Application of Dynamics Modal Testing Fun Kart Chassis

M.S.M SANI & N. NUBRA

ABSTRACT

This paper focuses on the experimental modal testing on the structure of fun kart chassis being a bit jumpy. If the structure like chassis is excited at the same value of natural frequency, resonance could occur and damage the structure. Thus, it is important to observe the mode shape and values of natural frequencies. Mode shapes, frequency resonance and damping factor are parameters that can be obtained through modal testing experiment. Two methods of performing modal testing were applied for the purpose of results comparison. The methods were roving impact hammer test and random excitation shaker test. These methods were performed in all three axes X, Y and Z to gather response signals from the chassis structure. Data analyzer was used to convert the response signal from the sensor which was in time domain to the frequency domain. These data were exported into ME' Scope VES as Frequency Response Function (FRF). From the FRF graph, the frequency range of interest was set to select the first four peaks in the FRF graph. These peaks were later simulated in ME' Scope as a mode shape of the chassis structure. The values of other parameters were recorded which came together with the simulation. Interpretation and comparison were made for both methods based on the results

Keywords: Natural frequencies, Mode shape, ME' Scope VES, Modal Analysis

INTRODUCTION

As time goes by, the improvement in technology grows larger, more advanced and sophisticated. Long before the first car was invented, people used horses and trishaws as their main transportation and never imagined that one day they could travel anywhere in a machine powered by fuel and engine. When cars were widely used and desired by the people in early 50's, that was the moment of a new era in the history of the vehicle whereby go-kart was first introduced to the public as a vehicle used not for transportation but for sports. In just over 40 years, go-kart has evolved and was well known all around the world. Nowadays, almost every country has manufactured their own go-kart for domestic market as well as abroad. When go-kart was first invented over 40 years ago, analysis on the chassis structure had already begun and became more advanced until today. This analysis continues not just for safety and stabilization but to enhance the properties of the structure. The method of analysis most popular type applied these days is the experimental modal analysis or modal testing.

Hence, this paper is focused on the procedures of implementing modal testing on the chassis structure as well as comparison of the results obtained from two different methods of testing. The first method was roving hammer impact test using impact hammer to excite the structure. The second method was random excitation using modal exciter or shaker for excitation. For each method, data was gathered in three directions or axes. At the end of the research, all modal parameters such as mode shape, natural frequencies and damping factor were compared for both methods.

MODEL DESCRIPTION

The first thing done was locating 27 impact points or degree of freedom (DOF) on the chassis structure. Then the radius, length and width of the chassis structure were measured for the purpose of designing it in Solid Works 2004. The drawing in the solid works software include the chassis structure and the location of the DOFs. These 27 DOFs were used to gather data and represent the modal parameters of the structure.

MODAL TESTING

As mentioned in the previous section, two methods were applied in this research. The first method was random excitation shaker test and the second method was roving hammer impact test. The chassis structure was hanged in the rig frame which was designed and fabricated to support the chassis structure during the experiment. Figure 1 shows the drawing of the rig frame in solid works before it was fabricated.

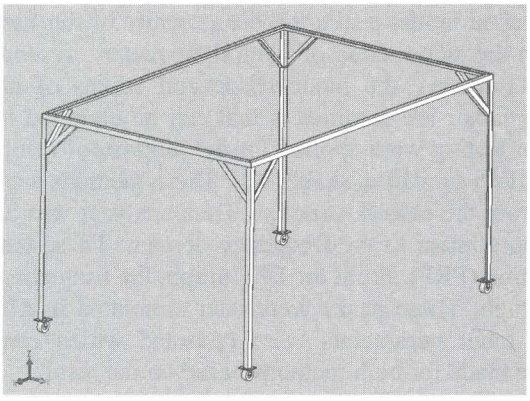

Figure 1: Test Rig frame

RANDOM EXCITATION SHAKER

For this method only accelerometer is moved from one point to another but the excitation point remains the same. The first experiment was conducted for z axis. Figure 2 shows the setup for this method whereby the position of the shaker was in z direction.

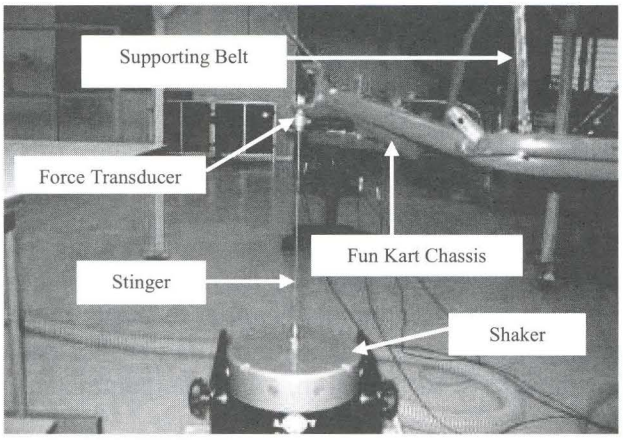

Figure 2: Location of the exciter in z direction

For the experiment to begin, laptop, data analyzer and amplifier were all switched on. Then, the amount of current and voltage supplied to the shaker was set on the amplifier. For this experiment, it was 3.5 A and 0.7 V respectively. Using amplifier, the voltage and current were set to the value as stated above to vibrate the shaker. Sensor or accelerometer was stuck on the impact point using wax. The shaker was set to vibrate at 1000 average rate. This means, the sensor will measure the response signal of the point and send the data to data analyzer until the shaker reached the average rate of excitation which was 1000 times. Finally, on the laptop screen, it was observed that there are FRFs and coherence graphs for the point being measured.

The same process was repeated with all the 27 DOFs. All the data from 27 DOFs were combined and saved as binary file which was one of the universal file formats (.uff). In ME' Scope this file is known as Data Block file. The procedures were repeated for another two exes which are X and Y. The only difference was the change in position of the shaker according to the axis being measured. Figure 3 and 4 shows the location of the shaker for X and Y axes.