
Easily damaged if overloaded

Mini40	X&Y - 20 lb, Z – 60 lbs Tx, Tz, Tz – 40 inlbs
Mini45	X&Y - 60 lb, Z – 120 lbs Tx, Tz, Tz – 80 inlbs
Mini58	X&Y - 150 lb, Z – 375 lbs Tx, Tz, Tz – 250 inlbs
Omega85	X&Y - 210 lb, Z – 420 lbs Tx, Tz, Tz – 370 inlbs

Kistler Gage #9602A

Piezo Resistive
Three Axis
Extremely fast response, but drifts under steady load

Capacity - 225 lb
Accuracy – 1.5% FS
Crosstalk - 3-5%

In Line Load Cells

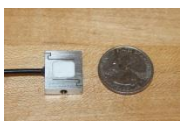
Strain Gage
Accuracy - .25% FS
Single Axis

Omni Instruments
450 lb capacity
Waterproof
Wt – 0.5#

??
250 lb capacity
Waterproof
Wt – 0.1#

Futek Junior S-Beam
25 lb capacity
Waterproof
Wt – 0.05#

Futek S-Beam
500 lb capacity
Wt – 1.25#



Futek Miniature S-Beam
25 & 5 lb capacity
Waterproof
Wt – 0.006#

Futek LCF 300
50lb capacity
Wt – 1.5#

BLH Electronics
1000 lb & 5000 lb
No Analog Output
Wt – 11.7#

Omegadyne Inc
20,000 lb
Wt – 4.3#

Force Measurement (cont.)

Futek Parallelogram Load Cells
Strain Gage
Accuracy - .05% FS
Single Axis

2.2 lb capacity
Wt – 0.05#

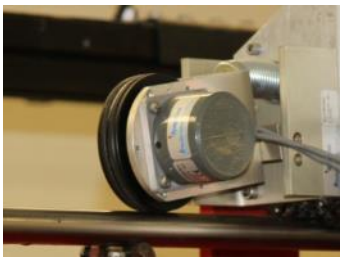
Other

Chatillion
Hand Held Load Cell
50 lb capacity
No Analog Output
Accuracy – 0.5% FS

Futek Bi-Axial Load Cell
50 lb/50 lb capacity
Wt – 1.0#

Speed Measurement

Speed is measured on both carriages by optical encoders linked to precision diameter wheels. The encoder output (~1000 pulses for 1.2 ft) is converted to an analog voltage by an F to V. Accuracy is better than 0.1%.



Speed measurements are validated by optic trips laid out on the tank rail using a NIST traceable metal tape measure. Response time - 5msec.

Bar Code Measurement – The 380 is fitted with a bar code speed/position measurement system. This system primarily provides input to the carriage speed control system.

Distance Measurement

Potentiometer Based

Stringpots and Heave Posts

- Accuracy - <.1% FS
- Not Waterproof
- Contact Sensor
- Acceleration Limitations (1g on retraction)

Typical Heave Post
6, 12, &18 Inch Capacity

Celesco PT101
12 to 60 Inch Capacities

Laser – MicroEpsilon & Acuity

- Range – 8 inch & 50 inches
- Accuracy – within micrometers
- Not Waterproof
- Non-Contact Sensor
- Limitations: requires non-reflective surface, minimum offset distance required

Linear Variable Differential Transformer (LVDT)

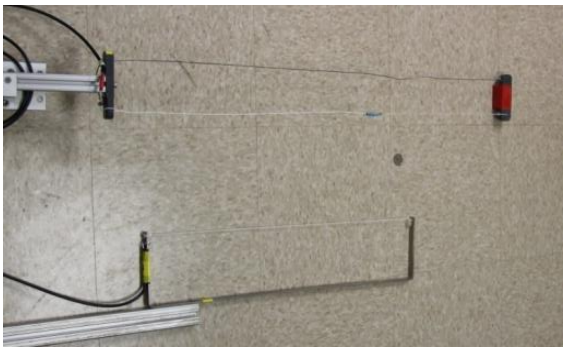
- Range – 2.5 & 1 inches
- Accuracy - 0.1% FS
- Not Waterproof
- Contact Sensor
- Acceleration Limitations

Senix Sonics

- Range – 4” to 40’ user selectable
- Accuracy – 4100 steps over full range
- Repeatability – 0.1% FS
- 16 deg cone angle
- Waterproof
- Non-Contact Sensor
- Data Rate Limitations (20Hz)

RBR/Akamina Capacitance Probes

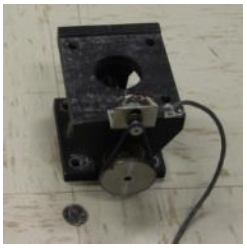
- Static water level measurement
- Range – 16” to 30”
- Accuracy – 0.15% FS
- Contact Sensor



Angle Measurement

Potentiometer Based

Pitch Pivots
Range +- 30 degrees
Accuracy - 0.25% FS
Not Waterproof
Analog
Works with high accelerations



Angular Displacement Transducer (ADT)

Range +- 60 degrees
Accuracy - 0.15% FS
Not Waterproof
Works on differential capacitance
Works with high accelerations

Shaft Position Encoder

Range 360 degrees
1400 pulses/rev
Not Waterproof
Works on LED behind a slotted wheel

Accelerometer Based

Schaevitz Inertial Inclinometer
Range 0- 30 degrees
Linearity - 0.02% FS
Not Waterproof
Not useful for dynamic measurements

Omni Instruments Inertial Inclinometers
Dual Axis
Range 0- 30 degrees
Resolution - 0.01 deg and 0.004 deg
Waterproof
Not useful for dynamic measurements

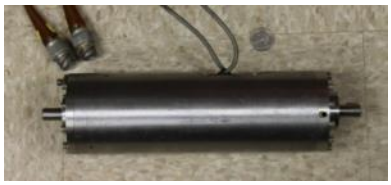
Signal Quest Gravity Gyro
Dual Axis (Pitch/Roll)
Range +-30 deg pitch, +- 90 deg roll
Resolution - 0.1 deg static 0.5 deg dynamic
Gyro corrected for motions, IP67

Spitronic Digit Level
Range 360 degrees
Resolution - 0.01 deg
Not Waterproof
Not useful for dynamic measurements
No Analog Output

Torque Measurement

Hydronautics Dynomometers

Variable reluctance gages
Measures Thrust and Torque
Require water immersion



Sizes:

Thrust (lbs)	Torque (in-lbs)
20	20
50	150
150	300

Cussons Dry Dynomometer

Strain gage system
Measures Thrust and Torque

Size:

Thrust (lbs)	Torque (in-lbs)
22	35
56	88

Cussons Submersible Dynomometer

Strain gage system
Measures Thrust and Torque

Size:

Thrust (lbs)	Torque (in-lbs)
157	354

Futek Dynamic Torque Cell

Strain gage system
Includes encoder for rpm
Accuracy – 0.2% FS

Sizes:
17.7 in-lbs
1770 in-lbs

Futek Static Torque Cell

Strain gage system
Measures only Torque
Accuracy – 0.2% FS

Size:
50 in-lbs

Vibrac Torque Cell

Optical system measuring angular displacement of torsion bar
Accuracy – 1% FS

Size:
32 in-lbs

RPM Measurement

Dart DC Motor Pickup

10 pulses/rev
5000 rpm max
NPN trigger
Requires Frequency to voltage conversion

Hall Effect Sensors

Senses ferrous objects
Requires geared wheel (typically 100 teeth/rev)
Requires Frequency to voltage conversion
Can measure magnet as well

Shimpo Handheld Tachometer

Non-contact laser or contact tachometer
6-100000rpm
Accuracy +- 2rpm

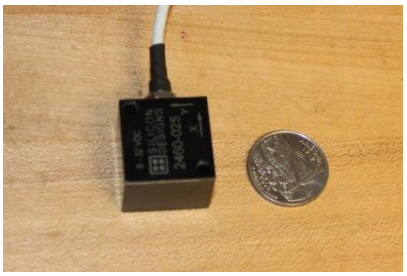
Acceleration Measurement

<u>Capacitive Accelerometer</u>

Silicon Designs - 25g
Linearity - 1.5% FS
Splash-proof
Very Fast Response good for dynamic measurements

<u>3 Axis Capacitive Accelerometer</u>

Silicon Designs - 25g
Linearity - 1.5% FS
Same as above but measures acceleration in 3 orthogonal directions



<u>Servo Pendulum Accelerometer</u>

Shearborn Sensors
Range 1g, 2g and 10g
Resolution - .05mg
Good for low frequency analysis

Inertial Measurement Units (IMU)

<u>Watson Solid State Vertical Reference Unit</u>

Measures 2-Axis angle displacement and angle rate
Range +- 30 degrees, +-100 deg/sec
Accuracy Static - 0.3 deg
Accuracy Dynamic – 2%
Very Expensive

<u>Xsens Mti-G IMU</u>

Measures 3-axis accelerations, angular rates
Acceleration Limit - 5g
Angular rate Limit – 300 deg/sec
120 hz output
Splash-proof
Inexpensive

<u>Smart Phone</u>

Uses capacitive accelerometers and GPS if available
Data rate is often too slow
Self contained

Pressure Measurement

Druck Differential Pressure Sensor

- Range – 0 to 40 inches H20
- Accuracy – 0.1% FS
- Response time - 10 msec

Validyne Differential Pressure Sensor

- Range adjustable by replacing diaphragms
- 0-35, 0-55, 0-222, & 0-550 inches H20 available
- Accuracy – 0.25% FS

Setra Differential Pressure Sensor

- 0-5 inches H20
- Accuracy – 1% FS

PCB Piezotronics Pressure Transducer #113B28

- 50 psi
- Accuracy – 1% FS
- Good for dynamic pressure, not static pressure

Analog to Digital Converters

National Instruments AtoD

- 8 Channel, 16 Channel, 40 Channel
- 16 bit
- Resolution - 0.0003 v
- -10v to +10v
- Can be ganged together for more channels

National Instruments AtoD

- 4 Channel
- 14 bit
- Resolution - 0.001 v
- -10v to +10v
- Can be ganged together for more channels
- USB Powered; can result in noise for certain instruments

Topography

Velodyne's HDL-32E LIDAR

360 deg field of view
240 ft range
1 inch accuracy

Signal Conditioning

Validyne Racks

7 Card
3 Card
Internal Power Supply

Validyne Signal Conditioners

Output +- 10V dc

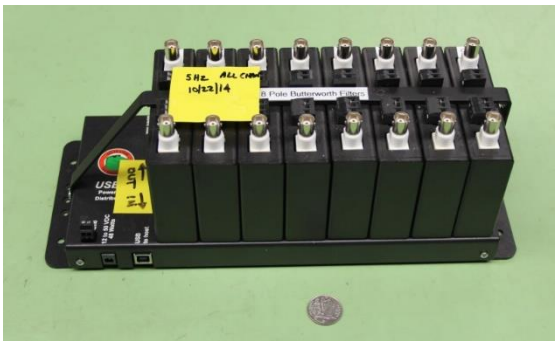
Block Gage
Pot Cards
Freq to V
Strain Gage
ThermoCouple

Block Gage Pot F to V

Futek Signal Conditioners

Output +- 10V dc
Strain Gages

Programmable Butterworth Filters



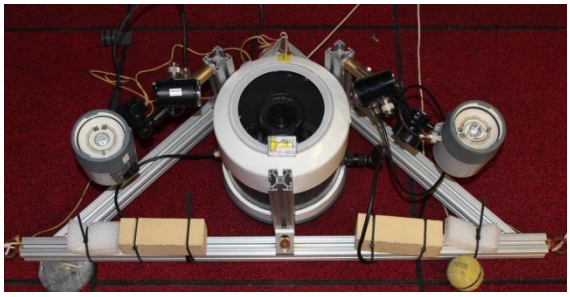
Cameras

Canon EOS 3Ti

Digital SLR
18 Megapixel still photos
HD Movie capability
16 Gb Memory Card

Underwater Camera Housing

Holds Canon camera facing up in 380. Optical trigger allows pictures at carriage speeds up to 30 fps



Carriage CCD Video Cameras

Axis M1135
Remote adjustable zoom and focus
Auto Iris

Submersible Lipstick Cameras

Waterproof
Fixed zoom
Large depth of field
Not HD

GoPro Hero

Waterproof
Wide Angle
Self Contained
HD

High Speed Video

5000 frames/sec
$60K