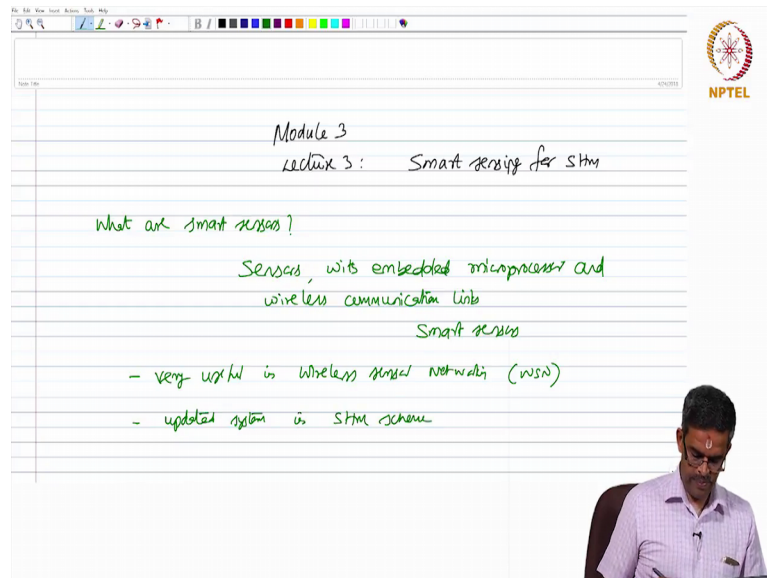


Structural Health Monitoring (SHM)
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Lecture - 48
Smart sensing for SHM - Part 1

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Module 3
Lecture 3: Smart sensing for SHM

What are smart sensors?

Sensors, with embedded microprocessor and wireless communication links

Smart sensors

- very useful in wireless sensor networks (WSN)
- updated system is SHM scheme

Welcome to the module 3, lecture 3; where we will talk about Smart sensing for Structural Health Monitoring. The first foremost question comes what are smart sensors? Sensors, with embedded micro process and wireless communication links are called smart sensors.

Smart sensors are very useful in wireless sensor networking. This is the most updated system in Structural Health Monitoring scheme.

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Advantages of smart sensors

- (1) Ability to continuously monitor the integrity of the structure in real time to provide improved safety to the public, particularly in case of aging structures (bridges)
- (2) Ability to detect damage at an early stage, which can reduce the cost of repair and also reduce the shut-down time of the structure

Let us ask another question. What are the advantages smart sensors?

It has an ability to continuously monitor the integrity of the structure in real time and can provide improved safety to the public, particularly in case of aging structures. For example, let us say bridges.

The second advantages; it has an ability to detect damage at an early stage, which can then reduce the cost of repair and also reduce the shutdown time of the structure.

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(3) It is helpful in predicting/observing initiation of damage

- (a) any other undesirable behavior of the structure (settlement of supports, fatigue formation etc)
- (b) They can be helpful to generate advance warning of removal of the structure to maintain it inoperational due to safety regulations

- It can prevent serious disaster, structural damages

Thirdly, it is helpful in predicting or observing initiation of damage or any other undesirable behavior of the structure. For example, settlement of supports, fatigue formation etcetera.

Therefore, they can be helpful to generate advance warning of removal of the structure or making it in operational due to safety regulations. So, essentially it can prevent serious disasters which are actually structural damages.

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Smart sensors - wireless

- In conventional wired sensors
 - many of wires
 - fibre optic cables or physical transmission medium
 - may become a serious issue for long-span bridges or tall buildings
- wireless sensors
 - have low cost and densely distributed network

Now, smart sensors more or less are wireless. Let us compare them with wired sensors. In conventional wired sensors there are many number of wires. Sometimes there can be fibre optic cables or physical transmission medium which may be a problem; becomes a serious issue in case of long-span bridges or tall buildings.

On the other hand, wireless sensors have low cost and densely distributed network.

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rapid advances - wireless sensors

- wireless communication
- micro-electro mechanical system (MEMS)
- Advanced information technology to enhance SHM quality
- sensors are also available with
 - self-calibration
 - self-diagnosis capabilities

There are rapid advances which happened wireless sensors like wireless communications, micro-electro mechanical systems which is MEMS. People also use advanced information technology to enhance the structural health monitoring quality. Sensors are also available nowadays with self calibration, self diagnosis, capabilities.

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Sensors have 3 components

- (1) sensing element: resistors, capacitors, piezo-electric module, photo diode etc.
- (2) signal condition & processing: amplifiers, linearizers, compensators & filtering
- (3) sensor interface: wires, plugs, sockets to communicate with other electronic components

If you look at the architectural design of sensors; essentially sensors have three components. Namely, the sensing element, signal condition and processing and the third

component is a sensor interface. Sensing element essentially consists of a resistor, a capacitor, a piezo-electric module and photo diode etcetera.

Signal conditional processing consists of amplifiers or amplification, linearization, compensation and filtering. Sensor interface consists of wires, plugs, sockets to communicate with other electronic components.

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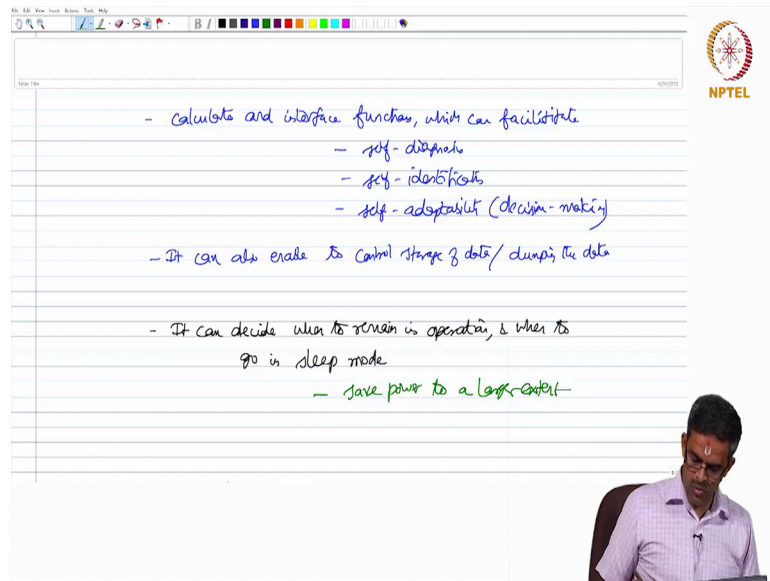
Essential difference b/w
Smart sensor and the Conventional sensor

- Smart sensors have micro-processor on board
- which makes them intelligent
- Microprocessors can perform the following functions
 - digital processing
 - analog to digital converter (ADC) or
frequency-code converter

So, there is an essential difference between the smart sensor and the conventional sensor. Let us see what is the difference? The essential difference is smart sensors have micro-processor on board, makes them intelligent. Let us see how?

Microprocessors can perform the following functions, digital processing, analog to digital converter ADC or frequency-code converter.

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- calculate and interface functions, which can facilitate

- self-diagnosis
- self-identification
- self-adaptability (decision-making)

- It can also enable to control storage of data/ dumping the data

- It can decide when to remain in operation, & when to go in sleep mode

- save power to a large extent

They can also calculate and interface functions which can facilitate self-diagnosis, self-identification and self-adaptability; that is they can be also useful to some extent on decision making. It can also enable to control storage of data or dumping the data.

More importantly, it can decide when to remain in operation and when to go in sleep mode. So, this can save power to larger extent. So, presence of micro processes makes the sensor intelligent in many ways.