



# The POSITIONING newsletter

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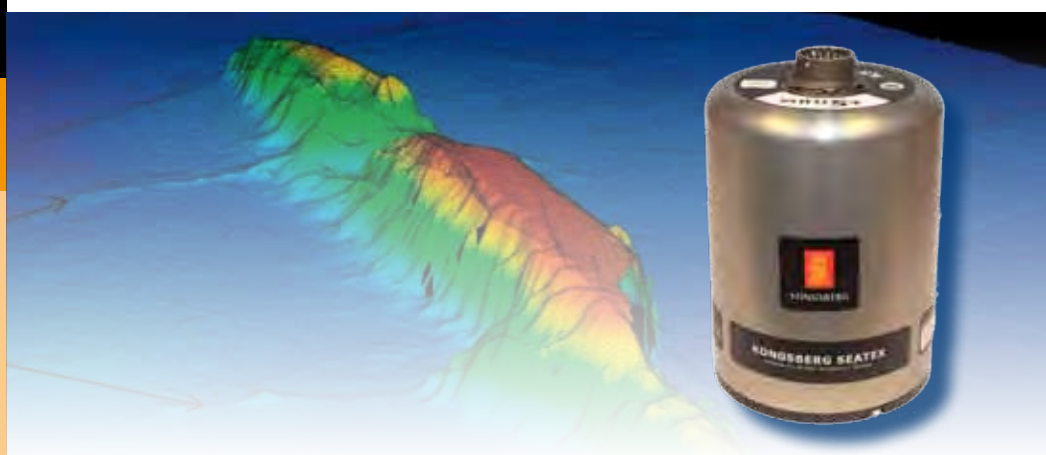
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### MEET US AT



## The best got better Fifth Generation MRU arrives



### Introducing MRU 5+

**With accuracy of 0.01° roll/pitch using MEMS technology, the brand new MRU 5+ challenges the boundaries of attitude determination. Years of experience, knowledge and development within inertial measurement technology, blended with a deep understanding of its applications, has culminated in the new MRU 5+.**

The first release of the Motion Reference Unit (MRU) was in 1992 at Oceanology International in Brighton. Since its launch, more than 7,000 units are now deployed world-wide, operating across a wide range of applications.

Since its introduction, the MRU has evolved from an initial roll and pitch accuracy of 0.3° to the current 0.01°, and is today considered as the de-facto industry standard in the maritime market for attitude determination sensors.

### MEMS Technology

Kongsberg Seatex has developed a new rate gyro specially tailored for maritime use, based on MEMS technology for the MRU 5+. The use of MEMS gyros enables long life and stable performance over time. It also combines very low noise, excellent bias stability and outstanding gain accuracy.

#### Key performance data MRU 5+

Roll/Pitch	0.01° RMS
In-run bias drift	0.1°/hr
Gyro scale factor error	300 ppm RMS
Angular Random Walk	0.015°/√hr
Accelerometer bias	0.08 mg
Accelerometer scale factor error	200 ppm RMS
Position drift within 2 and 5 minutes	3 m and 40 m CEP
(estimated gyro bias prior to free inertial mode, constant temperature)	

Based on this class-leading performance, the MRU 5+ is also an excellent IMU.

**You are hereby invited to our booth at OI 2010 to see the sophisticated new Motion Reference Unit.**

# The new generation Seapath®



## The new generation Seapath® 300 Family

**With an accuracy of 0.01°, utilisation of both GPS and GLONASS and PFreeHeave™, the Seapath Family now offers a unique solution for demanding operations in challenging environments. The possibility to use GLONASS in addition to GPS satellites significantly increases system availability, provides robust integrity monitoring and results in more precise solutions, particularly in environments with high levels of obstruction.**



### High Precision

Seapath 300 is a high grade family of products, developed by Kongsberg Seatex specifically for the hydrographic market and other high precision applications where heading, position, roll, pitch, heave and timing are critical measurements in order to achieve precise and accurate results. The Seapath 300 product family offers the best possible combination of GNSS signal and inertial data, enabling much better performance than each of the signals alone. It offers high output data rate (up to 200 Hz), zero delay on output

data, data available in up to eight different measurement points, a total of 16 configurable ports via Ethernet, 3 analog channels and 8 serial lines.

### Network Architecture

The Seapath 300 family is a two-module solution with a Processing Unit and an Operator Unit connected via Ethernet. The Processing Unit runs all critical computations independent of the user interface on the Operator Unit to ensure continuous and reliable operation. The Processing Unit runs in a safe mode protected from unintended



The configuration view for setup of the system



Operation view with motion data



Operation view with satellite information

user operations. Several Operator Units can be connected to the same Processing Unit in a networked architecture.

### Position Determination

The Seapath software comprises an 'All-in-One' signal processing core with advanced algorithms and true parallel processing of all available signals including Inertial Measurements and SBAS (e.g. WAAS, EGNOS, MSAS and GAGAN). DGPS/DGLONASS corrections from different sources are combined by the unique MULTIREF™ capability. There is no practical limitation to the number of reference stations handled by the Seapath software. The Seapath has a built-in autonomous real-time quality control feature continuously monitoring the quality of the calculated position. Alarms and warnings are activated if critical tolerances are exceeded or if position quality degrades. The lever arm compensation in the software enables selection of several measurement points on the vessel for which position data can be output. In addition to

utilising standard DGPS, XP/HP/G2 and RTK corrections, the Seapath can be operated in floating ambiguity mode and can determine position accuracy down to 15 cm RMS by the combination of a single frequency receiver and RTK corrections.

### Inertial Measurement Unit

An important part of the product is the inertial sensor of type MRU 5 or MRU 5+, which includes three angular rate gyros and linear accelerometers. Both sensors include the new unique angular rate gyro based on MEMS technology, developed by Kongsberg Seatex for these products only.

### Operator Software

The Seapath is operated through the operator software installed on one or more Operator Units (one Operator Unit on the bridge, one in the survey room). This software is used for performance monitoring, configuration and troubleshooting of the system.

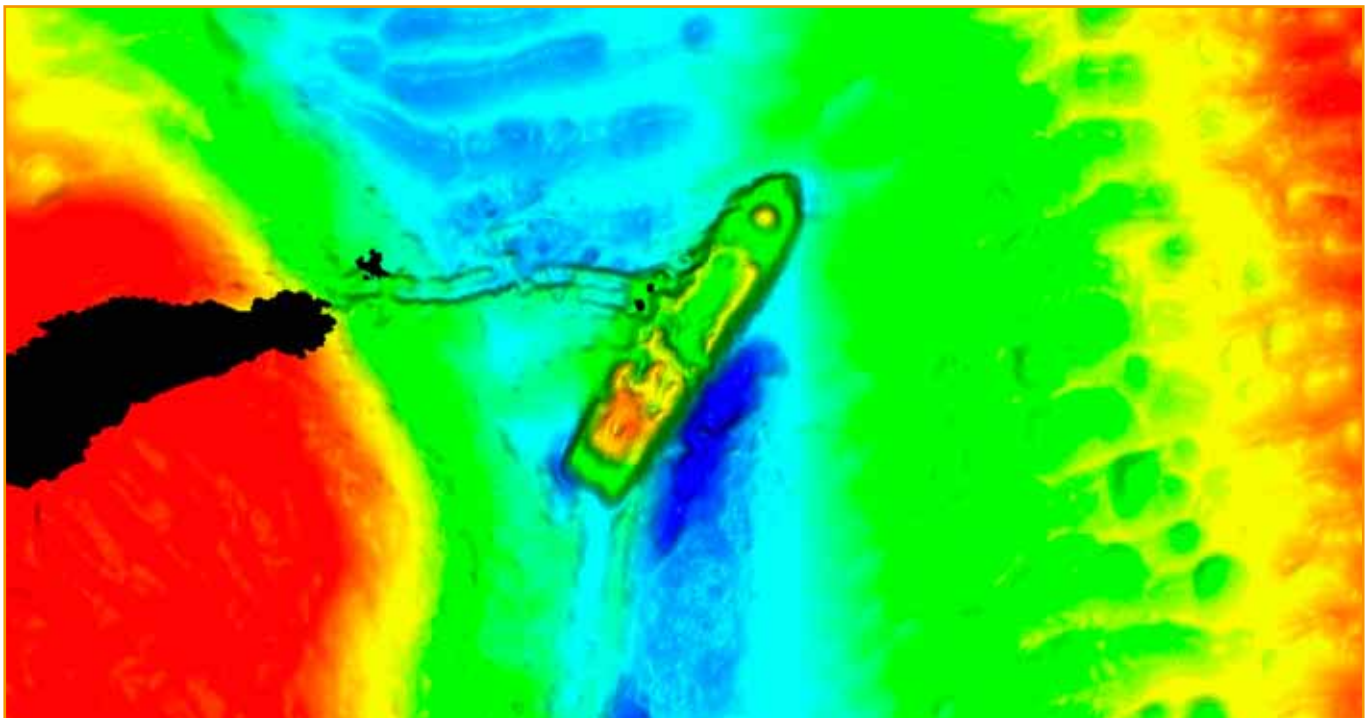
## SEAPATH AT A GLANCE

### Performance

- 0.01° Roll/Pitch
- Utilises GPS and GLONASS
- PFreeHeave™
- 16 configurable ports via Ethernet, 3 analog channels and 8 serial lines
- Ready for Fugro XP/HP/G2 correction services

### Applications

- Motion compensation of single and multi-beam echo sounders
- High precision seabed mapping to IHO standards
- Motion compensation of hydro acoustic positioning systems
- Dynamic Positioning
- Antenna stabilization
- Heading reference
- ADCP motion compensation



### PFreeHeave™ Performance

The newly developed PFreeHeave™ algorithm uses past measurements to output a correct and phase-free heave from Seapath. PFreeHeave™ offers advantages in long swell conditions and for applications that can utilise a heave signal that is delayed some minutes, such as seabed mapping applications. For real-time operations the traditional hydrographic survey heave filter can be output on a separate serial line or Ethernet.

**MRU PRODUCT RANGE**

The MRU product range, which is shown in the table below, is suitable for a wide range of applications.

	Roll/pitch	Heading	Heave	Acceleration [m/s <sup>2</sup> ]	Description
<b>MRU 5+</b>	0.01°		5 cm	0.001	Three axes high quality MEMS rate gyros and linear accelerometers. Free mounting orientation.
<b>MRU 5</b>	0.02°		5 cm	0.01	Three axes high quality MEMS rate gyros and linear accelerometers. Free mounting orientation.
<b>MRU 4</b>	0.05°	1.2°	5 cm	0.01	Three axes MEMS rate gyros and linear accelerometers together with three axes fluxgate magnetic compass. Free mounting orientation.
<b>MRU H</b>	0.05°		5 cm	0.01	Three axes MEMS rate gyros and linear accelerometers. Free mounting orientation.
<b>MRU Z</b>	0.15°		5 cm	0.05	Three axes MEMS rate gyros and linear accelerometers. Fixed mounting orientation.
<b>MRU 2</b>	0.1°			0.01	Two axes MEMS rate gyros and linear accelerometers. Fixed mounting orientation.
<b>MRU D</b>	0.35°			0.05	Two axes low cost MEMS rate gyros and linear accelerometers. Fixed mounting orientation.
<b>MRU 1</b>				0.01	Single axis linear accelerometer. Fixed mounting orientation.

**SEAPATH 300 PRODUCT RANGE**

The Seapath 300 product range, which is shown in the table below, is suitable for a wide range of applications.

	Heading <sup>1)</sup> [deg] RMS	Roll/Pitch [deg] RMS	Heave [cm] RMS	Position Horizontal RMS	Position Vertical RMS	Description
<b>Seapath 300</b>	0.05	0.02 <sup>2)</sup>	5 or 5%	0.7 <sup>4)</sup> m		Two L1 GPS receivers <i>Upgrade kit for Seapath 200 available</i>
<b>Seapath 300+</b>	0.04	0.01 <sup>3)</sup>				
<b>Seapath 310</b>	0.05	0.02 <sup>2)</sup>	5 or 5%	1 cm + 1.6 ppm <sup>5)</sup>	2 <sup>5)</sup> cm + 3.2 ppm	One L1 and one L1/L2 GPS receiver. <i>Upgrade kit for Seapath 200 RTK available</i>
<b>Seapath 310+</b>	0.04	0.01 <sup>3)</sup>				
<b>Seapath 320</b>	0.05	0.02 <sup>2)</sup>	5 or 5%	0.5 <sup>4)</sup> m		Two L1 GPS/Glonass receivers
<b>Seapath 320+</b>	0.04	0.01 <sup>3)</sup>				
<b>Seapath 330</b>	0.05	0.02 <sup>2)</sup>	5 or 5%	1 cm + 1.6 ppm <sup>5)</sup>	2 <sup>5)</sup> cm + 3.2 ppm	One L1 and one L1/L2 GPS/Glonass receiver
<b>Seapath 330+</b>	0.04	0.01 <sup>3)</sup>				

- 1) with 4m antenna separation  
2) with MRU 5  
3) with MRU 5+  
4) with SBAS or DGPS input  
5) with RTK corrections

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