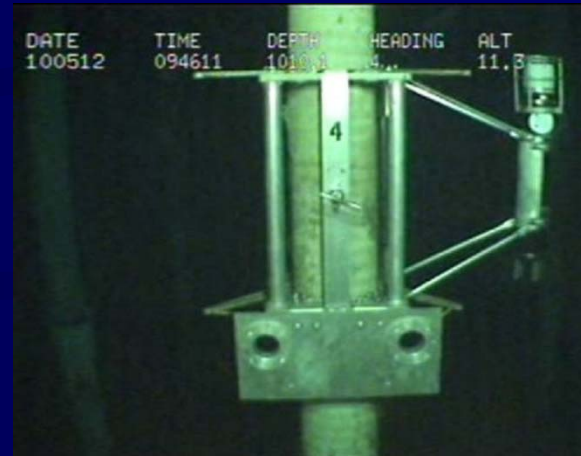


*FSI Riser
Monitor
Solutions*



Data Acquisition System for Deepwater Riser Fatigue Management



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*Sensors
Systems
Service*

Riser Motion

Wave-Induced Vibration

- May be significant on long risers

Vortex-Induced Vibration (VIV)

- Caused by flow irregularities around riser

Drilling-Induced Vibration (DIV)

- Caused by rotation of drill string
- Could result in Riser failure due to fatigue

➤ System to Monitor VIV and DIV during drilling operations

- Allows near real time adjustment of drilling speed to ensure operation within safe limits

High Vibration = Increased Riser Fatigue = Shortened Riser Life



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FSI Riser Monitor System

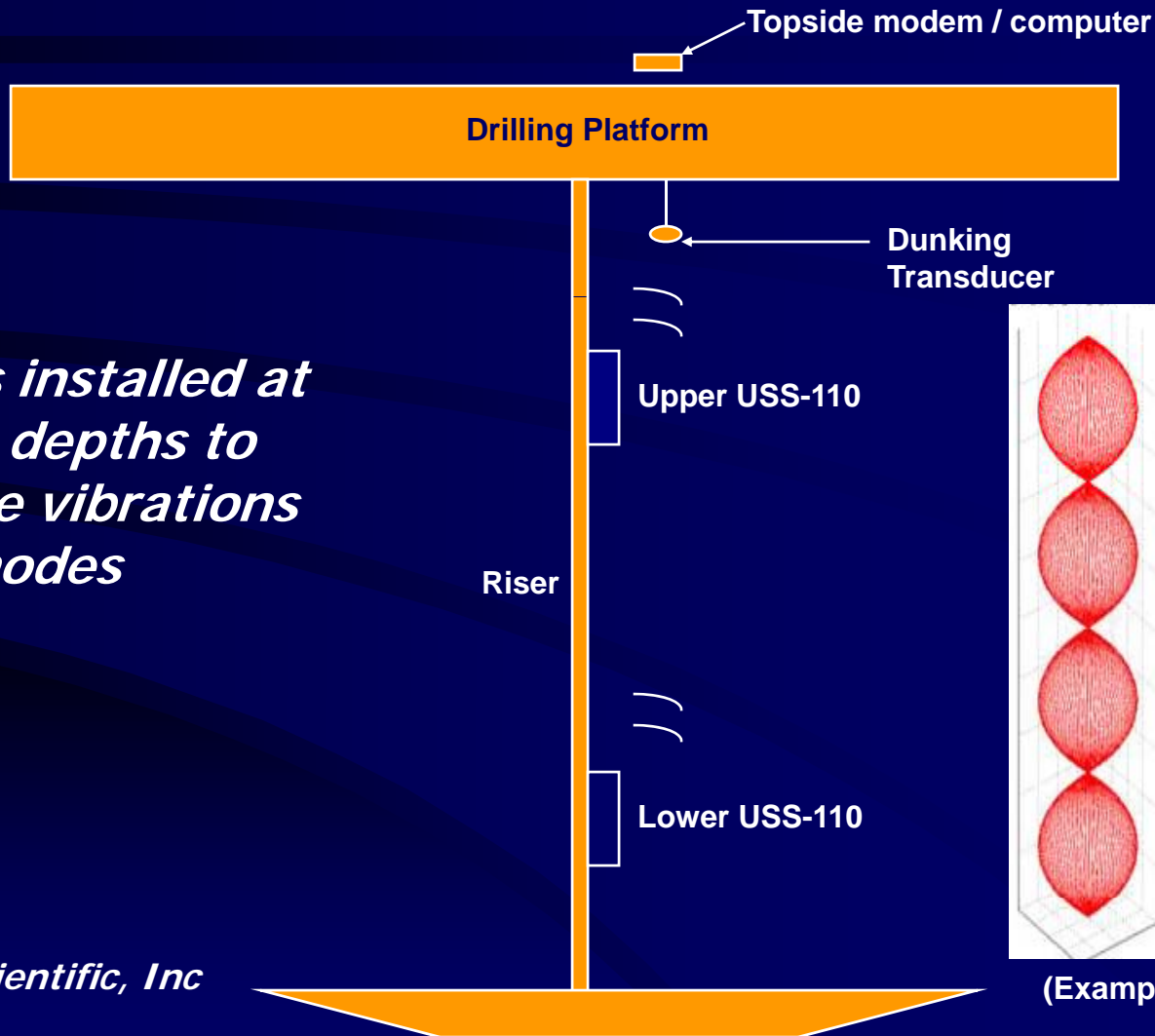
- **Motion Monitoring Systems Measure DIV & VIV of Risers or other Sub-Sea Structures**
- **Used operationally during drilling operations for safety and fatigue monitoring**
- **Near-real-time data gives early indication of excessive vibration**
- **Data Transmission via Acoustic Modem - No Cables Required**
- **Self-Contained**
 - **Inclinometer & accelerometer based**
 - **Battery powered**
- **ROV Deployed**
 - **Spring loaded clamps**
 - **Units can be retrieved, batteries replaced, and redeployed**



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Riser Monitor System Application

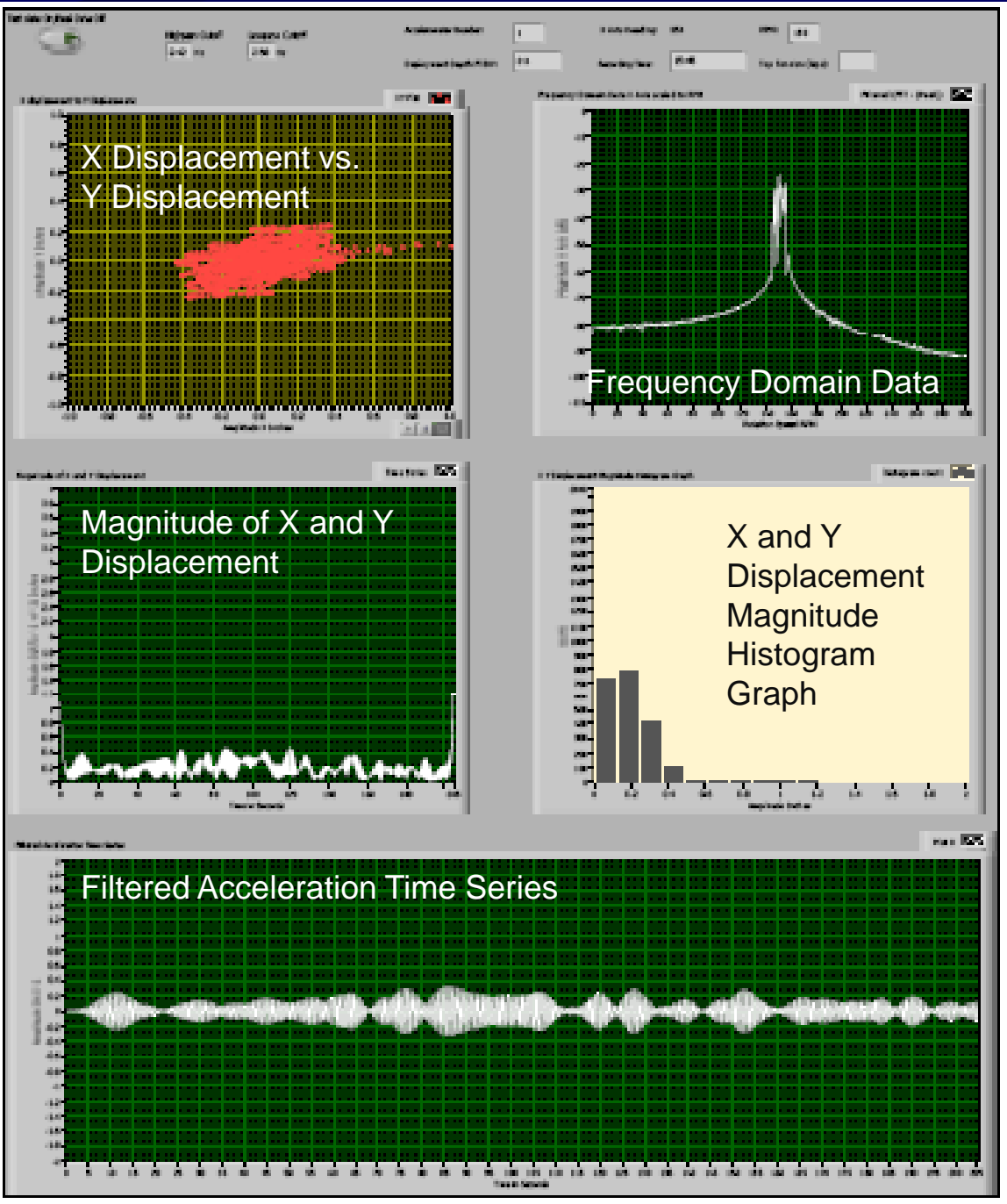
Sensors installed at specific depths to measure vibrations at antinodes



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Data Examples

Nominal Vibration



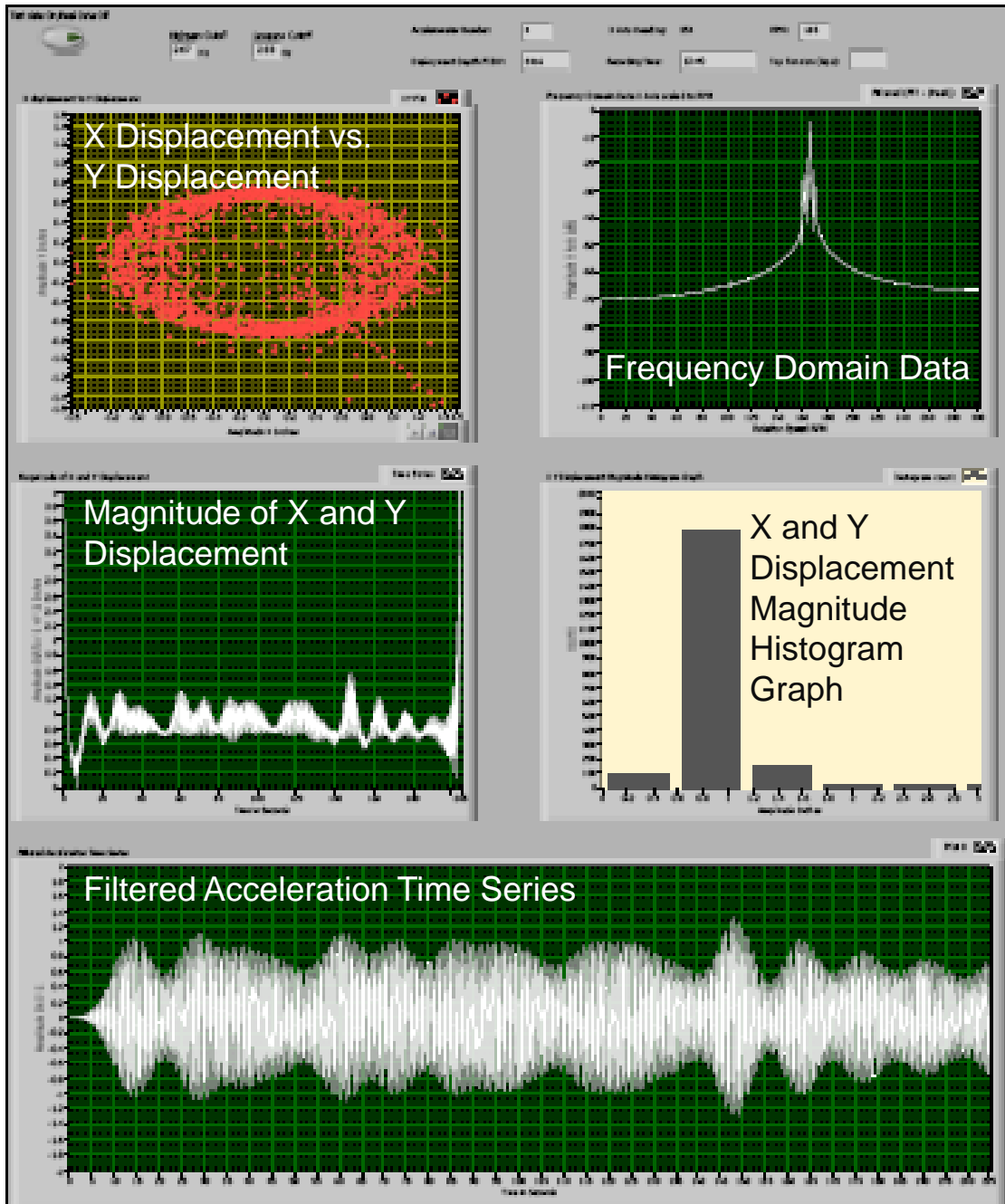
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Data Examples

Unsafe conditions After Drilling Speed Increase



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Riser Monitor Systems

Main System Components

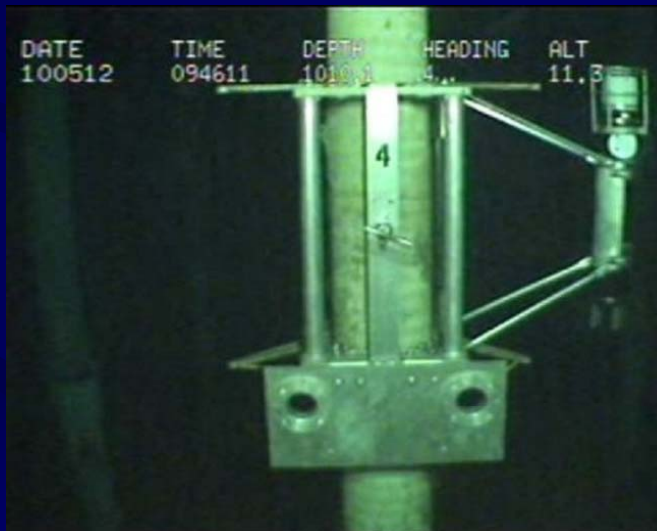
- ROV deployable clamp
- USS-100 Sensor Subsystem with acoustic modem
- Topside Subsystem
 - Modem communication & data telemetry
 - Labview based data processing and display



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Riser Monitor System

ROV Deployed Riser Clamp



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Riser Monitor System

FSI's USS-110 Sensor



- Real-time remote acquisition of DIV, VIV, stress, and other analog data
- Flexible platform allows for the input of up to 5 additional channels of analog data (i.e. LVDT, strain gauges, etc.)
- Internal alkaline battery pack for up to 6 months of operating life
- High speed bi-directional acoustic link to topside system
- Topside software package provides seamless integration between the acoustic modem and the topside computer
- Directional or omnidirectional transducer configurations available.



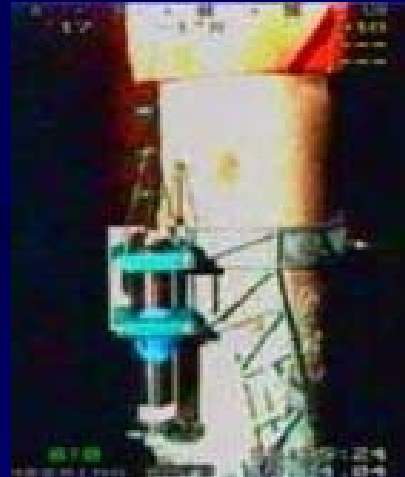
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Riser Monitor Systems

FSI Prior Experience



- Unocal accelerometer and strain gauge monitoring while drilling deep water riserless exploration wells in Makassar Straights (SEDCO 601 and Ocean Baroness, 2002-2003)
- Developed ROV deployable clamp to study VIV and DIV in West Seno platform in 2004
- Current Chevron program



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FALMOUTH SCIENTIFIC MONITORS CHEVRON DEEP WATER RISERS TO INSURE DRILLING INDUCED VIBRATION (DIV) IS WITHIN SAFETY LIMITS

Cataumet, MA, USA – September 10, 2012 – Falmouth Scientific, Inc. (FSI), a global leader in precision oceanographic instrumentation and marine systems integration, is pleased to announce that it is providing equipment and services to Chevron Makassar Ltd in Indonesia to monitor the drilling induced vibration (DIV) on Deep Water Top Tension Risers (TTRs) during Extended-Reach Drilling (ERD) operations.

FSI's USS-110 accelerometer/inclinometer based systems are placed at specific depths on the risers by reusable ROV deployable clamps that were custom designed and manufactured specifically for this application by FSI and their partner, Electronics Measurements Company of Houston, TX. The data from the systems is transmitted acoustically and monitored in near real time by support engineers on the platform, and used to identify overstress conditions that could potentially result in rapid fatigue and reduced service life of the risers.

FSI has a strong history in this arena dating back to the original system deployments for Unocal in this same geographic region in 2000 to 2004. FSI is able to provide complete system solutions that include hardware, software, and on-site support engineering.



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Falmouth Scientific

- Founded in 1982
- Development of precision sensors for the oceanographic industry

Acoustikos

- Founded in 2000, merged in 2003
- Specialized in acoustic engineering & rapid product development
- Began riser monitor work with Unocal in Indonesia

Hegg Marine Solutions

- Acquired by FSI in March 2010
- Specialized in training, survey support, and system integration

FSI Facilities

- 10,000 psi pressure tank
- 12-ft acoustic test tank
- Mechanical and Electrical CAD design stations
- 3,000 sq. ft. production
- Potting facility
- Company research vessel
- Close proximity to industry resources and open water test locations



FSI Product & Service Areas

- *Sensors*
 - *Current, Wave, Tide, Motion*
- *Systems*
 - *Acoustic, Seismic, Sonar*
- *Service*
 - *Transducers*
 - *System Integration*



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Thank you for your time and attention

- Preventing fatigue and failure due to DIV is essential to ensure safe drilling and production operations over many years
- The FSI Team has developed and deployed a near-real-time monitoring system that allows rig operators to control riser fatigue due to DIV to within safe design limits
- FSI hardware has functioned extremely well and FSI-trained riser monitoring engineers have provided timely data and guidance to drilling management



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