CONDITION BASED
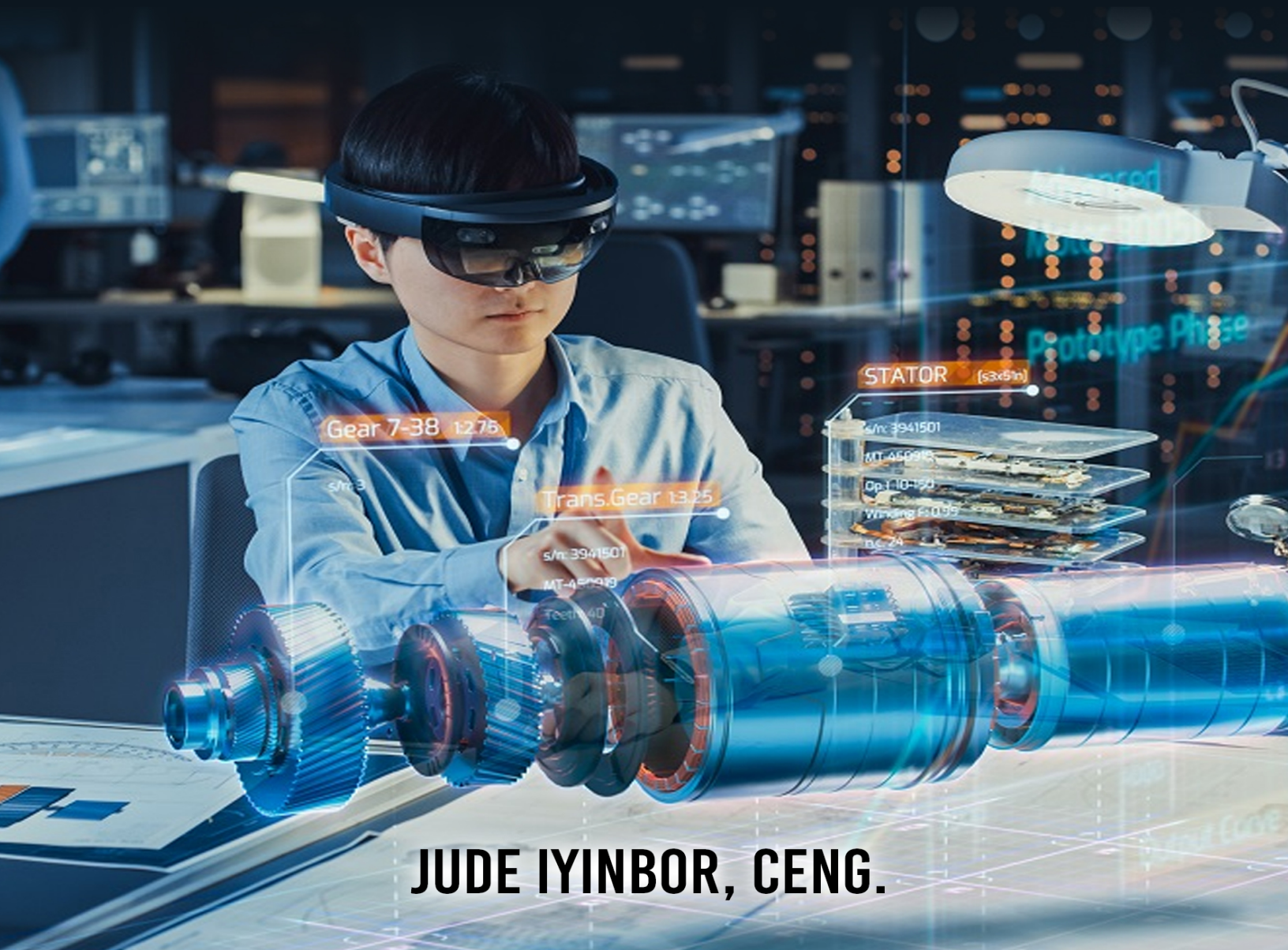
MAINTENANCE

Purpose of Vibration Analysis

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Condition Based Maintenance:
Purposes of Vibration Analysis By: Jude Iyinbor, CEng.

Introduction

Vibration analysis is the interpretation of vibration data (overall trend readings, spectral content, time waveform, orbit plots, etc.) to tell the health status of primarily rotating machinery without carrying out any intrusive or invasive checks. Vibration analysis is often seen as a Predictive Maintenance technique that is used to ascertain the operating and mechanical health condition of rotating machinery.

This technique has been around for decades and is still one of the most effective ways to detect and quantify impending mechanical defects in rotating equipment. This helps to avoid catastrophic in-service failures and keep equipment reliability and production bottom-lines as high as possible.

Purposes of Vibration Analysis

Vibration trends and signatures are effects that are caused by machine conditions. Given the useful information that is contained in vibration data, its analysis can be carried out for the following three purposes:

Detection

Vibration analysis can be used to detect developing machinery problems prior to them becoming severe issues resulting in unscheduled downtime. This can be done by carrying out regular periodic vibration monitoring of equipment under normal operating conditions. If done correctly, periodic vibration monitoring can help detect changes in a machine's health such as impending defective bearings, worn or broken gears, worn impeller blades, shaft misalignment, fan unbalance, mechanical or structural looseness and electrical motor problems just to mention a few.

Diagnosis

When a hint or abnormal behavior confirms that something is not right, we can't tell what the problem is. This is where diagnosis steps in. There are certain cases where a problem has been noticed through unusual noise or from a change in vibration trend, but without the ability to specifically pinpoint the actual problem. Vibration analysis is excellent for diagnosis of machinery faults. This can involve setting up more advanced data acquisition techniques and in-depth analysis of spectral content to conclude on the specific problem and the associated severity. You should have periodic vibration data collection established to monitor for trends and gradual changes, then follow up with the tools and expertise to diagnose the nature of the changes detected. Using diagnosis alone without the availability of historical trended data can be challenging. Late diagnosis or troubleshooting could also imply that a considerable amount of damage has already occurred.

Validation

Validation is the process of verifying that a machine overhaul or repair was done correctly. This is one of the least used purposes and a lot of programs miss out from the benefits of validation. This is also viewed as an acceptance test to make sure repairs have been done properly. For example, if a machine was diagnosed with damaged bearings and recommended for replacement, vibration analysis following replacement should show that any defect frequencies present before overhaul would be gone. Additionally, in many industries where planned shutdowns for turnaround maintenance or periodic out-of-service maintenance events are performed to overhaul all machinery (or bad actors), this approach of using vibration analysis to validate work is very useful. From experience, a lot of overhauls have been rejected and repeated until analysis of vibration data can validate that a proper job has been done. This has demonstrated tremendous value and helped many operators to increase ROI.

Benefits of Vibration Analysis

Vibration analysis can be used to significantly improve the reliability of rotating equipment and avoid sudden in-service catastrophic failures. Plus, when used as a part of an overall maintenance strategy program, it maximizes ROI and increases overall efficiency by better channeling time and effort.

Vibration analysis can be used as a:

- Source of information for safe machinery operation.
- Tool for detecting changes in machine health condition and diagnose the cause and severity of a change.
- Validation of corrective actions and overhauls after planned turnaround or out-of-service maintenance events.
- Method to identify improper maintenance and operation practices such as
  - Improper bearing installation, inaccurate shaft or pulley alignment, imprecise balancing, or incorrect electric motor overhaul.
  - Operating a machine out of its design specification like operating centrifugal pumps out of their performance curves.

Vibration analysis also helps to:

- Reduce preventable unplanned machinery downtime.
- Avoid costs associated with sudden failures.
- Avoid infant mortality (i.e., early machine failure and mediocre performance) due to unnecessary intrusive maintenance techniques.
- Ensure the use of quality data to make better maintenance decisions.
- Maximize component life by providing data to support extending time intervals between service overhauls.

Brain Teasers: Check your Comprehension

Q1: Which one of the following is grouped as a purpose for vibration analysis?

(A): Detection (B): Repair (C): Blaming team members

Q2: Which one of the following is described as the least used purpose of vibration analysis? (A): Diagnosis (B): Detection (C): Validation

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