UNIVERSITI TEKNIKAL MALAYSIA MELAKA

OPENCOURSEWARE

BETM 3583

Vibration Analysis and Monitoring

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Contents

1. Introduction to Vibration Analysis
   - Definition and Importance
2. Time Domain Analysis
3. Frequency Domain Analysis
4. Modal Analysis & Random Vibration

Learning Outcome

1. Understand the importance of vibration analysis and monitoring
2. Understand and apply the techniques of vibration monitoring system

Introduction of Vibration Analysis

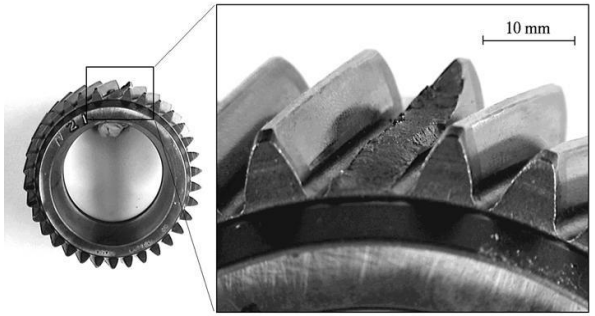
What is Vibration Analysis and Monitoring ?

- Basically, it is a maintenance tool
- Part of Condition-Based Maintenance (CBM)
- Also applied in quality control, process monitoring, etc.

Introduction of Vibration Analysis

Why is it important ?

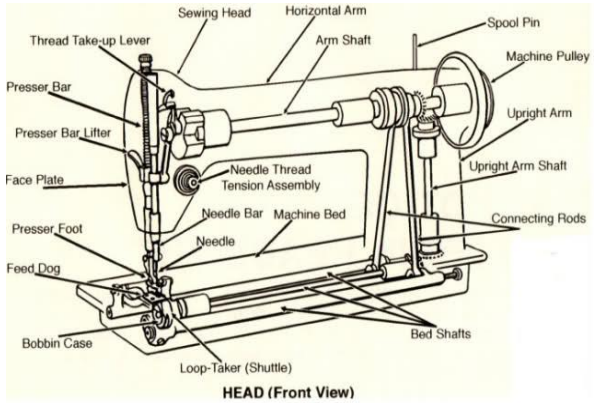
- As importance as maintenance in a machinery
- To avoid Failure
- To diagnose / prognose a machinery condition



Introduction of Vibration Analysis

Maintenance Strategies – A Review

1. Run to break
   - Traditional way
   - Running machine until broken
   - The longest time between shutdown
   - Catastrophic failure
   - Repair time & Cost increase
   - Small machinery



Introduction of Vibration Analysis

Maintenance Strategies – A Review

2. Preventive (Time-based) Maintenance

- Regular intervals
- Time between failure
- Can be planned well in advance
- Excessive number of parts replacement
- Sometimes replacing good parts

Introduction of Vibration Analysis

Maintenance Strategies – A Review

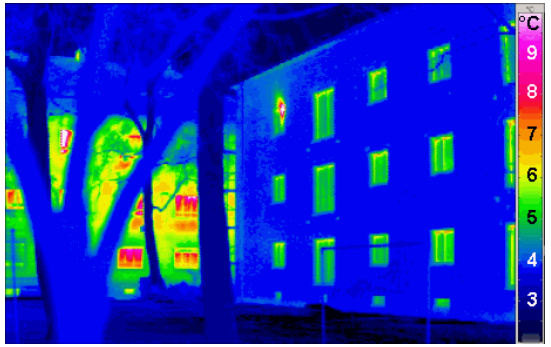
2 Condition-based Maintenance (CBM)

- Also called as ‘Predictive Maintenance’
- Regular monitoring
- Maintenance in optimum time
- The best maintenance strategy
- Suitable for ‘long period operation’ machine
- One of the technique : Vibration based

Introduction of Vibration Analysis

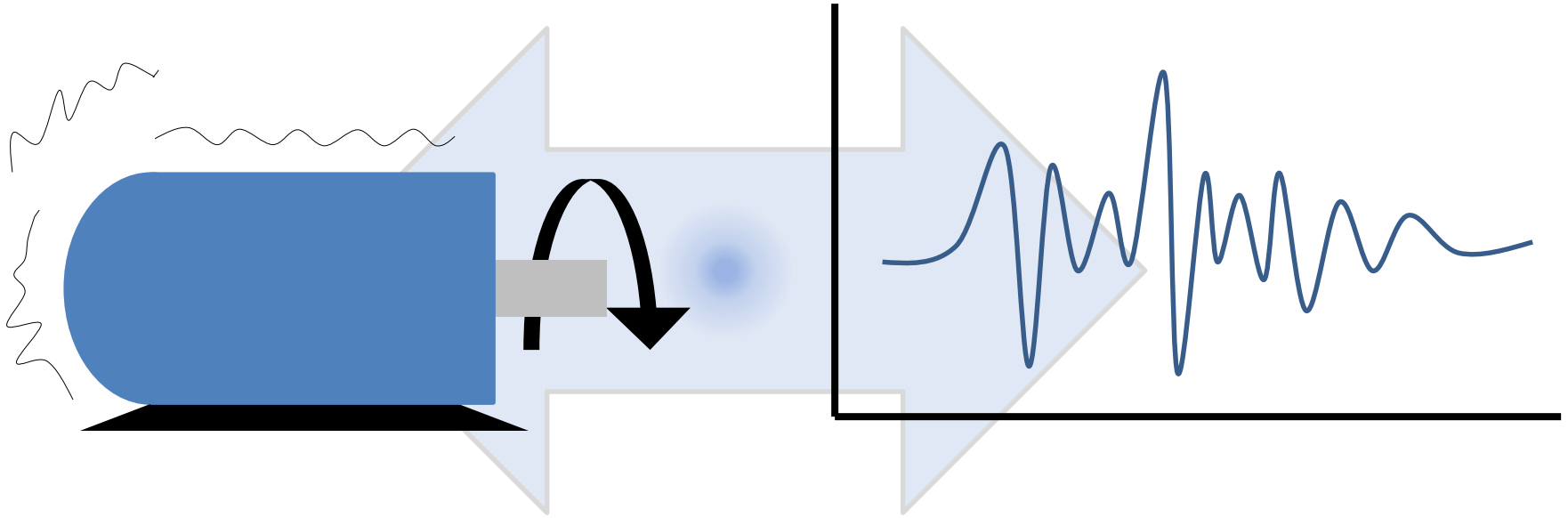
Condition Based Maintenance

1. Vibration Based
2. Oil Analysis
3. Thermography
4. Etc.



Introduction of Vibration Analysis

Vibration Based Maintenance

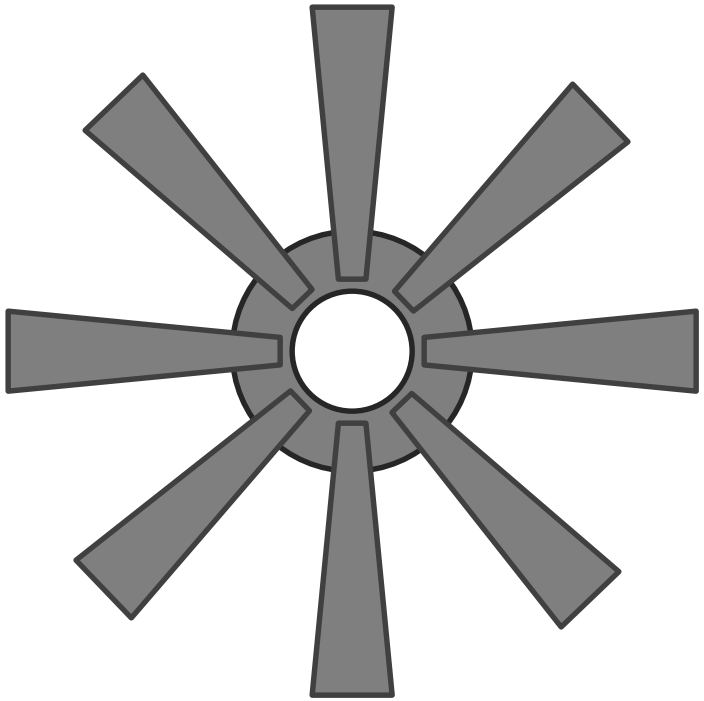


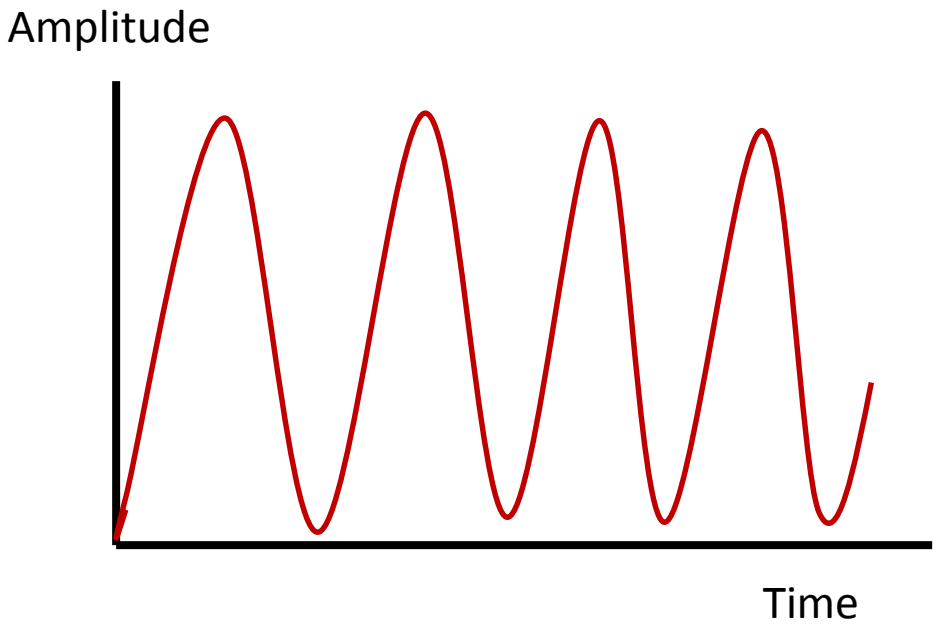
Time Domain Analysis

- Time waveform : electrical signal time history obtained from vibration sensor
- Trace of voltage changes
- Graphed with time
- A view how the machine is vibrating over time

Time Domain Analysis

Fan Blade





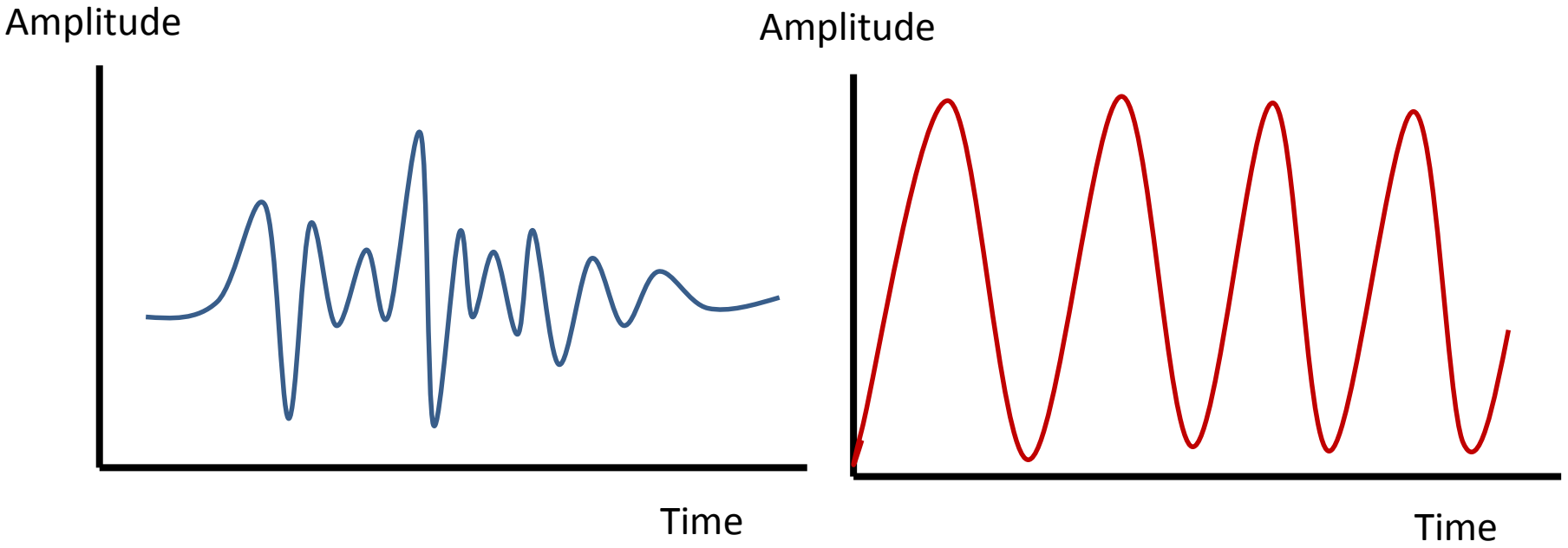
Time Domain Analysis

The centrifugal force is transferred from the fan blade to the bearing at the shaft

Vibration sensor catch the vibration signals at the bearing

This movement in a periodic motion is called as : Simple harmonic motion i.e. Sine Wave

Time Domain Analysis



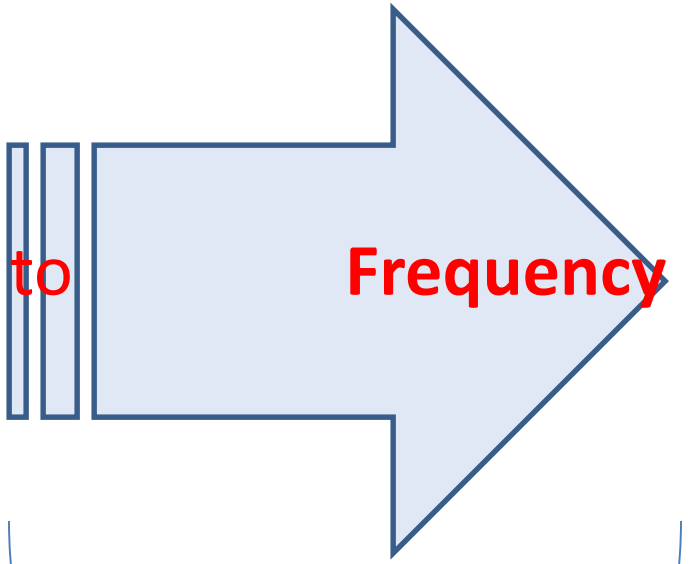
Sometimes, time domain is not enough for analysis and monitoring, despite it already gives many information

Frequency Domain Analysis

Analysis that is based on Frequency Spectrum

Transformation from

Time Waveform to **Frequency Domain**

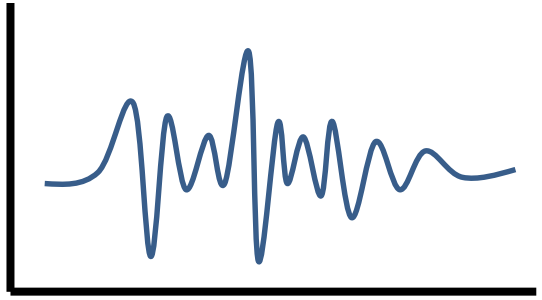


Fast Fourier Transform

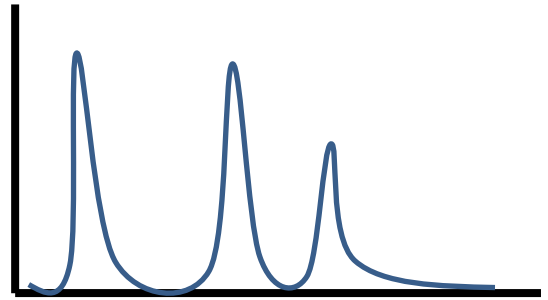
Frequency Domain Analysis

Time Waveform to **Frequency Domain**

Fast Fourier Transform



Time



Frequency

Frequency Domain Analysis

Frequency Domain →

1. Very useful for diagnostic purposes
2. Also be used in communications, geology, remote sensing, etc.

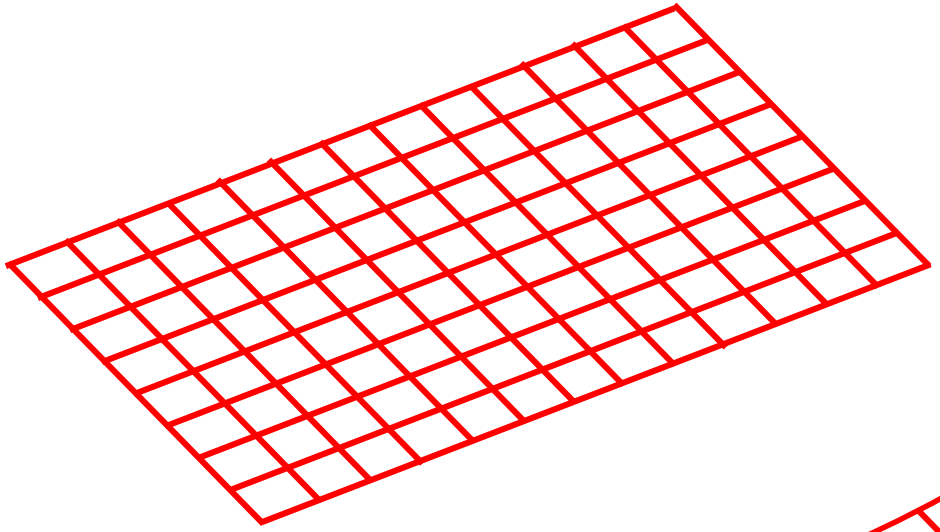
Modal Analysis & Random Vibration

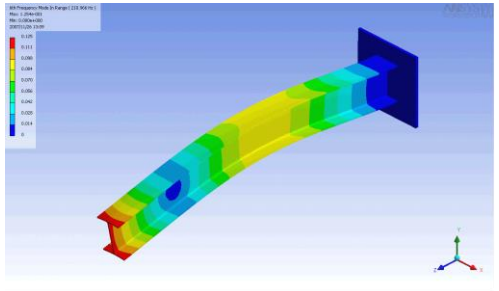
Modal Analysis :

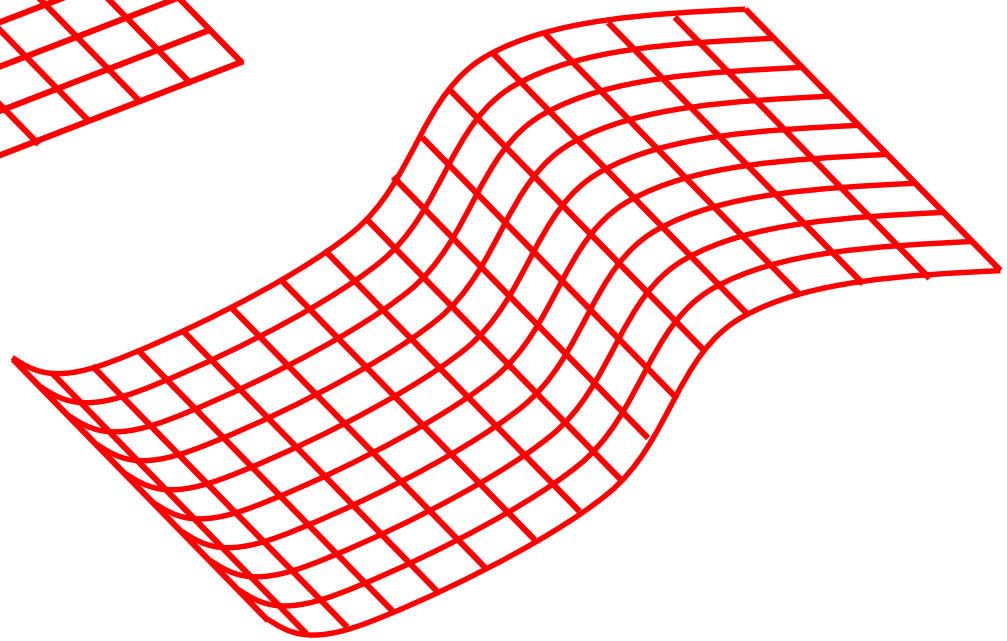
Study of the structural dynamic properties under vibrational force or excitation.

Modal Analysis & Random Vibration

Modal Analysis : Plate Vibration







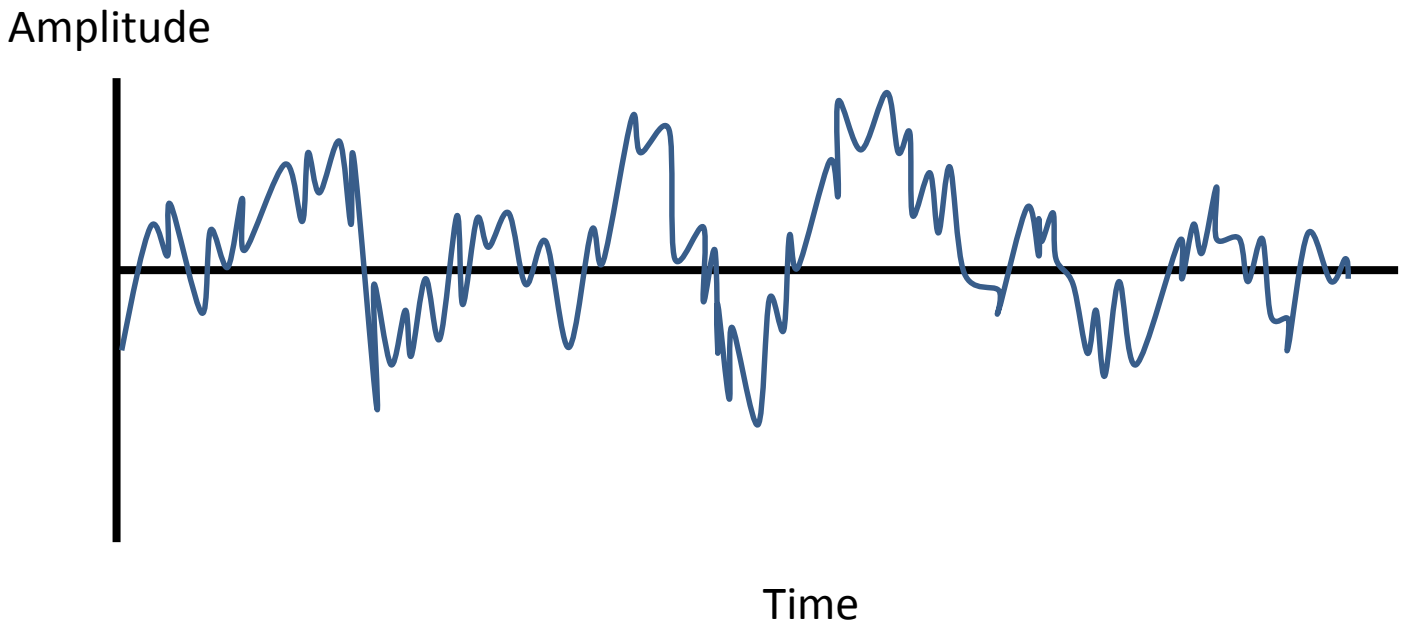
Modal Analysis & Random Vibration

Random Vibration

In some cases, vibration motion is often non-deterministic, which can be said that future behavior can not be accurately predicted.

Modal Analysis & Random Vibration

Typical Random Vibration in Time Domain



Modal Analysis & Random Vibration

Vibration in modeling → Simple harmonic motion

Vibration in practice → Random vibration

Thank you

Q n A