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Automatic Boogie System

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Abstract*: Rocker bogie are important for conducting in-situ scientific analysis of objectives that are separated by many meters to tens of kilometers. Current mobility designs are complex, using many wheels or legs. They are open to mechanical failure caused by the harsh environment on Mars. A four wheeled rover capable of traversing rough terrain using an efficient high degree of mobility suspension system. The primary mechanical feature of the rocker bogie designis its drive train simplicity, which is accomplished by using only two motors for mobility. Both motors are located insidethe body where thermal variation is kept to a minimum, increasing reliability and efficiency. Four wheels are used because there are few obstacles on natural terrain that require both front wheels of the rover to climb simultaneously. A series of mobility experiments in the agriculture land, rough roads, inclined, stairs and obstacles surfaces concluded that rocker bogie can achieve some distance traverses on field..*

Keywords: Rocker bogie; Wheel type mobile robot; Stair climbing; Rover

I. INTRODUCTION

The rocker bogie suspension system, which was specifically designed for space exploration vehicles have deep history embedded in its development. The term “rocker” describes the rocking aspect of the larger links present each side of the suspension system and balance the bogie as these rockers are connected to each other and the vehicle chassis through a selectively modified differential.

There is an increasing need for mobile robots which are able to operate in unstructured environments with highly uneven terrain. These robots are mainly used for tasks which humans cannot do and which are not safe. In order to achieve these tasks, any mobile robot needs to have a suitable mobile system according to each situation. Among these mobile systems, it’s the rocker-bogie suspension system that was first used for the Mars Rover Sojourner and it’s currently NASA’s favoured design for rover wheel suspension. The rocker bogie suspension is a mechanism that enables a six-wheeled vehicle to passively keep all six wheels in contact with a surface even when driving on severely uneven terrain. There are two key advantages to this feature. The first advantage is that the wheels' pressure on the ground will be equilibrated. This is extremely important in soft terrain where excessive ground pressure can result in the vehicle sinking into the driving surface. The second advantage is that while climbing over hard, uneven terrain, all six wheels will nominally remain in contact with the surface and under load, helping to propel the vehicle over the terrain. One of the major shortcomings of current rocker bogie rovers is that they are slow. In order to be able to overcome significantly rough terrain (i.e. obstacles more than a few percent of wheel radius) without significant risk of flipping the vehicle or damaging the suspension, these robots move slowly and climb over the obstacles by having wheels lift each piece of the suspension over the obstacle one portion at a time. While performance on rough terrain obstacles is important, it should be also considered situations where the surface is flat or it has almost imperceptible obstacles, where the rover should increase its speed to arrive faster from point to point

II. LITERATURE REVIEW

Jun Yang, Mingming Dong, Jiatong Ye

Suspension is divided into non-independent suspension and independent suspension. These two kinds of suspensions are widely used in general vehicles. General vehicles can travel on urban roads and highways. But they cannot travel on rough roads or extremely uneven roads. The rocker-bogie suspension is proposed to solve that problem. It is widely used in planetary rover. The purpose of this paper is to systematically compare the performance of these rovers. This

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paper review the different rocker-bogie suspensions designed by different countries and demonstrate their capability to improve the performance of the suspension of rovers. Various technologies in which different configurations, component combinations and mechanical designs are used to improve the performance of the suspension are also discussed in this paper

Bei He, Fuli Yang, Ke Zheng, Xuedan Tao, Wang Yao
With the big data and smart grid more and more valued, the power big data will become an inevitable trend. The power big data has a complex structure and various kinds, with the characteristics of dispersion, diversity and complexity. The traditional data processing method can not meet the requirements of smart grid development. Therefore, the application of big data technology in smart grid is very essential.

Luo, Y. Liu, C. Wang, X. Tan
In this paper, we study the observability inequality on a kind of linear parabolic equation.To show the observability estimate, we first derive the inequalities about the norms of the solution and its gradient, then reduce a lemma of inequality from a corollary directly[1]. At last, combing these inequalities with Nash inequality and Poincare inequality, we give the proof of the observability estimate.

Hongwei An, Renjie Xu, Luohua Zhao
In this paper, we will summarize the existing three-dimensional virtual human body model representation and drive deformation method with real-time and realistic requirements as a starting point, and propose a combination of surface model and skeleton driving to realize virtual human motion drawing

III. DESIGN OF ROCKER BOGIE

Selection of Materials
Selection of material is an important step in designing of any componentThe main advantages of material selection are:

- It increases the reliability of product
- It reduces the cost of product
- It can also optimize the weight of product.

Hence, for the links of rocker bogie (For The Body of Bogie) we select the PVC Pipe as material.

Wheel Design
The wheels are needed to be wider for increasing the traction to traverse upon the obstacles & their diameter depend upon the availability and amount of speed required. The actual rover uses billet wheels, and machine the wheel and tread from one piece of round aluminium stock. The main problem during the selection of the wheels is light weight consideration and the distribution of load on the wheels. Hence, for the light weight and cost effectiveness of the rover we will choose rubber wheel for robot available in the market depending upon the calculations. While our wheel design may not be optimized in terms of strength and weight reduction, it will result in a cost effective solution with minimal manufacturing time, and a wheel that should meet all design goals.

Velocity 8cm/s			Velocity 10cm/s			Velocity 12cm/s		
RPM	Diameter		RPM	Diameter		RPM	Diameter	
	m	cm		m	cm		m	cm
10	0.153	15.277	10	0.191	19.096	10	0.229	22.915
20	0.076	7.638	20	0.095	9.548	20	0.115	11.458
30	0.051	5.092	30	0.064	6.365	30	0.076	7.638
40	0.038	3.819	40	0.048	4.774	40	0.057	5.729
50	0.031	3.055	50	0.038	3.819	50	0.046	4.583
60	0.025	2.546	60	0.032	3.183	60	0.038	3.819
70	0.022	2.182	70	0.027	2.728	70	0.033	3.274

DOI: 10.48175/568

80	0.019	1.910	80	0.024	2.387	80	0.029	2.864
90	0.017	1.697	90	0.021	2.122	90	0.025	2.546
100	0.015	1.528	100	0.019	1.910	100	0.023	2.292

Calculation of Wheel Diameter

Motor selection

Since the bogie consists of six independtly drive wheels hence the drive motor is needed for every wheel.The Selection of drive motor depends upon the speed of the rover that is desired. We will try to design the rover for a speed of 10 cm/s and will choose the parameters based upon it. The rover is designed to cross the obstacleand hence need more traction thus the motor choose should be of low rpm but the rpm cannot be very low because to maintain the speed the diameter of the wheel will have to be increased thus an optimum rpm motor is needed to be selected. We will be using a 30rpm motor with 12V DC because it is well suited depending uponthe requirements and calculations.

Power Supply

The MER has to travel the surface of mars where there is no availability of power source thus it usedsolar cell to charge the battery and derive the power from the battery for the motors and other equipment's. Butsince we are using the bogie on the earth surface and our main focus is the development of mechanism rather than the power source so we will be using the cheapest possible alternative that is the 12V vehicle battery.

Control

The Control of the rover will be manual with the help of a joysticks for driving each side of the rover separately. It will be helpful while taking a turn. All the connections will be wired and no wireless means will be used because we need to simulate the mechanism and not the actual rover and to make it cost effective in allpossible manners. We used Rf 2.4ghz multi channel remote for the control.

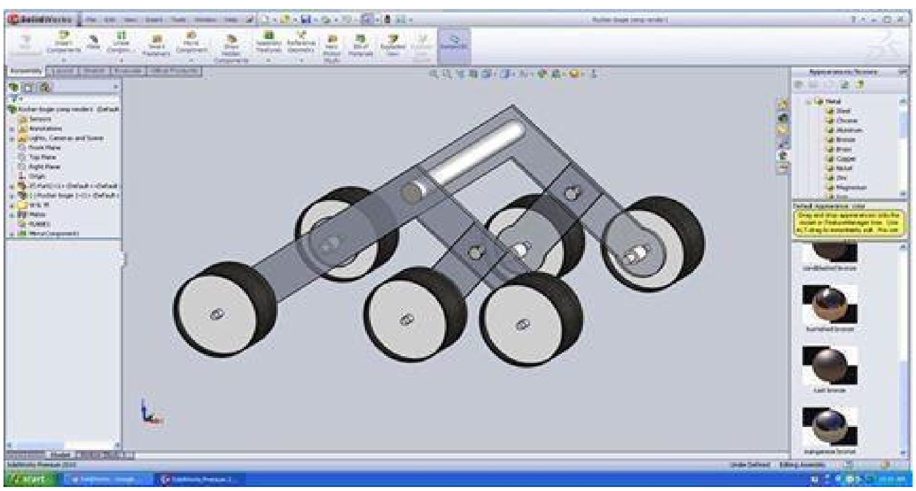

Fig- Design Of Rocker Boggie

Diameter of Wheel

$V = \pi DN/60$

Assumed speed be 10 cm/s i.e. 100mm/sTherefore,

$100 = \pi DN/60$

Velocity 10cm/s		
RPM	Diameter	
	m	Cm
10	0.191	19.096
20	0.095	9.548
30	0.064	6.365

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40	0.048	4.774
50	0.038	3.819
60	0.032	3.183
70	0.027	2.728
80	0.024	2.387
90	0.021	2.122
100	0.019	1.910

Table- Calculation of Diameter & RPM

So the selected D-N combination.

Calculation of Wheel Base

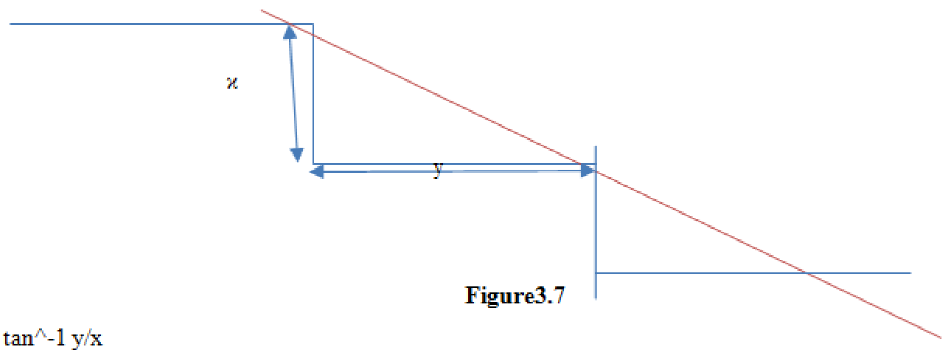
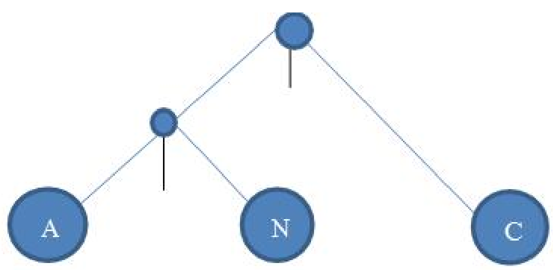


Figure3.7

ϴ= tan^-1 y/x

Length of Links



AN=NC

<BNC=45 + 45 = 90

<NBC = < NCB = 45

therefore, NC = NB …….. using Pythagoras theorem Find BC.

HeightCalculation height^2 =BC^2 – NC^2 net height = radius + height

Track Width SSF = Tw/2h SSF=1.3 standard

IV. CONCLUSION

This project will try reaching nearly all of our design requirements, and in many respects exceeding original design goals. Furthermore all components, mechanical and electrical, will be thoroughly tested as a completed system in real-world field testing conditions to validate their success. Overall, preliminary estimates for the general scope, budget, and timeline, for the project will be closely followed; with the exception if the project goes moderately over budget.

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