

**Structural Health Monitoring (SHM)**  
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**Lecture – 59**  
**Part - 1: SHM design – Part 1**

Friends, welcome to the 9th lecture in module 2 sorry module 3. Where we are going to extend the discussion what we had in the last lecture about SHM design and its suitability to offshore structures ok. We are going to discuss about that.

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I Components of SHM system

Hardware components of SHM system - 4 functional Modules

1. Sensor unit
2. Data acquisition unit
3. Computational core
4. Wireless communication channel

} ⇒ SHM system

Comments

(1) Commercially available hardware components will be used  
- technical details will be examined for  
its versatility, availability & cost

First let us see what are the components of a SHM design, Structural Health Monitoring system as applicable to any kind of structure, but our focus is related to offshore platforms at this moment.

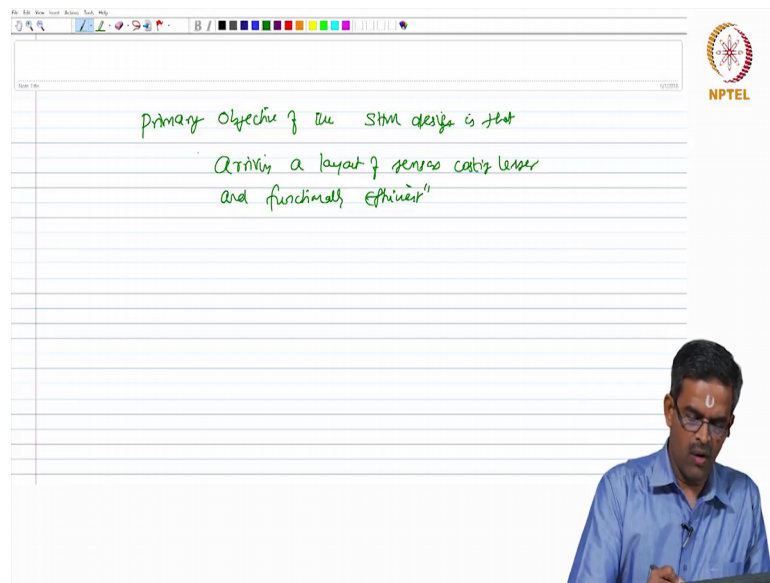
So, the hardware component of structural health monitoring system consists of 4 functional modules; one refers to sensor unit, second module refers to data acquisition unit, third module refers to computational core, and fourth module refers to wireless communication channel.

So, there are 4 modules which are going to design. We are going to see the characteristic of the design of these 4 modules, which is now going to a merge tool a SHM system which can be applied to offshore platforms. So, the most important commonness between

these modules; one in all the modules we are going to use commercially available hardware components ok.

The idea is not to make it custom design. But commercially available commercially available hardware components will be used that is the first condition we have. So, the technical details of these components will be examined for it is versatility, availability and cost I mean we are looking for different sub conditions, which need to be satisfied.

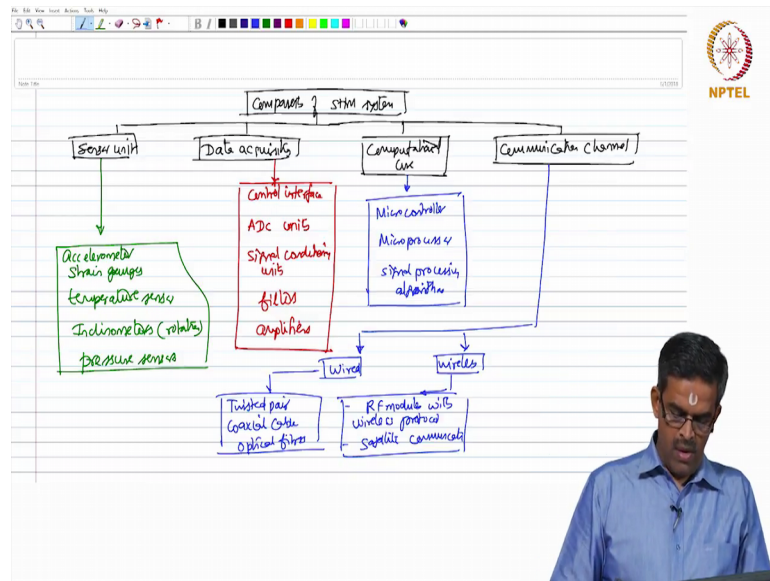
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primary objective of an SHM design is that it is a layout of sensors costing lesser and functionally efficient

Of their SHM design of the structural health monitoring design is that a layout of sensors, costing, lesser, and functionally efficient ok, that is the object.

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The components are structural health monitoring system into 4 basic modules, which comprises of sensor unit, data acquisition; computational core, and communication channel consists of 4 modules ok. Just now we saw that, because we need to measure the deck acceleration of the platform, we need to measure the strain to check the feasibility of permanent deformation in the material.

We need to also measure the temperature variation, because sometimes the fire sensors can also be used to raise an alarm of prospective fire in the platform temperature sensor we need to measure rotations. So, we need inclinometers to measure rotation I mean of course, the pressure sensors should to measure the stress. So, all this will comprise in the sensing unit control interface, analog digital converter units, signal conditioning units, filters and amplifiers.

The computational core microprocessor, signal processing algorithm, and the communication channel consists of 2 things. One could be for the wired, one could be for the wireless, for the wire we will have twisted pair of wires, we will have coaxial cable, and we will have also optical fibers.

As far as wireless system is concerned we will go for radiofrequency modules with wireless protocol, we will also enable satellite communication ok.

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(2) Sensing Unit

- fundamental blocks of system design
- sensor-based structural health monitoring
  - measure 2 quantities
    - i) kinematic (accelerations, inclination, strain & displacement)
    - ii) Environmental (temp, humidity, wind direction/speed etc)
- Wireless sensors are supposed to monitor both type of quantities
- It also enforces level of monitoring
  - offshore structures are massive
  - upto what level monitoring need to be done
  - extent, measurements are to be taken!

Now let us talk about each one of the modules separately let us start with the sensing unit of a system design. Sensor based structural health monitoring system measure 2 quantities; one is kinematic quantities, like acceleration, inclination, strain, and displacement.

The second will be environmental quantities; like temperature, humidity, wind direction and speed etcetera. Wireless sensors are proposed to monitor both kind of quantities. Wireless sensors are supposed to monitor both types of quantities. It also enforces level of monitoring why this is important in this case now offshore structures are massive.

So, we want to ensure up to what level monitoring need to be done. In sense up to what extent measurements are to be taken this is to be pre decided.

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Sensor technology - advancements are rapid

- sensors
- wireless - sensing unit
- smart-sensing units

Basic criteria

- (1) Capability to capture both local & system-level responses (extent)
- (2) Capability to acquire data in both consistent & retrievable manner for long-term data processing & analysis
- (3) Adaptability to operational conditions & environment

" sensors - are commercially available  
- cost is - production is massive

Sensors → Sensing requirements / Instrumentation capability → Match

Now, as we all agree sensor technology has advanced very forward or very rapid and smart sensing units.

So, one can use a combination of these based upon certain basic criteria. What is the basic criteria, which we must check before we do select these type of sensors; one we should check for the capability to capture both local and system level responses this is what we check as the extent of measurement. Second is capability to capture or to acquire data in both consistent and retrievable manner, for long term data processing in analysis.

Thirdly, we have to check the adaptability to operational conditions and the hostile environment (Refer Time: 12:15) by the, with all that we have a prerequisite. We must choose sensors that are commercially available in the market.

So, that the cost can be brought down if the production is massive ok, that is the idea. So, we need to match 2 cases 1 the sensing requirements 2 the instrumentation capability.