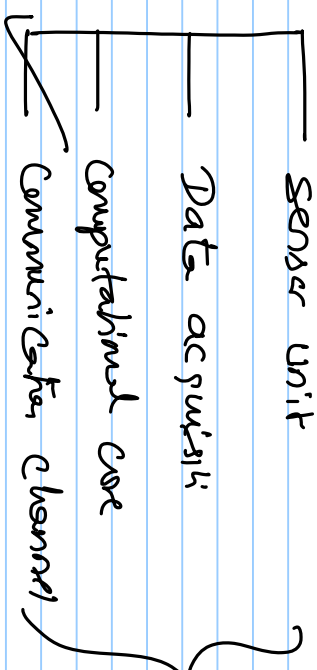


Module 4

Lecture 2: Design of sensor layout
for STM is low scale

- (i) wired sensor network
 - layout, design, specifications, pitfalls
 - (ii) wireless sensor network
- low scale of a model of offshore compliant structure
- large displacement under wave loads

Components of STM



Communication Channel is governed by

- 1) data rate
- 2) open space range
- 3) encoding reliability
- 4) bandwidth of RF

Recent advancements

wireless communication is preferred

- i) reliability of data
- ii) range of data

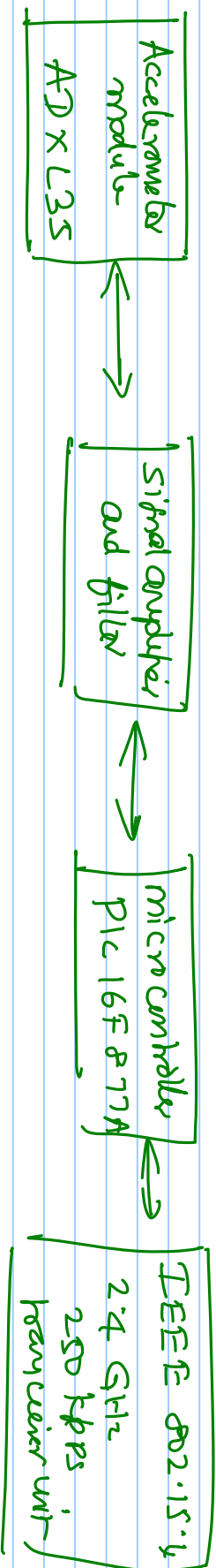
Wireless communication, over a large area, for sensor measurements

- may face issues related to

- interference
- path loss
- reflections

} vital parameters for
wireless sensor networks
(WSN)

Design of SHM system - I



Conceptual design - SHM-I

- Primary objective: - to assess the vital requirements & health monitoring of offshore compliant structures
- displacement - govern the design and not the member strength

failure may be caused

due to large displacements

(member level / local level)

but @ the global level
(system level)

rigid-body motion capturing

sensing & processing

- accelerometer — wired
- microcontroller unit
- wireless transmitter — transmission is wireless

Accelerometer : ADXL 335 - MEMS technology

- Output in voltage
- highly sensitive
- compact in size/shape
- digital - condensed voltage outputs
- It is poly-silicon, surface micro-machined device
- Adaptable to open-loop measurement architecture

range of the sensor $\pm 3g$

- model - exercises handling of sensor (aprior knowledge)

Micro-controller unit

- PIC 16F-1784
- This integrates logic storage memory & interface circuits
- Built-in module of 8-bit, high performance RISC CPU
 - 256 bytes of EEPROM data memory
 - 10-bit ADC
 - (2) timers to activate/deactivate the sensor (sleep mode)

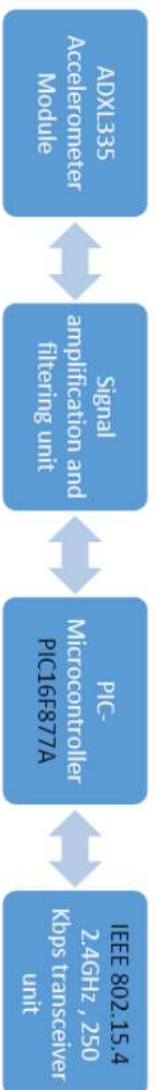
- Synchronized serial port, which is configured as SPI or I2C bus and UART
- PIC controllers are re-programmed so that they can use flash memory
- Microcontroller is used to process the acquired signal from the accelerometer module
 - Withstand high temperature variation

PLC microcontroller are not compatible with RS232 Module,

Hence MAX232 is used to convert

the TTL voltage level into RS232.

- Power is supplied by lead-acid, re-chargable battery
MR645, 6V, 4.5Ah - connected to 25V-1000
capacitor
- further connected to the transformer to receive power supply
- power supply is regulated (5V) using IC 7805.
- chip is located onboard, which is well protected by a hard cover



STM-1 ✓

- MC processing unit, located on board, performs pre-processing analog to digital output from the sensor
- processed data is then transmitted through wireless unit
 - wireless transceiver of 2.4GHz is connected to the computer, where no data loss is seen

When the distance b/w the sender node and the receiver increases, power consumption also ↑, proportionally

- In the present design, IEEE 802.15.4 ZigBee application is used for wireless communication
- Wireless receiver unit is connected to COM port of a PC through a serial USB converter

Scaled model -

Buoyant log storage & Repair, heat platform
(BLSRP)

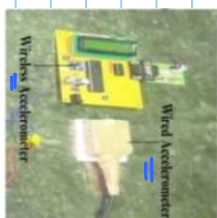
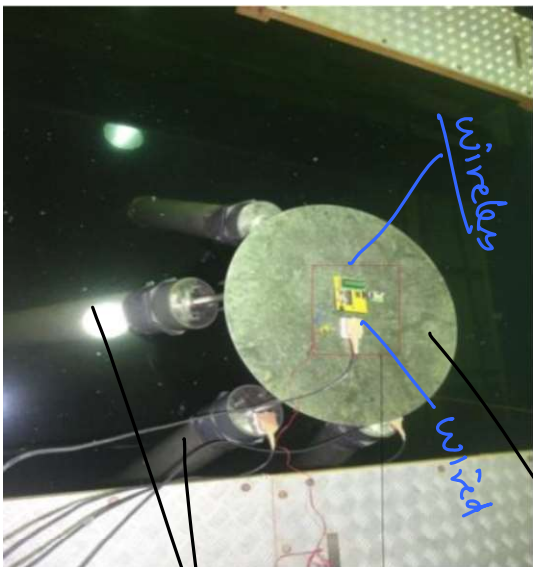
- Novel type of geometry

- used for LNG storage & processing (highly hazardous)

To understand the failure mode, a predicted failure is caused on the scaled model of BLSRP.

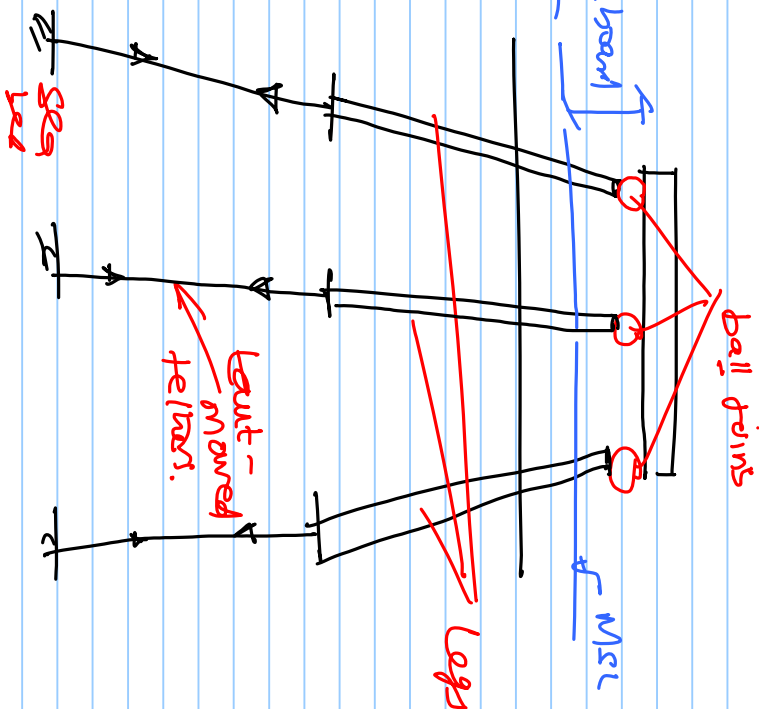
- BLSRP - is commissioned in the wave flume waves are added upon & repaired BLSRP. is measured (lots with wired/wireless)

deck (circular & shape)



⑥ legs - Buoyant legs

ball joints do not transfer rotations from legs to the deck
- partially isolates the deck



BLSP

- Wired sensor are connected to the DAD system through wires
- Data is further processed in the control server - DAD -
- Wireless sensors , micro controller unit MEMS Accelerometers
- Zigbee module

Acquired data from wireless sensor is transmitted via Zigbee module, which is connected to

the micro controller

- Control server receives the data transmitted by Zigbee module

- Measurements are taken using both wired/wireless sensors, is 11th.
- Bots of team are placed @ middle of the deck
- Model is excited by a regular wave (10cm wave height)
 - Wave period is varied from 1.2s to 2.0s.
- Data acquisition of bots wired/wireless are carried out simultaneously, without any time lag

Specifications of the accelerometer module

Accelerometer type	Wired B12/200 MEM Transducer	Wireless ADX L335
Max range	$\pm 200 \text{ m/s}^2$	$\pm 30 \text{ m/s}^2$
Sensitivity	80 mV/V	330 mV/g
Excitation voltage	$1.8 \text{ to } 3.6 \text{ V}$	$1 \text{ to } 5 \text{ V}$
Noise density	N/A	$300 \text{ Ng}/\sqrt{\text{Hz}}$

Summary

- STM design/layout - for lab-scale study
- Specifications of various modules present in the design

— STM-I

— STM-II

//