JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

ANAYLSIS OF ROCKER BOGIE SUSPENSION SYSTEM

[1] Etikala Chandrakanth Reddy, [2]. Konatham Bhanu Prakash, [3] A.C.Raghu Kishore Yadav, Assistant professor (,MTech)

ABSTRACT

Rocker bogie mechanism is a mechanism mainly employed within the mars rovers to conquer the basic terrains while keeping balance. It's NASA's preferred mechanism for room automobiles and rovers. It contains 2 arms with steering wheel mounted to each and every. Each arm is attached by way of a movable joint. This allows to employ a suspension-based mechanism which distributes the automobile ton as consistently as you possibly can actually on protrusions as well as unusual surfaces. The look involves a springtime totally free suspension dependent differential drive process which enables the bogie to go more than rubble, pebbles easily. The cameras and sensors installed on a rover should be healthy to function also and properly to increase the life spam of theirs. Additional vibrations as well as jerks result in quicker damage within receptors, circuit boards as well as digital cameras. The rocker bogie mechanism was created trying to keep this particular of brain by offering optimum stableness in all of the terrains. As a result, we examine the layout and also fabrication on the rocker bogie mechanism by fabrication of this particular basic surfaces automobile making use of ideas of the bogie mechanism. All-terrain movable robots are totally different from some other standard movable robots, since they think about the impact of unstructured surface and the environment of its. Thus, the robots are created to work efficiently on all-natural terrains which could be sloped, difficult, as well as deformable and therefore are utilized within these kinds of areas as serious room exploration brilliance as well as recovery as well as army. The rocker bogie suspension product is a passive spring less as well as symmetric mechanism. Each and every edge on the rocker bogie carries a bogie and a rocker: the rocker is attached to the back-steering wheel, and also the center steering wheel as well as the forward steering wheel are linked with the bogie. The 2 sides of the paper of rocker bogie are linked through the differential bar linked to the primary body, and this guarantees the 6 wheels will be in exposure to the soil constantly giving a steady wedge just for the systematic tools & receptors. The rocker arm as well as bogie are

built by using various PVC and PVC pipes perspective pipe as well as for interconnecting all of the arms, we're consuming SHM strip with appropriate fastened. For linking the steering wheel, we're planning to utilize cross match jigs to repair rigidly as well as within of the steering wheel DC motor' are repaired as well as since it is equipped within the steering wheel it is able to bring down the winter perturbation also additionally, it bring down the vibration within the body. Digital camera, ultra-sonic sensor, Barometric sensor, Temperature sensor are managed by Arduino UNO (uno board and microcontroller) is in touch with 12v battery power. Plus, most 6 engines are linked through the exact same 12v electric battery, along with overall rover are managed through telephone or maybe pleasure stick that is attached through WIFI component. The rocker bogie style comprising of absolutely no springs as well as stub axles within every steering wheel that enables the chassis to get more than virtually any hurdles, like rubble, ditches, sand, and so on. Which are further up to increase the wheel's diameter of dimension while trying to keep many wheels along the floor optimum period. As when compared with any kind of suspension process, the tilt balance is restricted through the level on the middle of gravity and also the recommended structure has the same.

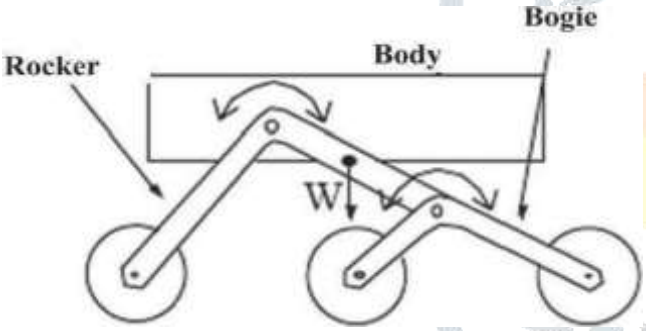
1 INTRODUCTION

1.1 BASIC DESCRIPTION

NASA recently started an ambitious exploration program of Mars. Pathfinder is the first over explorer in this program. Future rovers will need to travel several kilometers over periods of months and manipulate rock and soil samples.

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 modified differential.

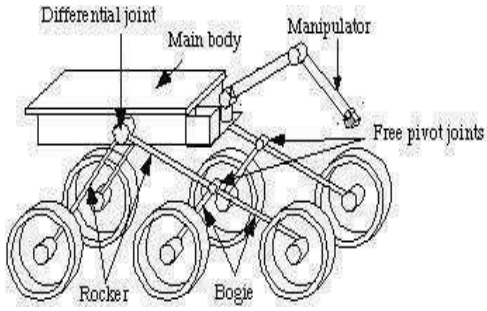
In the system, “bogie” refers to the conjoining links that have a drive wheel attached at each end. Bogies were commonly used to bare loading as tracks of army tanks as idlers distributing the load over the terrain. Bogies were also quite commonly used on the trailers of semitrailer trucks as that very time the trucks will have to carry much heavier load.[1]



As accordance with the motion to maintain centre of gravity of entire vehicle, when one rocker moves up- ward, the other goes down. The chassis plays vital role to maintain the average pitch angle of both rockers by allowing both rockers to move as per the situation.[4]

The physics of these rovers is quite complex. To design and control these analytical models of how the rover interacts with its environment are essential. Models are also needed for rover action planning. Simple mobility analysis of rocker-bogie vehicles have been developed and used for design evaluation in the available published works.

The rocker-bogie configuration is modeled as a planer system. Improving the performances of a simpler four wheel rover has also been explored.[2]Figure 1.2 Three Dimensional view



of Rocker Bogie Mechanism

LITERATURE REVIEW

2.1 STUDY

The rocker-bogie system is the suspension arrangement used in the MarS rovers (mechanical robot) introduced for the Mars Pathfinder and also used on the Mars Exploration Rover (MER) and Mars Science Laboratory (MSL) missions. It is currently NASA's favored design.[8]

The term “rocker” comes from the rocking aspect of the larger link on each side of the suspension system. These rockers are connected to each other and the vehicle chassis through a differential. Relative to the chassis, when one rocker goes up, the other goes down. The chassis maintains the average pitch angle of both rockers. One end of a rocker is fitted with a drive wheel and the other end is pivoted to a bogie.

The term “bogie” refers to the links that have a drive wheel at each end. Bogies were commonly used as load wheels in the tracks of army tanks as idlers distributing the load over the terrain. Bogies were also quite commonly used on the trailers of semitrailer trucks. Both applications now prefer trailing arm suspensions

The rocker-bogie design has no springs or stub axles for each wheel, allowing the rover to climb over obstacles, such as rocks, that are up to twice the wheel's diameter in size while keeping all six wheels on the ground. As with any

suspension system, the tilt stability is limited by the height of the center of gravity. Systems using springs tend to tip more easily as the loaded side yields.[9]

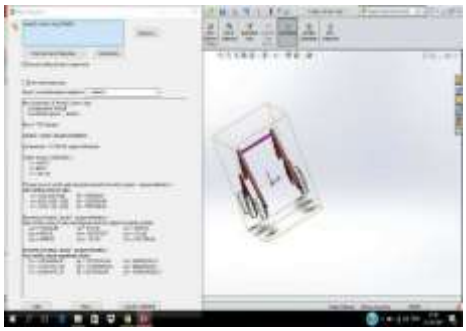
Based on the center of mass, the *Curiosity* rover of the Mars Science Laboratory mission can withstand a tilt of at least 45 degrees in any direction without overturning, but automatic sensors limit the rover from exceeding 30-degree tilts. The system is designed to be used at slow speed of around 10 centimeters per second (3.9 in/s) so as to minimize dynamic shocks and consequential damage to the vehicle when surmounting sizable obstacles.

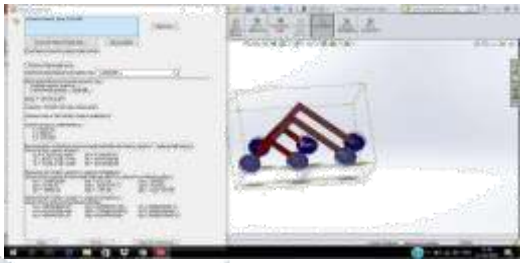
JPL states that this rocker bogie system reduces the motion of the main MER vehicle body by half compared to other suspension systems. Each of the rover's six wheels has an independent motor. The two front and two rear wheels have individual steering motors which allow the vehicle to turn in place. Each wheel also has cleats, providing grip for climbing in soft sand and scrambling over rocks. The maximum speed of the robots operated in this way is limited to eliminate as many dynamic effects as possible so that the motors can be geared down, thus enabling each wheel to individually lift a large portion of the entire vehicle's mass.[6]

DESIGN OF ROCKER BOGIE MECHANISM

3.1 MASS CALCULATION OF PARTS

Here mass of assembly is given below with moment of inertia





3.2 SELECTION OF MATERIAL

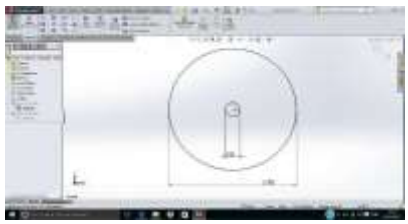
Selection of material is an important step in designing of any component The main advantages of material selection are :

It increases the reliability of product It reduces the cost of product

It can also optimize the weight of product

So the selected D-N combination is – D = 70 mm , N = 27.28 rpm

Now Drafting of wheel is done on Solid works with wheel diameter of 70 mm .

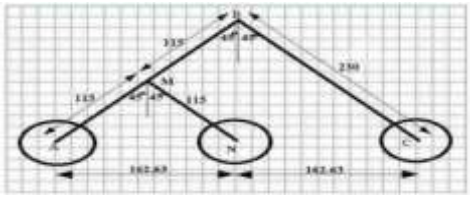


3.1.2 DESIGN OF LINKS

If horizontal length of stairs is 400 mm

Then wheel base = horizontal length of stairs – ($R_f + R_r$)

R_f = radius of front wheel



RESULT AND DISCUSSION

After the realized simulation, the results has been generated and analyzed that the simulated model can run on a plane without any inclination with 10 cm/s.

RBM can move on a curved path with slope

RBM can climb on steps having less height but there is a difficulty to climb on large height steps.

Centre of Gravity position in each of the two operating modes, contrasting the response of these two distinctive configurations of the rocker-bogie suspension against upcoming obstacles that can be present along the system generated obstacles and roadblocks.

CONCLUSION OF RBM

Presented situation was faced presenting two modes of operation within same working principle which is a rocker-bogie system with a robust obstacles traverse features and another is an expanded support hexagon achieved by rotating the bogies of each side of the vehicle. The proposed paper produces a novel design in pursue of increasing the rocker-bogie mobility system in conventional heavy loading vehicle behavior when high-speed traversal is required.

The proposed modification increases in the stability margin and proved with valuable and profitable contrasting with the 3D model simulations done in SOLIDWORKS. In future, if the system installed in heavy vehicles and conventional off road vehicles, it will definitely decreases the complexity as well as power requirements to retain bumping within it

Future scopes of Rocker Bogie Mechanism are in military operations as a weapon carrier & for locating coal deposits in coal mines.

REFERENCES

[1] P. Panigrahi, A. Barik, Rajneesh R. & R. K. Sahu, “Introduction of Mechanical Gear Type Steering Mechanism to Rocker Bogie”, Imperial Journal of Interdisciplinary Research (IJIR) Vol2, Issue5, ISSN: 2454-1362,2016.

[2] A. Bhole, S. H. Turlapati, Raja shekhar V. S, J. Dixit, S. V. Shah, Madhava Krishna K, “Design of a Robust Stair Climbing Compliant Modular Robot to Tackle Overhang on Stairs” arXiv:1607.03077v1 [cs.RO], 11 Jul 2016.

[3] M. D. Manik, A. S. Chauhan, S. Chakraborty, V. R. Tiwari, “Experimental Analysis of climbing stairs with the rockerbogie mechanism”, Vol2 Issue-2 P.No. 957-960IJARIIE-ISSN(O)-2395-4396, 2016.

[4] B. D. Harrington and C. Voorhees, “The Challenges of Designing sthe RockerBogie Suspension for the Mars Exploration Rover”, Proceedings of the 37th Aerospace Mechanisms Symposium, Johnson Space Center, page No. 185-1985, May 19-21, 2004.

[5] Y. L. Maske, S. V. Patil, S. Deshmukh, “Modeling and MBD simulation of stairclimbing robot with rocker bogie Mechanism”, International Journal of Innovative Research in Technology, 101743, Volume 1 Issue 12, Page no. 267-273,ISSN: 2349-6002, 2015.

[6] N. Yadav, B. Bhardwaj, S. Bhardwaj, “Design analysis of Rocker Bogie Suspension System and Access the possibility to implement in Front Loading Vehicles”, IOSR Journal of Mechanical and Civil Engineering, e- ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 3 Ver. III, PP 64-67, May - Jun. 2015.

[7] L. Bruzzone and G. Quaglia, “Review article: locomotion systems for ground mobile robots in unstructured environments”, Mech. Sci., 3, 49–62, 2012. DOI:10.5194/ms-3-49-2012

[8] F. Ullrich, A. Haydar G., S. Sukkarieh, “Design Optimization of a Mars Rover’s RockerBogie Mechanism using Genetic Algorithms”, Proceedings from 10th Australian Space Science Conference, Page No. 199-210, 2010.

[9]. Hong-an Yang, Luis Carlos Velasco Rojas*, Changkai Xia, Qiang Guo, School of Mechanical Engineering, Northwestern Polytechnic University, Xi'an, China, Dynamic RockerBogie: A Stability Enhancement for High- Speed Traversal- Vol. 3, No. 3, September 2014, pp. 212~220 ISSN: 2089-4856. [10]. R.E. Moore, Interval analysis (Englewood Cliffs, NJ: Prentice-Hall, 1966). (8)

[11]. Note that the title of the book is in lower case letters and italicized. There is no comma following the title. Place of publication and publisher are given.