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Editors:

*Dr Aidatul Fadzlin Bakri, Nurzafira Zainul Abidin, Sr Dr Noor Akmal Adillah Ismail,
Dr Har Einur Azrin Baharuddin, Assoc. Prof. Ts Gs Dr Abdul Rauf Abdul Rasam*



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Vibration Simulation & Analysis Teaching Tool (VSATT): An Interactive Learning Tool Based on MATLAB Simulink and GUI

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INTRODUCTION

The use of a Graphical User Interface (GUI) as an interactive teaching tool has been increasingly popular in many areas of study. A MATLAB-GUI program as a teaching tool in engineering courses would not only improve the learning experience but could also improve student understanding of the subject itself. An example of a simulation of a Single Degree of Freedom (SDOF) forced vibration system is given to demonstrate the role of all the different parameters of the model, so students can get a real interactive experience.

PROBLEM STATEMENT

The current practice of teaching involves mainly visual and auditory stimuli, where lecturers present the concept to the student during lecture sessions. In passive learning settings, students sit in lecture halls and take notes whilst listening to the lecture.

The use of GUI in learning enables an active learning setting where students can develop higher-order critical thinking and analysis skills. This is because active learning requires students to engage in meaningful activities and think deeply about the concepts they're learning. It is believed that when students engage in active learning, they are more likely to retain what they've learned.

OBJECTIVES

To address this issue, the current program Vibration Simulation & Analysis Teaching Tool (VSATT) was developed and introduced to promote interactive learning environment for better understanding of the forced vibration problems.

This simulation could analyze and display vibration behavior under various conditions as input by users (students). The simulator would allow the user to test different input parameters and observe how this would affect the respond behavior. Also, the introduction of VSATT could offer a different learning experience to students.

METHODOLOGY

VSATT is a MATLAB Program (R2017b, The MathWorks, Inc) execute-file, which was developed as a teaching tool for the Vibration course (MECS21. This course is enrolls by semester5 students (third year).

Using this tool, the student able to simulate two cases simultaneously to observe the difference in displacement behavior due to parameter changes. The GUI can also be applied potentially in research as researchers can make quick assessments and calculations of conditions. The emphasis is given for the program to practical applications and potential situations for its use. The GUI development also emphasizes on ease of use, neat visual appearance and fast computation time to ensure successful content delivery.

NOVELTY

VSATT is a newly developed MATLAB-based program which could calculate accurately the displacement over different initial parameters. The program will be used during the teaching and learning sessions for the third chapter in the course Vibration (MECS21).



DETAILS OF PRODUCT

The tool consists of two sections which are Simulink block diagram, GUI and m-file programming. Using this tool, students are able to learn the time response behavior and observe the effect of parameter variation of vibration element such as mass, spring and damper as it can be repeated several times.

Table 1: Special Feature of VSATT

Simple and easy to use	The program is employing an analytical approach (exact solution), with direct input and can produce results with good accuracy. The interface has been constructed to be user-friendly. The choice for inputting parameters includes an editable text area, a drop-down menu, and click on buttons.
Concurrent results for on-the-spot comparison	The basic program provides the possibility for the user to change parameters and observe how different parameters would affect the respond of the vibration system
Visual representation	The visual representation of displacement offers the user a better understanding the respond of the vibration system.
Easy for Editing	The program could be edited to include new and/or remove current parameters/components.
Interactive and Exciting Learning Platform	The real-time outputs, graphics and interactive environment will allow the users (students) to involve in active learning. Therefore, the students could understand better the forced vibration problems, as they themselves input the variables and then visualize the response immediately.

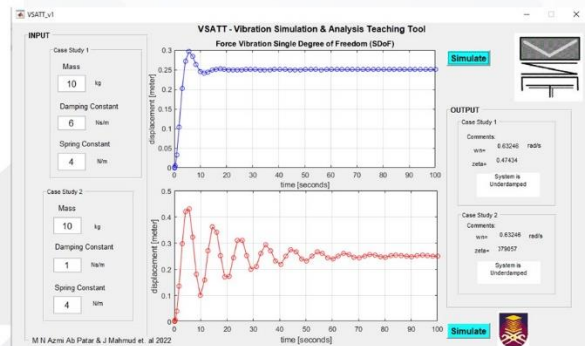


Figure 1: VSATT GUI upon execution

POTENTIAL FOR COMMERCIALIZATION

We focuses on industries related to plants, machinery, equipment, system and structure that experience vibration. The general target are Oil & Gas, automotive, aerospace and manufacturing industries. In addition, VSATT can also be promoted to the Training and Consultation companies.

For commercialization, VSATT is ready to be commercialised, either as it is (VSATT interface, execute file) or with the option for an upgraded/ customised program.