

TVET: Application of SolidWorks and Simulink in 2 DOF Simple Quadruped Robot Modeling

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ABSTRACT

TVET introduced to produce skilled human capital as skills are essential for poverty reduction, economic recovery and sustainable development. Among the things that can give added value to engineering students are their skills of using available software to develop 3D models and implement the simulation. The objective of this paper is to develop 3D Model of 2 DOF quadruped robot and analyze the performance through simulation. The process undertaken to simulate the robot is explained starting from the use of SolidWorks to build the 3D model, SimMechanics to export the model to Matlab till Simulink is applied for robot movement analysis. It is found that simple quadruped robot with 2 DOF movement successfully simulated. The result from this result shows a method of 3D simulation can help students in the development of an engineering project in which they will get an idea about the project carried out early on.

INTRODUCTION

Simulation has long been used as one method to analyze a system [1]. There are various types of software that can be used, starting from the software to build up a 3D model to software that can analyze the system performance. However, the utilization of this software among engineering students in the polytechnic is still lagging behind.

In addition, the use of simulation software also helps in the teaching process [2, 3]. Students may be fed up with the old method of learning where notes and textbooks are used to describe related theory about robot. By using the specific software, students will not only enable to observe the virtual robot, but robot's 3D model can be build according to their creativity.

This paper describes the development phase taken in applying two renowned software solutions to simulate simple quadruped robot which are SolidWorks and Matlab Simulink. The next section reviews some of the current ideas

and techniques used in implementing robot simulation. Then, 3D robot modeling and simulation setup will be explained in two sections before show some results obtained from the research. The last section provides a review of the tasks completed and offers suggestions to possible future work.

RELATED WORK

Just about every engineering fields use and benefit from computer simulation including robotics. There is research that using Matlab/Simulink and Matlab/Virtual Reality [4] to simulate four degree of freedom robot. The CAD models of the robot firstly design in SolidWorks. As a result, dynamic behavior of the robot enabled to simulate. Similarly, those tools also been used to model and simulate 5-axis robot arm trajectory [5]. The objective of the research is to clarify the methods throughout developing automatic robot arm 3D model that can handle objects without human intervention. While SolidWorks used in many studies to build the 3D model alone, there are other software

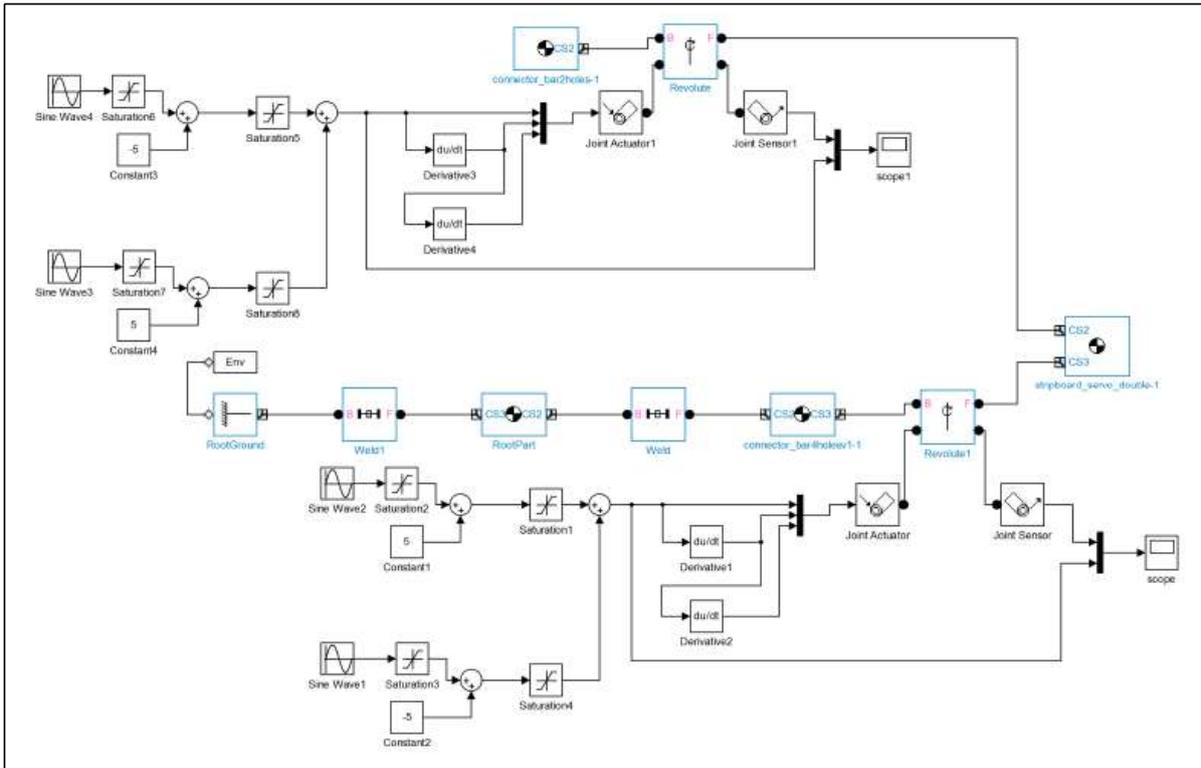


Fig. 6 2 DOF Quadruped Simulink Blocks with Input Signal and Scope

Input signal provided at joint actuator to enable the rotation of servomotors as shown in Fig. 6. With sine wave like signal, the range of servomotor rotation will be based on the signal amplitude. Joint sensor used to detect servomotor rotation. For this study, the output position is equal to input signal since ideal model is assumed for all joints. Referring to Fig. 7, 2 DOF quadruped robot is constructed in Simulink after clicking play button. This is the initial position where both servomotors angle were at 0° .

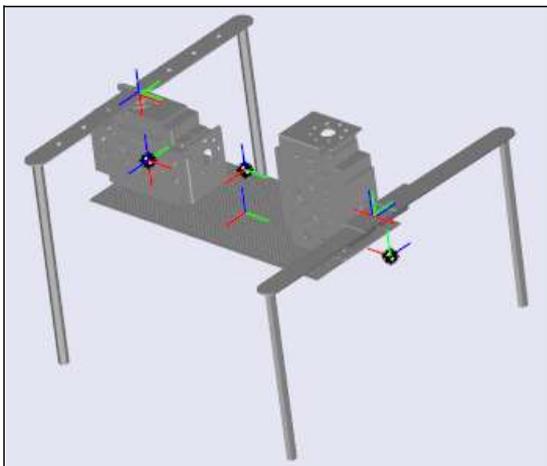


Fig. 7 2 DOF Quadruped Robot Initial Position

There are several reasons for realizing a simulation of 2 DOF quadruped robot such as to check the functionality of the construction and to determine the trajectory of the robot legs. Two servomotors used to control the movement of quadruped robot. Each servomotor control front and back legs.

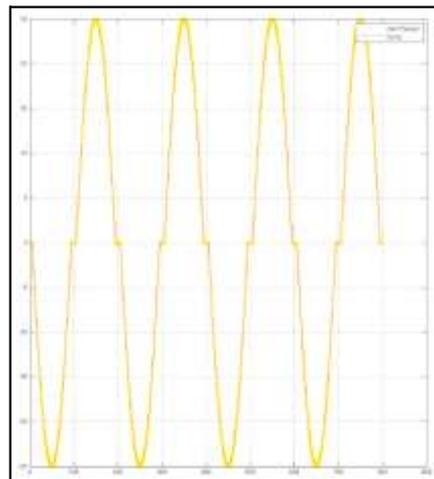


Fig. 8 Front Servomotor Input Signal

The function of front legs is for lifting while the back legs push the robot. With the rotation range of front servomotor between -25° to 25° , the quadruped robot is lifted on the right and left side alternately as in Fig. 8. The graph shows

RESULT

that the front legs are in initial position which is 0° for a moment each time the cycle is complete. In addition, the robot can be lifted higher by making the rotation range larger.

For the pushing purposes, the rotation of back servomotor is limited from -35° to 35° . Instead of rotate on vertical plane, back servomotor rotation is on the horizontal plane. As a result, the quadruped robot should move forward by the effect of generated forces. Fig. 9 represent input signal supplied. It is show that there is resting moment every completed cycle time similar with front legs to permit the quadruped robot to be in initial state before the start of new step.

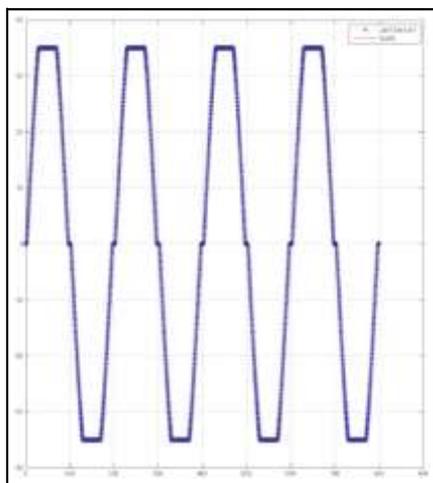


Fig. 9 Back Servomotor Input Signal

Besides that, back servomotor will hold down at the maximum angle to allow the quadruped lifted to maximum setting height. From both graph, the servomotors rotate with same frequency but with difference range.

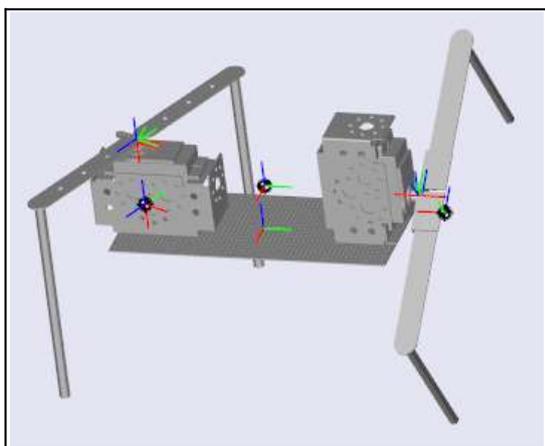


Fig. 10 Front Leg Raise on Left Side
The period of each cycle is set to 200 seconds. The resting moment, 0° for front servomotor is 10 seconds and about seven seconds for back

servomotor. Three seconds different due to the waiting time of back servomotor at the maximum positive and negative angle. Fig. 10 show the legs position of quadruped robot when front servomotor at -25° and back servomotor at 35° angle. At the opposite maximum position, where the front servomotor at 25° and back servomotor at -35° is shown in Fig. 11.

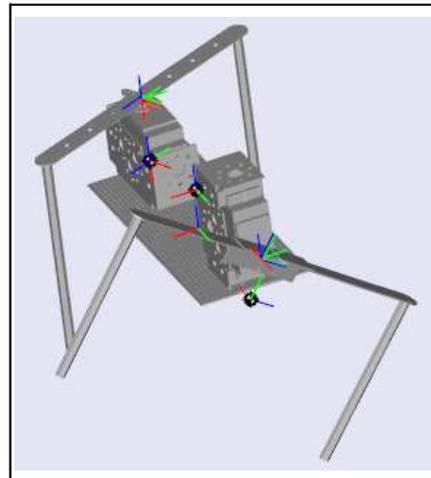


Fig. 11 Front Leg Raise on Right Side

CONCLUSION

The result shows the objectives of this study had been achieved. In the simulation, servomotors will rotate to respective angle of supplied input signal. Lift and push forces produced should enable the quadruped robot to move. Simple 2 DOF quadruped robot had been developed in order to show SolidWorks and Simulink are software that highly suitable for polytechnic students for simulation purposes. It is easy to use while polytechnic students already have basic knowledge about CAD software. Apart from that, students may be disclosed in advance of a simulation technique before continuing their studies to a higher level. For future works, actual quadruped robot will be developed to verify the results obtain from this study. Proper selection of servomotors is crucial as the correct torque is required to lift and push the robot body. A wide range of microcontrollers available today, user friendly microcontroller is proposed for the prototype development since both servomotors angle must be fine tune to move the robot.

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