Note Title 5/3/2018

Module 4

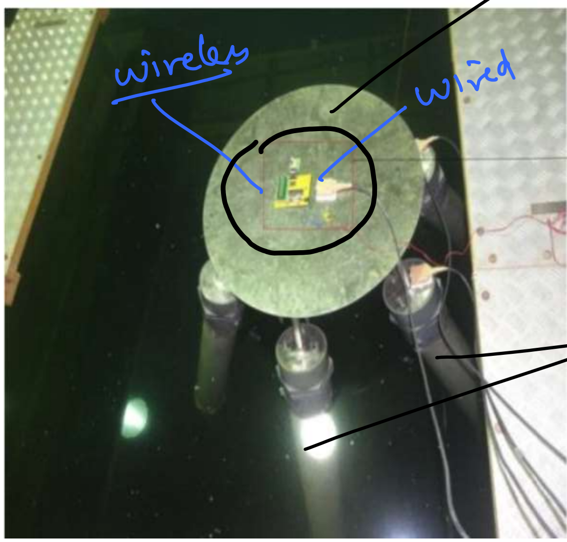
Lecture 3

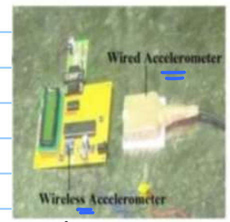
STM applied to BLSRP (Lab scale)

BLSRP - Buoyant leg storage & Regasification platform

Note Title 5/3/2018

deck (circular in shape)





6 legs - Buoyant legs

ball joins do not transfer rotations from legs to the deck

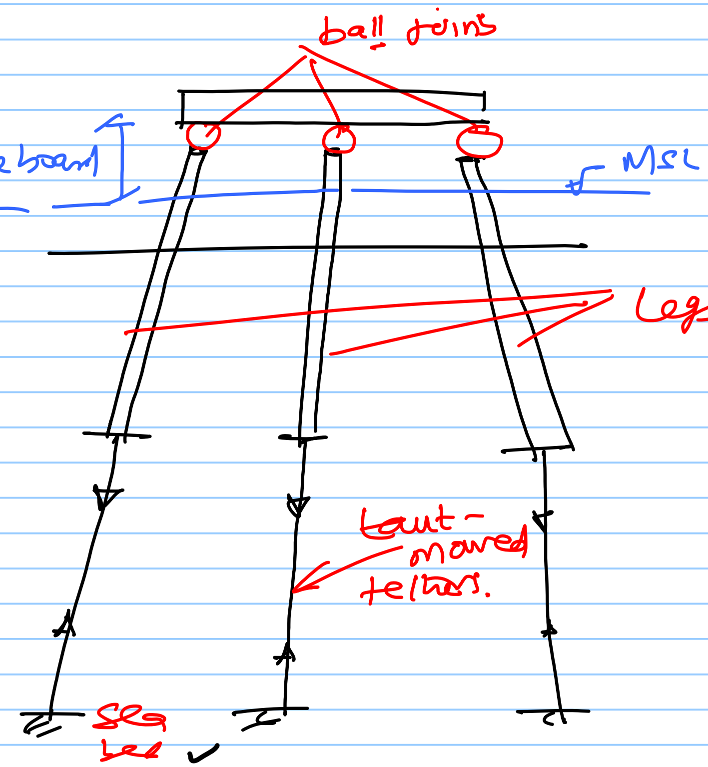
- partially isolates the deck

BLSRP

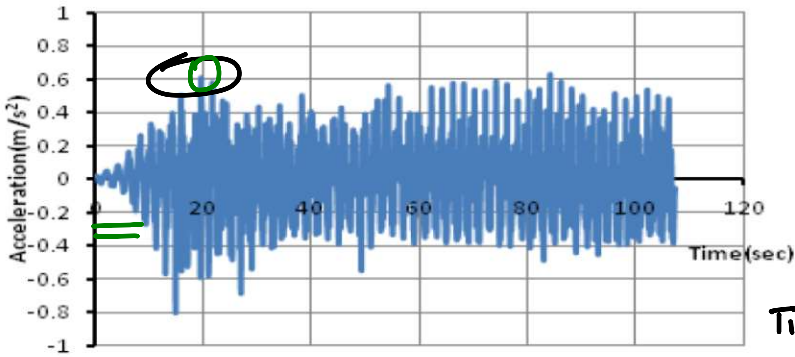
New-generation

+ deep-draft - II^r SPAR || +

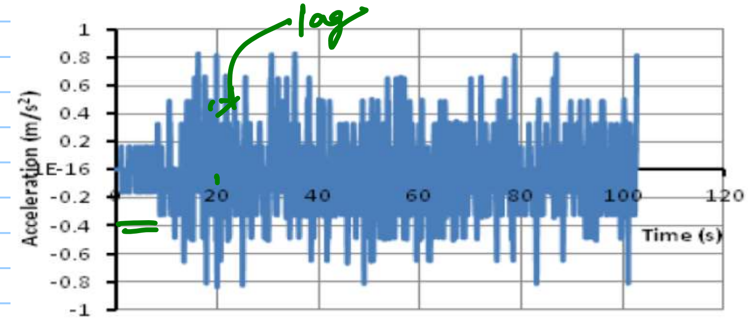
taut-moored - TLP.



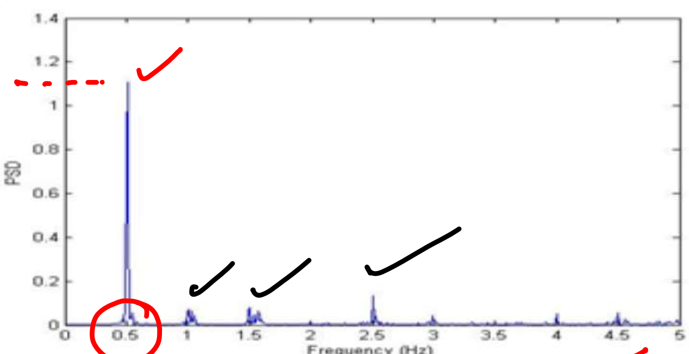
Accelerometer	Wired B12/200 HBM Transducer	Wireless ADX L335
Maxm range	$\pm 200\ m/s^2$	$\pm 30\ m/s^2$
Sensitivity	80 mV/V	330 mV/g
Excitation voltage	1.8 to 3.6V	1-6V
Noise density	—	$300\ \mu g/\sqrt{Hz}$



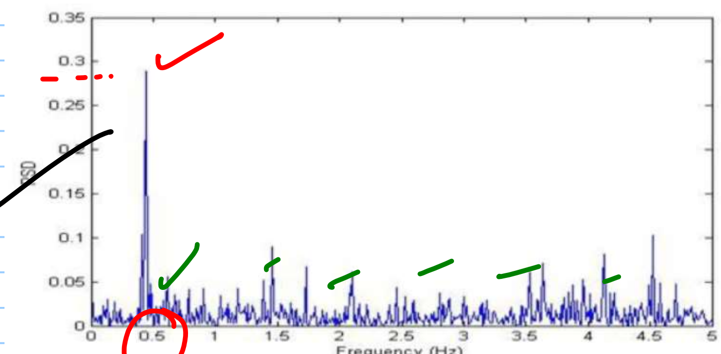
Time history



time history



PSD



PSD

WIRED (surge response of the deck)

WIRELESS

- Max value acquired by wired sensor is $\underline{0.63\ m/s^2}$

  corresponding value, acquired using wireless sensor is $0.65\ m/s^2$

  overall maxm value (wireless) = $\underline{0.82}\ m/s^2$

max value, measured from wireless sensor doesn't match with that of wired sensor.

- due to the noise ratio in the device
- difference in their sensitivity

- By comparing the <u>overall maxm value</u>, error is about <u>30</u>%
- There exist <u>time</u> delay, compare the corresponding peak - is about 4.2%.

ratio b/w peak signal to the noise (wireless) is about 9%.

PSD

- There are a few mismatches is PSD b/w wired/wireless sensors
- In the wired case, peak occurs @ 0.5 Hz
  - consecutive peaks, (low magnitude) – 1.0, 1.5, 2.5 Hz
- In the case of wireless, frequency component occurs @ multiple frequencies – max occurs closer to 0.5 Hz

reasons for multiple peaks :

1) delay in transition time

2) due to white noise in the wireless sensor data

3) difference in sensitivity

4) type of measuring method

- Random noise presence are due to post-processing effect

→ differences are mainly due to system architecture (wired/wireless) adopted for acquisition.

- Qualitative data acquired in both the cases does not change significantly - WSN ✓

- Improvements are required in the WSN architecture
- also required in processing units, data-transmitting techniques.

SHM system - 1

- need to be upgraded
- sensor used is a combination of accelerometer & gyroscope
  - both (translational rotational)

Primary difficulty is SHM - system 1. ?

- not capable of processing the data
  - It can only acquire the data
  - transmit the data

SHM - system 2 → processing unit will be integrated to the acquisition unit

- Sensor node will have a separate zigbee module, which is connected to RS 232 & Hyper-terminal tool to collect the data in parallel.

- delay in the transmission of data is addressed by using Advanced transmission protocols

<u>Key issue</u>

- Sensor nodes should <u>directly communicate</u> to the <u>central server</u>
  - this can reduce signal to noise ratio
  - reduce delay in transmission

- New additions - <u>Alert</u> Monitoring System (AMS)

Design of SHM system -2

a) Sensor units

- each sensor unit - will have interface signals.
- major parameter, measured will be displacements
  - rotational
  - translational || (σ, ϵ)

- sensor used to measure
  - acceleration
  - displacement

Not the strain & loads ||

- acceleration/displacement sensors are to be chosen depending upon the functional requirements of the platform.

- sensors - based on the following factors
  1) sensitivity
  2) operating frequencies || ensure perfect compatibility with motor characteristics of the platform.

- Scalability

- MPU 6050. - MEMS-based accelerometer & gyroscope module

- tri-axial accelerometer
- tri-axial gyroscope
- digital motion processor
- 16-bit digital analog to digital converter (ADC)

- In the accelerometer module
  - each axis has separate proof mass
  - displacement along axis corresponds to the separate proof mass.

two additional characteristics are used

1) reduced settling effects

2) control of sensor drift by eliminating board-level cross-axis alignment errors b/w the sensors

operating current is limited to 3.8 mA

- (full power with accelerat. @ 1 kHz sample rate)

both { fast/slow accelerations | model
fast/slow displacement |

BLSRP < 120 - 150s (surge, sway, yaw)
5 - 10s (heave, roll, pitch) ||

<u>Summary</u>

- SHM design – lab scale
  - BLSRP – model
    - Examine the η of the SHM

SHM-1 – compared wired/wireless
- mismatch

✓ SHM-2 – factors – are identified