THE MECHANICAL ANALYSIS OF A LEGGED FIELD ROBOT FOR THE REDUCTION OF LONGITUDINAL MASS-DRIFT AMOUNTS

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ABSTRACT: In this paper, we present a legged field robot with a biologically inspired concept like the leg structure. The robot has a feature of only hip-joint actuators for the simplicity of mechanism and control. One of the robot's objectives is to achieve the ability to travel quickly for the reconnaissance of a broad area. Currently, the solar panel is used for better endurance time of mobile field robots. This platform can get some additional features. Firstly, if the platform stops in the field, the solar panel rotates for generating better power with perpendicular to the sun. Secondly, if the platform moves in the field, the solar panel rotates for balancing and the compensation of mass-drift amounts. In particular, in this study we discuss the mobile platform with upper panel such as solar panel and pitch joint between main body and solar panel.

***Keywords**: Longitudinal Mass-drift Amounts, a Legged Field Robot, the Pitch Balancing*

1. INTRODUCTION

Currently, a biologically inspired concept is widely used in the engineering section for better performance, adaptability and reliability. The representative of this trend in mobile field robot areas is the leg structure for generating the locomotion. [1][2][3] This leg base platform has better the overcome ability against complex terrains compared to the wheel base platform. In the past research, the longitudinal mass drift of a legged field robot with acceleration and deceleration is discussed in the flat-body platform without additional equipment like solar panel for the ability to travel quickly. [4]

In this study, we discuss the mobile platform with upper panel such as solar panel and pitch joint between main body and solar panel like Fig. 1.

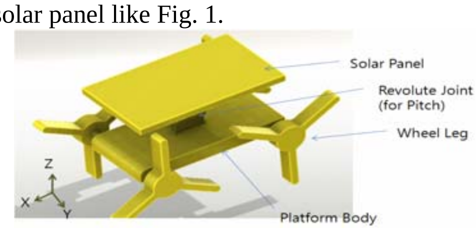


Fig. 1 Platform Concept

This platform has four wheel-legs that consist of three limbs with 120^{o} angle between each other. The solar panel is equipped for better endurance times. This platform can get some additional features. Firstly, if the platform stops in the field, the solar panel rotates for generating better power with perpendicular to sun. Secondly, if the platform moves in the field, the solar panel rotates for balancing and the compensation of mass-drift amounts.

In the section 2, based this platform, we discuss the case study such as fixed joint condition as joint between the body and the solar panel, revolute joint condition and revolute joint with control condition. Finally, we describe the conclusion of this study and further works.

2. THE COMPARISON STUDY

Here, we discuss the comparison study with multi-body dynamics simulations of ADAMS^{TM} and co-simulations of MATLAB^{TM}. For same simulation conditions, we assign the revolute speed profile at each wheel leg like Fig. 2.

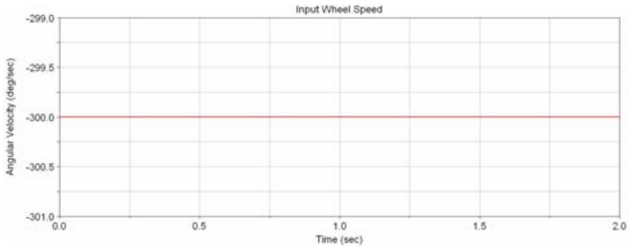
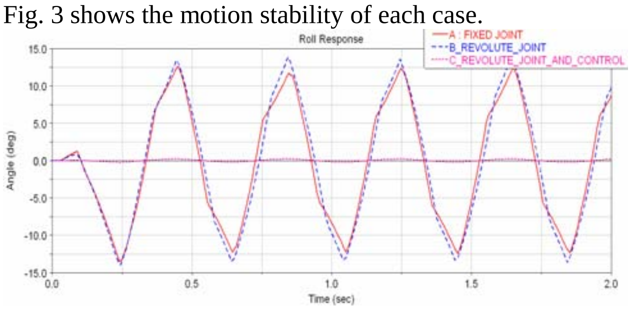
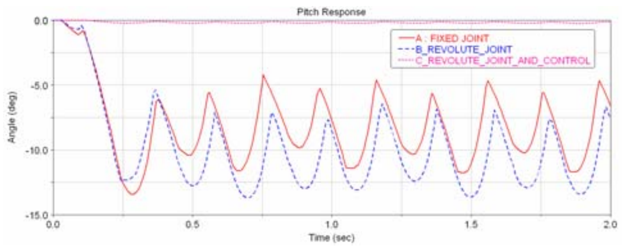


Fig. 2 the profile of revolute speed

We compare the stability of motion like body roll and pitch angle, and the fast travel ability like the forwarding speed. Fig. 3 shows the motion stability of each case.



(a) Roll Response



(b) Pitch Response

Fig. 3 Responses of the roll and pitch angle

Fig. 4 shows the mobility such as the forward speed of each case.

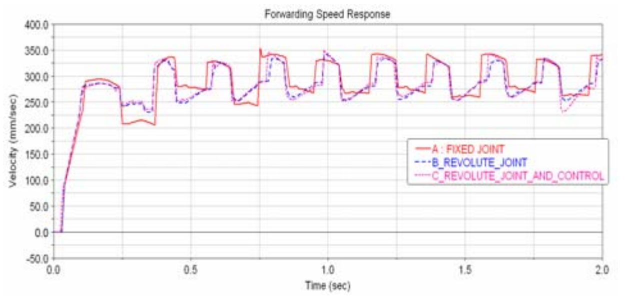


Fig. 4 Responses of the forwarding speed

For control, we measure the pitch angle of platform body in simulation circumstance at each sampling time. Then command value is 0^o like initial conditions. Then error angle derivates. After controller, control signal multiplied with platform body inertia. Finally, this signal transfers to the revolute-joint actuator as the torque compensation signal for the pitch balancing.

According to Fig. 3 and Fig. 4, we reveal that Case C(pitch balancing) has far more stable motions and more fast movements at the same actuating condition.

3. CONCLUSION AND FURTHER WORKS

In this study, we discuss the mobile platform with solar panel and the feasibility as pitch balancing devices. As further works, we plan to implement the platform with solar panel and the experiment validation. Then we expand joints as roll, pitch and yaw like the agile platform between the body and the solar panel for the roll, pitch and yaw balancing.

ACKNOWLEDGEMENT

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[5] ADAMS MANUAL

[6] MATLAB-SIMULINK MANUAL