

Vibrations and acoustics


9. Structural Health Monitoring

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1

1

What is structural health monitoring (SHM) ?



It is a tool to assess the current and future state of health (condition) of a structure

Why do we need SHM ?

- Because of the aging of expensive and critical structures (airplanes ...)
- In order to reduce the costs (life and money) associated to current practice

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What is the current practice to assess the condition of structures ?

- Scheduled maintenance
- Visual inspection techniques



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What is the current practice to assess the condition of structures ?

Local inspection techniques



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Main problems associated to current practice

- Risk of failure between two maintenances
- High costs
- Structure cannot be used while inspecting
- Difficulty to detect damage that is not visible



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What is the vision for SHM in the future ?



- Large sensor networks
- Embedded intelligence
- Autonomous health monitoring

From www.eads.net

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What is vibration based SHM



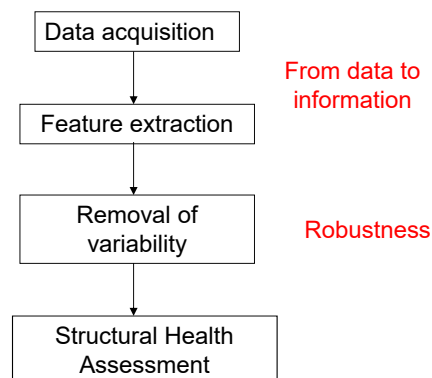
Damage
=
Change in the vibration characteristics

- Advantages :
- Could detect hidden damage
 - Permanent monitoring
 - Low-cost, global method

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The different steps in SHM



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An example : off-shore wind turbine monitoring

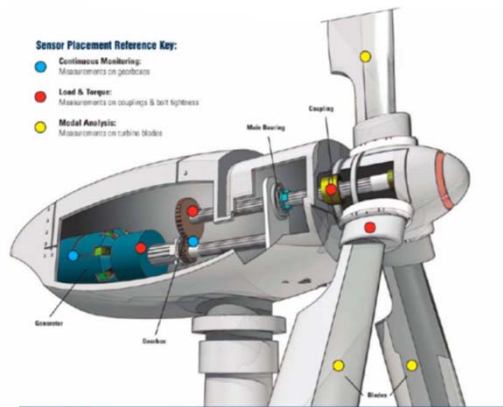


- Ambient vibrations : wind, waves
- Permanent monitoring, real-time data streaming

9

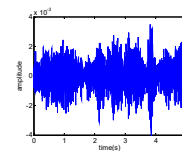
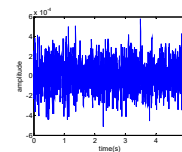
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Data acquisition



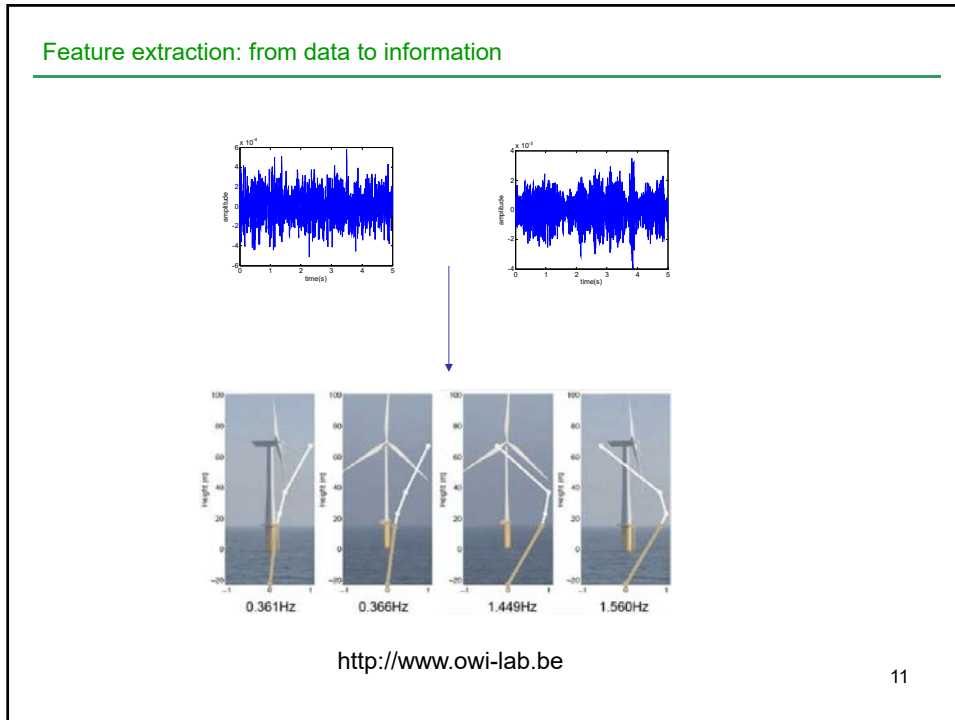
2 IMI SENSORS A PCB PIEZOTRONICS DIV Complete specifications available at www.imi-sensors.com

Filtering (anti-aliasing)
→ AD conversion
Denoising
...

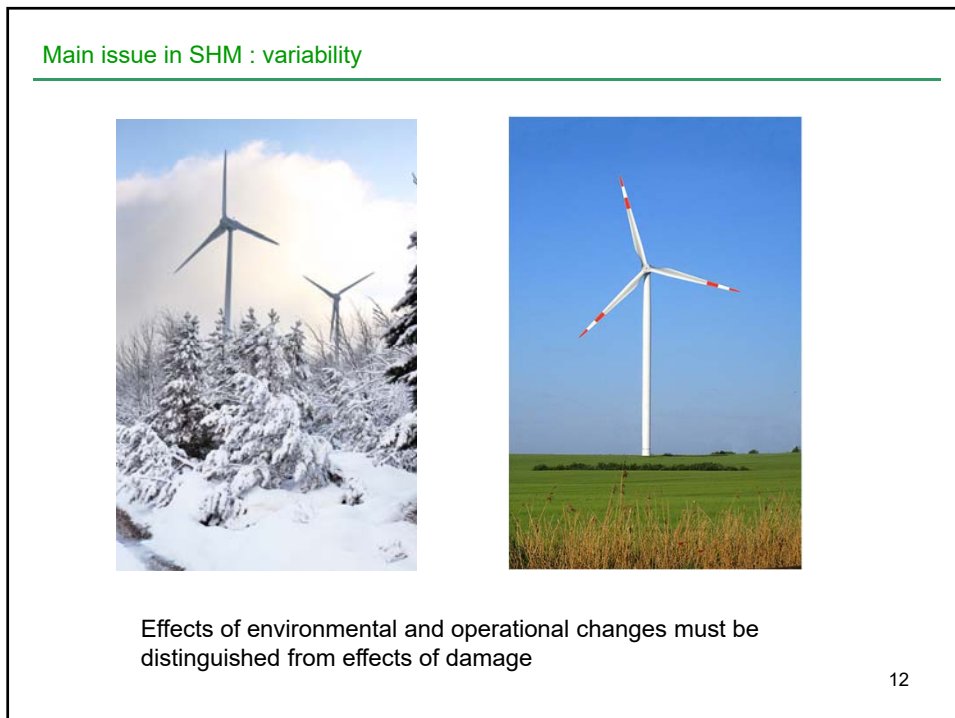


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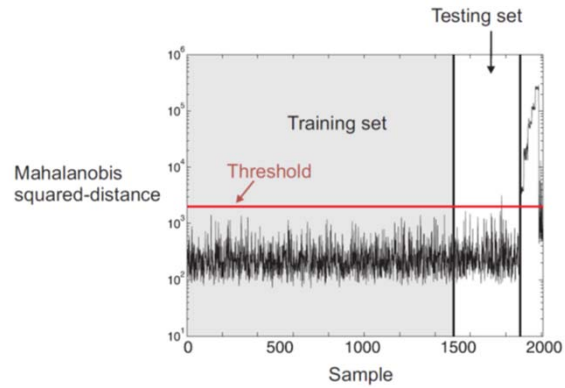


12

Structural Health Assessment

- The four levels of SHM :
- damage detection
 - damage localization
 - damage quantification
 - residual lifetime estimation

Example of level 1 control chart



13

13

Aircraft health monitoring



https://www.youtube.com/watch?v=bSbReXT_bBs

14

14

Example of an SHM system



<https://www.youtube.com/watch?v=sMMMxib-yWc>

15

15

Example of an SHM system



<https://www.youtube.com/watch?v=4Lo9-W3sVmE>

16

16

Example of an SHM system



<https://www.youtube.com/watch?v=nE7AxPzOst8>

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17

Example of an SHM system



<https://www.youtube.com/watch?v=UbmToxTI7gs>

18

18

Example of an SHM system



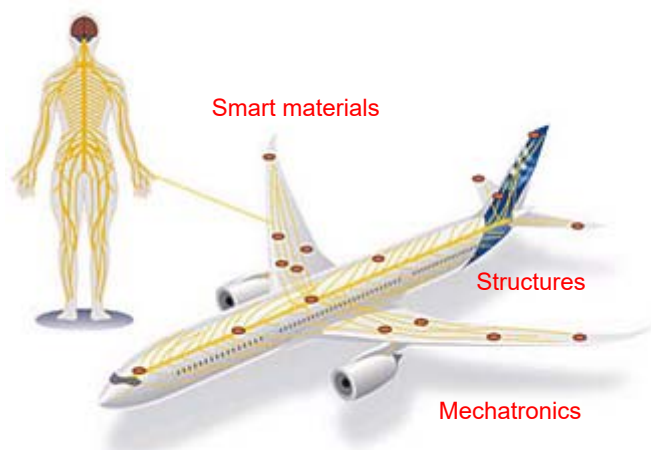
<https://www.youtube.com/watch?v=aKcDBg8c4hk>

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Conclusion

A dream for the future ?



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