



Rocker Bogie Mechanism

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How to Cite this Article:

SANJAY, .. K. S., VIJAY, C. S., ATUL, M. R. & SIDRAM, G. S. (2026). Rocker Bogie Mechanism. International Journal of Creative and Open Research in Engineering and Management, <i>02</i></i>(04).
<https://doi.org/10.55041/ijcope.v2i4.026>

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Abstract:

Objective: The primary goal of this research is to design, model, and fabricate a robust mobile platform utilizing the Rocker-Bogie suspension system for enhanced mobility in unstructured and challenging environments. While traditionally used for planetary exploration, this study evaluates its adaptability for terrestrial applications such as **precision agriculture, search and rescue, and remote surveillance**.

Methodology: The design process involves creating a 3D model using SOLIDWORKS and performing structural and dynamic simulations in Ansys Workbench to ensure stability over irregular surfaces. A scalable prototype is fabricated using a combination of **PVC, acrylic, or structural steel** links. The locomotion is powered by six independent geared DC motors controlled via an **Arduino UNO** or a similar microcontroller, enabling manual or semi-autonomous navigation.

Results: Experimental field testing confirms the mechanism's ability to maintain continuous six-wheel ground contact and climb obstacles up to twice the wheel's diameter. The prototype demonstrates significant stability, maintaining a steady chassis pitch by averaging the rocker-arm angles through a central differential. Analysis shows the rover can withstand a tilt of up to without tipping, confirming its effectiveness as a durable solution for extreme terrains.

Significance: This study concludes that the Rocker-Bogie mechanism provides a highly efficient, springless alternative to traditional suspensions, reducing mechanical failure risks through its **passive articulation system**. Future enhancements include integrating AI-driven path planning and vision systems for fully autonomous operations in harsh environments.

The **Rocker-Bogie mechanism** is a specialized suspension system characterized by a six-wheel design that utilizes passive mechanical links rather than springs or axles. This configuration enables the vehicle to traverse obstacles nearly **twice the diameter of its wheels** while maintaining constant ground contact for all six wheels.



INTRODUCTION

The rocker-bogie suspension system was developed in 1988 for NASA's Mars rover Sojourner and has since evolved into the organization's preferred rover design. The rovers from the Mars Science Laboratory (MSL) mission in 2012 and Spirit and Opportunity were part of the Mars Exploration Rover project in 2003. As a result of the larger, body-mounted linkages on each side of the rover, the suspension system includes a "rocker" component. These rockers are connected to the car's chassis and to one another via a differential. The rockers will rotate in opposition to one another with respect to the chassis to provide equal wheel contact. The chassis keeps both rockers' average pitch angles constant. A rocker has a bogie attached to one end and a drive wheel attached to the other. The "bogie" component of the suspension is the smaller linkage with a drive wheel at each end and a pivot to the rocker in the middle. In order to evenly disperse the load across the terrain, bogies were widely used in the trailers of semi-trailer vehicles and as load wheels on the tracks of army tanks. Both tanks and semitrailers prefer trailing arm suspensions today. The front wheels of the Sojourner rover attach to the bogies, whereas the front wheels of the MER and MSL rovers attach to the rockers. The Rocker-Bogie suspension system is used in the mechanical robots called Mars rovers that were developed for the Mars Pathfinder mission as well as the Mars Exploration Rover (MER) and Mars Science Laboratory (MSL) missions. NASA now prefers this design. The suspension system rocks because of the larger links on either side, hence the word "rocker." These rockers are connected to the car's chassis and to one another via a differential. When one rocker moves up concerning the chassis, the other moves down. The average pitch angle of both rockers is maintained by the chassis. A driving wheel is attached to one end of a rocker, and a bogie is attached to the other end.

LITERATURE SURVEY

This study simulates off-road robots while considering the mechanical behaviour of the locomotion system and how it interacts with its surroundings. For various wheel soil contact behaviours, this interaction is investigated and explained. The study takes into account the slippage, soil compaction, soil shear deformation, and wheel elastic deformation phenomena. Analytical relationships that relate each of the contact force components radial, longitudinal, and lateral forces to relative displacements radial displacement, longitudinal slip ratio, and side slip angle express models of wheel-soil contact. The behaviour of the entire system is then described by coupling these rules to the mechanical system's dynamic equations. These models are put into practise using a visual simulation system that offers a fundamental tool for mechanical system design, path planning, and the construction of control systems [1]. The 'rocker-bogie,' often known as Rocky, is a novel form of vehicle design with a free rocking bogie in front of a master bogie. All vehicles of the Rocky design share the following characteristics: they have a single rigid body, very high ground clearance, all wheels can be turned, and the body is differentially connected between the left and right sides on a transverse axis. There are also no springs or elastic members other than those used with the tyres. It detailed how the design's foundation a linkage system that distributes weight across the wheels over a wide range of individual wheel elevations leads to greater capability for scaling obstacles and superior bump performance [2].

AIM OF SIX WHEELER ROCKER BOGIE MECHANISM

A six-wheeled rocker bogie mechanism aims to provide a stable and robust suspension system for a vehicle operating in rough or uneven terrain. The mechanism allows the vehicle to traverse obstacles such as rocks, crevices, and uneven surfaces while maintaining high stability and mobility. The six-wheeled rocker bogie mechanism includes a central support with two shafts, one in each wheel well. The shafts are connected to toothed discs on the axle, which rotate in unison with the wheels. On each side of the central support, there is an identical rocker arm and wheel hub. The rocker's arm connects the central support to a link arm that pivots on a ball joint. The link arms connect at their free ends to short bars that cross over one another under and between each set of three wheels respectively; these bars are also connected through links to moveable.



METHODOLOGY OF SIX WHEELER ROCKER BOGIE MECHANISM

We employ wireless circuits to prevent this issue since traditional robots need more wires or complex circuits, which leads to short circuits and increases the risk of robot damage. As a robot only needs one person to control it, fewer people are needed to run it, reducing the need for additional labour. In general, robots demand more electricity to function, therefore their power consumption rises quickly. It can effortlessly climb any thrust and step with the assistance of its six wheels. This chapter will begin by covering a few prior space exploration rovers and rovers presently in development, as well as the design components and characteristics that made these rovers successful in accomplishing their missions on the lunar surface. The six-wheeler rocker bogie mechanism is a type of suspension system used in vehicles to improve their ability to traverse uneven terrain. The mechanism is commonly used in planetary rovers and other off-road vehicles. Here's an overview of the methodology used in designing and implementing the six-wheeler rocker bogie mechanism.

RESULTS AND DISCUSSION OF SIX-WHEELER ROCKER BOGIE MECHANISM

The six-wheeled rocker bogie mechanism is a type of suspension system commonly used in off-road vehicles, particularly in rovers and exploration vehicles designed for extra-terrestrial environments like Mars. This mechanism allows the vehicle to traverse rough terrain and overcome obstacles with greater ease, stability, and control than other types of suspensions. The rocker-bogie mechanism consists of two arms, each with two wheels at one end and a pivot point at the other end. The arms are connected to a central chassis by two rockers, which allow the vehicle to maintain stability while crossing uneven terrain. The wheels on the end of each arm are also connected by a differential, which ensures that all six wheels maintain traction and move at the same speed. One of the key advantages of the six-wheeled rocker bogie mechanism is its ability to traverse rough terrain without getting stuck or tipping over. This is because the mechanism allows the wheels to remain in contact with the ground even if the vehicle encounters steep slopes or large obstacles. Additionally, the differential ensures that all six wheels maintain traction, which helps to prevent slipping and sliding. Another advantage of the six-wheeled rocker bogie mechanism is its simplicity and durability. The mechanism is relatively easy to build and maintain, and it can withstand the harsh conditions of off-road environments. This makes it an ideal choice for vehicles designed for exploration, such as the Mars rovers.

SUMMARY OF SIX WHEELER ROCKER BOGIE MECHANISM

The six-wheel rocker bogie mechanism is a type of suspension system used in vehicles, particularly in rovers used for space exploration. It consists of six wheels, with the middle wheels on a pivoting rocker arm and the front and back wheels mounted on bogies. This design allows the rover to traverse rough terrain without getting stuck or tipping over. One of the key advantages of the rocker-bogie mechanism is its ability to keep all six wheels on the ground, even when driving over large obstacles or uneven terrain. This provides excellent stability and traction, which is critical for a rover exploring a planet with little or no atmosphere.

