Introduction

Our main purpose has been developing an on-line structural health monitoring system based on VCM for already operating Francis turbines in a hydro-power plant. Vibration Condition Monitoring (VCM) is about monitoring a plant’s vibration in order to understand plant’s structural health at a time. It monitors the plant real-time to predetermined upcoming faults in the system.

Objectives

- Obtain natural frequency of structure
- Give warning/critical damage by detecting
- Develop a software
- Train a machine learning model

Damage Identification Levels

Level 1: (Detection)
- Giving a qualitative indication that damage is present with a probability

Level 2: (Localization)
- Locating the position of a damage

Level 3: (Assessment)
- Informing on severity of a damage

Level 4: (Consequence)
- Informing about actual health and safety condition of a structure given the damaged status

Methods

Short-time Fourier transform (STFT) is a time-frequency method which is used to condition monitor rotating machines. STFT method can provide more information about a signal in both time and frequency domains. Therefore, STFT gives a better representation of the signal than the conventional methods in machine condition monitoring.

Methods (contd.)

The basic idea of the short-time Fourier transform is that if one wants to know what frequencies exist at a particular time, then take a small part of the signal around that time and analyse it, neglecting the rest of signal. Compared to FFT, STFT illustrates use both time and frequency domains at the same time.

Furthermore, STFT improves the frequency resolution and time resolution. By providing this it helps us to examine the results more efficiently.

Encountered Problems

In our data, sampling time was 1 second (1Hz). When we converted time domain data to frequency domain we were only able to observe between 0–0.5 Hz frequency range because of the 1 second sampling time. To have a better understanding of frequency domain, we need to have a wider frequency range (up to 50–Hz). The reason for this is that vibration data was taken from a turbine working at 333 rpm (5.55Hz). Hence our interest was in multiples of this natural frequency; where we expect large harmonic oscillations. Therefore, we should have obtained wider frequency range to analyze the data.