



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**

# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 2, February 2021

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

**Impact Factor: 7.512**

9940 572 462

6381 907 438

[ijirset@gmail.com](mailto:ijirset@gmail.com)

[www.ijirset.com](http://www.ijirset.com)

# Comparative study between Mechanical braking and Mechatronic system controlled Anti-lock braking

Prof. Pawan Mokhadkar<sup>1</sup>, Prof. Harish G Langar<sup>2</sup>

Assistant Professor, Department of Mechanical Engineering, JDIET, Yavatmal, India<sup>1</sup>

Assistant Professor, Department of Electronics & Telecommunication Engineering, JDIET, Yavatmal, India<sup>2</sup>

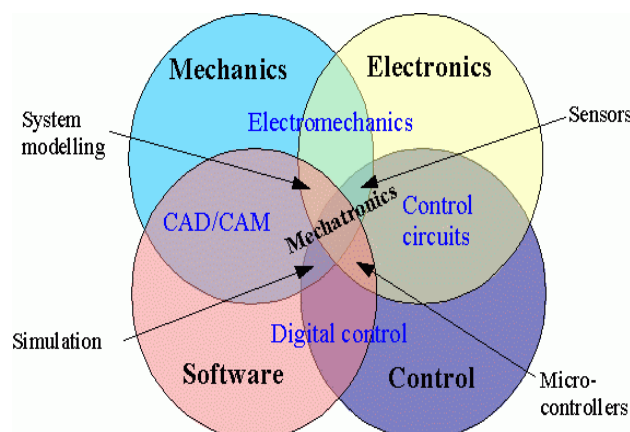
**ABSTRACT:** Mechatronics branch is mainly works on Mechanical and Electronics parts like Hydraulics, Pneumatics, Control valves, sensors, transducers, motors, LVDT etc. Mechatronics is a multidisciplinary field that refers to the skill sets needed in the contemporary, advanced automated manufacturing industry. At the intersection of mechanics, electronics, and computing, mechatronics specialists create simpler, smarter systems. Mechatronics is applied in a wide range of industries, such as manufacturing, automotive, aerospace, healthcare, and consumer electronics. Examples include industrial automation, robotics, automated vehicles, and smart appliances.

This paper states the comparison of purely mechanical system and Anti lock braking system in context with various aspect like different parts used, construction, working principle, pros and cons etc.

**KEYWORDS:** Mechatronics, Anti-lock Braking, Stability, Steerability, Electronic Control Unit (ECU), signal processing, PLC etc

## I. INTRODUCTION

Mechatronics is a multidisciplinary field that refers to the skill sets needed in the contemporary, advanced automated manufacturing industry. At the intersection of mechanics, electronics, and computing, mechatronics specialists create simpler, smarter systems. Mechatronics is applied in a wide range of industries, such as manufacturing, automotive, aerospace, healthcare, and consumer electronics. Examples include industrial automation, robotics, automated vehicles, and smart appliances.



In this paper we will have comparative study of braking system used purely on mechanical system and then mechatronics system.

Mechatronics applies all the basic principles related to machines, electronics, and informatics combined and synergized into one. Generally, combining all these elements is created to create a new technology that is useful for humans.

The application of mechatronics is usually not far from things such as machinery, electronics, and informatics. It's just that it was created more complex to fulfil a certain function. One of the characteristics of the application of mechatronics is that it is multipurpose.

As we know, of course, all the fields mentioned will be encountered by humans around them every day. Therefore, mechatronics is considered one of the most important types of science, and its impact can be felt directly in daily human life.

Hence, mastering the science of mechatronics means that we can also become useful people for the lives of others through various mechatronic devices that we create for human life so that they can be used and benefited.

### Examples of Mechatronic Application Techniques That are Beneficial to Human Life

Studying mechatronic engineering can have very good long-term prospects because graduates from these fields of study are very much sought after by companies where mechatronics knowledge will be indispensable in a company for various purposes.

This is because there are still very few people who even understand what mechatronics is. Sometimes its application in everyday life is not given much attention even though the application of mechatronics is very important for human life; here are some examples of the application of mechatronics technology.

#### 1. **ABS ( Anti-lock Braking System )**

The first mechatronics applications are usually found in the automotive world, where the braking system is vital in the automotive sector. Manufacturers must pay close attention to the braking system in their products.

This is what ultimately led to the creation of ABS or anti-lock braking system; ABS itself is one of the applications of mechatronics where ABS is a system integrated into a vehicle that helps the driver stay safe while driving, even on slippery roads or when sending a premature delivery.

The vehicle's wheels will not be locked even if the driver brakes suddenly and extremely with the ABS technology. With the ABS technology, you will be safer when driving.

#### 2. **ESP ( Electronic Stability Program )**

Along with the development of increasingly sophisticated technology, one of the impacts is the automotive world. Each automotive product is more comfortable and safer, along with various advanced technologies to support these automotive products.

One of the features that use the mechatronic principle is or electronic stability control. That is a technology integrated with a computerized system that has an important function to improve security in terms of car control through sensors that can detect and minimize slippage. Therefore, this program always ensures that the vehicle is in good control.

#### 3. **ABC ( Active Body Control )**

ABC or active body control is an advanced suspension technology system that consists of various components integrated into a single system that makes the technology operable. The working system of this technology can dampen the car in all road conditions.

Whether it's a good road or an extreme road due to damage or steepness, this system will increase the comfort of the driver and passengers by controlling the springs and damping each wheel of the vehicle.

The performance of this ABC system has been integrated by a computer so that it can work automatically; for example, this system will use hydraulics to reduce enormous pressures and use conventional shock absorbers to overcome small pressures.

#### 4. **Motor Management System**

The next application of mechatronics is the motor management system, an integrated system that controls and controls the entire performance of the machine and is controlled by a single device called an electronic control unit or contents.

As a result, the machine can be controlled and always in the best performance because the data on the machine is computerized very sophisticatedly. In this technology, all machine components utilize sensors as inputs which will then be processed in the electronic control unit.

#### 5. **Comfort in Turbulence System**

Turbulence is one of the most common terms encountered in the aviation sector and is already familiar. Turbulence itself should not be ignored and underestimated because it can cause various dangerous events.

One of the positive impacts of mechatronic technology is the creation of comfort in turbulence system technology, where the system functions to minimize the impact of turbulence which can increase the comfort of wrong passengers.

#### 6. **Robojet Manipulator**

People do not widely know this tool, but its function is very important for human life. This robot manipulator is a piece of heavy equipment usually used to dig tunnel systems where the working mechanism is regulated and driven using a hydraulic system. The manipulator robot can scan the profile of the tunnel that you want to excavate.

Furthermore, it can calculate the exact direction and the concentrated liquid to be sprayed accurately because this tool requires a paint sprayer that has a function to accurately attach the concentrated liquid to the part to be excavated.

#### **Elements and Structures in Mechatronics**

One of the requirements that must be met in mechatronics is to fulfill all the basic components or elements that make up the mechatronic structure itself. The following are the elements and structures that make up mechatronics.

The first sensor component is an element that receives data from an object you want to control. Then there is the controller component, where this component functions to determine whether the controlled object meets the needs or there are other irregularities.

Then there is a data path; this component is in charge of distributing commands obtained from the controller. The next page is the actuator, where this element has a vital function, namely converting energy. The conversion is done by changing the form of electrical energy into mechanical energy.

The last component or element is an energy source. Of course, this component has a vital function, namely providing energy to all elements that need it evenly; all of these components must be complementary and integrated to create a perfect application of mechatronics.

#### Application of Mechatronics in Manufacturing Industries.

Mechatronics is a conception that can be defined as the application of electronics and computer technology to control the indications of mechanical systems. It is a multidisciplinary method to product and manufacturing system design. It consist of application of electrical, mechanical control and computer engineering to improve product, processes and systems with greater flexibility, effortlessness in redesign and ability of reprogramming. Mechatronics can also be named as replacement of mechanics with electronics or enhance mechanics with electronics. There are many application of mechatronics used in various industries. Some of the mechatronics applications used in the manufacturing industries are:-

1. Robotics A respectable example of mechatronics application is robots most of them are made using software, electronics, and mechanical design in a synergetic way. They are designed to move materials, as well as perform a variation of programmed tasks in manufacturing and production settings. They are often used to execute duties that are dangerous or unsuitable for human workers, such as repetitious work that causes monotony and could lead to injuries because of the carelessness of the worker. Applications are performed with precision and superior repeatability on every job.

2. CNC Bending Computer numerically controlled (CNC) bending is a manufacturing process that is carried out by CNC press brakes. These machines can bend sheet metal work from just a few mm across to sectors many meters long on the major industrial machines. CNC press brakes either have a fixed bottom bed with the V block tooling held in place and a top beam which travels under force with the V blade tools this is known as down materializing. The opposite is an up forming machine with the bottom bend moving and the top beam fixed. Both process methods will produce the same sheet metal components and there are no limitations to the design of your component to suit any machine.

00:30

3. Rapid prototyping Rapid prototyping is the fast fabrication of a physical part, model or assembly using 3D computer aided design (CAD). The making of the part, model or assembly is usually finished using additive manufacturing, or



more commonly known as 3D printing. Rapid prototyping (RP) includes a variety of manufacturing technologies, although most utilize layered additive manufacturing. However, other technologies used for RP include high-speed machining, casting, molding and extruding.

4. Micro- electromechanical yaw-rate sensor Yaw-rate sensors measure vehicle movement thru the vertical axis. The sensing principle is capacitive and based on Coriolis forces, applied to a rotating mass the resulting charge flows are detected. Also for this mechatronic system separately from manufacturing precision the highly-accurate design of interaction of the own parts is essential. Micro-electromechanical sensing elements are also used for air-flow, acceleration and rollover sensing.

5. Automated guided vehicles Computer-controlled and wheel-based, automatic guided vehicles (AGV) are load carriers that travel along the floor of a facility without an onboard operator or driver. Their movement is directed by a combination of software and sensor-based guidance systems. Since they move on a predictable path with precisely controlled acceleration and deceleration, and include automatic obstacle detection bumpers, AGVs provide harmless movement of loads. Typical AGV applications include transportation of raw materials, work-in-process, and done goods in support of manufacturing production lines, and storage or other movements in support of picking in warehousing and delivery applications.

6. Sensors: A Sensor is a device that identifies the progressions in electrical or physical or other quantities and in a way to deliver a yield as an affirmation of progress in the quantity. In simple terms, Industrial Sensors are input devices which provide an output (signal) with respect to a specific physical measure. In the manufacturing industrial, sensors play a vital part to make the products intellectual and exceptionally automatic. These permit one to detect, study, measure and process a variety of transformations like alteration in position, length, height, exterior and dislocation that occurs in the Industrial manufacture sites. These sensors also play a pivotal role in predicting and preventing numerous possible proceedings, thus, catering to the requirements of many sensing applications.

7. Industrial Barcode Reading Barcodes are used as a means of quick identification. Nearly every industry uses barcodes to automate and simplify traceability by tracking everything from where something was produced and when it was shipped, to which retailer sold the product, at what time, and for how much. Overall, barcodes provide better accuracy, and sorting abilities than relying on manually-entered data.

8. Fast Hole Drilling EDM (Electrical Discharge Machining) High-speed EDM hole drilling was designed especially for fast, accurate small- and deep-hole drilling applications. Small holes that were once almost intolerable to drill by conventional machine tools are now being performed with ease. With the capability of drilling through virtually any conductive material, the use of this technology is continually expanding. High-speed EDM hole drilling applications created to expand to mold and part manufacturing-injection nozzles, oil drain holes, and dowel pins, as well as turbine blades, and safety wire holes in hex nuts.

9. Sinker EDM (Electrical Discharge Machining) Sinker EDM involves of an electrode and work piece submerged in an insulating liquid such as, more typically, oil or, less regularly other dielectric fluids. The electrode and work piece are connected to a suitable power supply. The power supply generates an electrical potential between the two parts. As the electrode approaches the work piece, dielectric breakdown occurs in the fluid, forming a plasma channel, and a small spark jumps. The sinker EDM will burn any electrically-conductive material without inflicting the same physical stresses produced by other types of machining. This can help to improve the overall condition of the finished product compared to other cutting and shaping processes. They are still commonly used in the manufacturing of dies and molds and can be used as a "lights out" type of cutting.

10. Laser Cutting Laser cutting is a technology that uses a laser to slice materials. While typically used for industrial manufacturing applications it is a accurate method of cutting a design from a given material using a CAD file to guide it. The process works by having a intensive and precise laser beam run through the physical that you are looking to cut, delivering an precise and smooth finish. Initially, the beam pierces the material with a hole at the edge, and then the beam is constant along from there. It works by having a focused and precise laser beam track through the material that you are looking to cut, delivering an accurate and smooth finish. Initially, the beam pierces the physical with a hole at the edge, and then the beam is continued along from there. The laser basically melts the material away that it is run over, so is more like melting than cutting. This means that it can easily cut light things such as cloth up to tougher metals and gemstones such as diamonds.

## II. MECHANICAL BRAKING AND ANTI-LOCK BRAKING SYSTEM

The mechanical braking system powers the hand brake or emergency brake. It is the type of braking system in which the brake force applied on the brake pedal is carried to the final brake drum or disc rotor by the various mechanical linkages like cylindrical rods, fulcrums, springs etc. In order to stop the vehicle. In this system large efforts needed due to mechanical linkages, but if we work smartly then we can reduce this effort by using mechatronics system.

Mechanical brakes consist of mechanical elements for the deceleration or stop of axes in equipment drives. They use levers or links to transmit force from one point to another. Braking slows or stops the movement of the coupled axes. There are several types of mechanical brakes. Band brakes, the simplest brake configuration, have a metal band lined with heat and wear-resistant

### Components of Mechanical Brakes

Some of the components of mechanical brakes are as follows

- Brake Shoes or Pads: These are made of friction material that presses against the drum or rotor to create friction and slow down the wheel's rotation.
- Brake Drum or Rotor: This is a rotating component that the brake shoe or pad presses against to create friction and slow down the wheel's rotation.
- Caliper or Brake Lever: This is the component that applies pressure to the brake shoe or pad to create friction and slow down the wheel's rotation.
- Brake Fluid: This is used in hydraulic brakes to transfer the pressure from the brake pedal to the caliper or brake lever.

### Working principle of Mechanical brakes

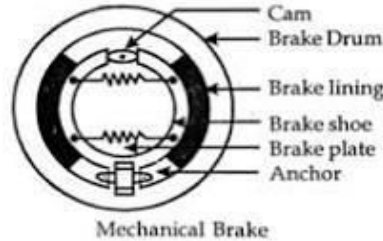
Mechanical brakes work by converting kinetic energy (motion) into thermal energy (heat) through friction. When the brake pedal or lever is pressed, the brake shoe or pad presses against the drum or rotor, creating friction. This friction converts the kinetic energy of the moving object into thermal energy, which is dissipated into the environment. As a result, the object slows down or comes to a stop.

### Advantages of Mechanical brakes

- Reliability: Mechanical brakes are simple and reliable, making them ideal for use in harsh environments or where other types of brakes may fail.
- Cost-effective: Mechanical brakes are less expensive than other types of brakes, making them a cost-effective solution for many applications.
- Easy to maintain: Mechanical brakes are easy to maintain, and most of the components can be replaced individually, which reduces downtime and repair costs.

### Disadvantages of Mechanical brakes

- Low stopping power: Mechanical brakes have limited stopping power compared to hydraulic or electromagnetic brakes, making them unsuitable for high-performance applications.
- Heat buildup: Mechanical brakes generate a significant amount of heat, which can cause damage to the components or affect their performance if they are not properly cooled.
- Wear and tear: Mechanical brakes experience wear and tear, which reduces their performance over time and requires frequent replacement of brake



### ANTILOCK BRAKING SYSTEM

- Anti-lock braking system (ABS) is an automobile safety system that allows the wheels on a motor vehicle to maintain tractive contact with the road surface according to driver inputs while braking, preventing the wheels from locking up and avoiding uncontrolled skidding.
- ABS generally offers improved vehicle control and decreases stopping distances on dry and slippery surfaces.
- ABS modulates the brake line pressure independent of the pedal force, to bring the wheel speed back to the slip level range that is necessary for optimal braking performance.

### OBJECTIVES OF ABS

To reduce stopping distance

1. The road surface type and conditions can be inferred from the vehicle's braking pressure, wheel slip measurements, and deceleration rate comparisons.
2. The wheel slip is regulated so that the road adhesion coefficient is maximized. By keeping all of the wheels of a vehicle near the maximum friction coefficient, an antilock system can attain maximum frictional force
3. In turn, this strategy leads to the minimization of the vehicle stopping distance.

Stability

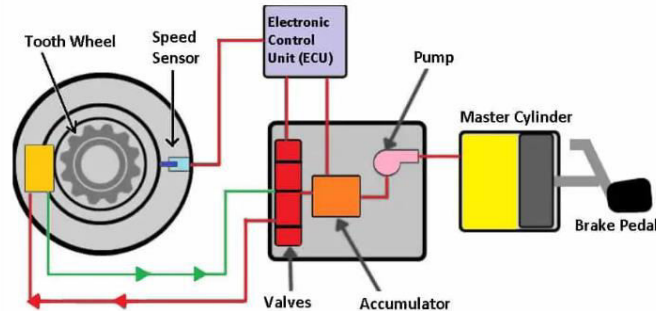
1. A locked-up wheel generates a reduced braking force, smaller than the peak value of the available adhesion between tires and road. A locked-up wheel will also lose its capability to sustain any lateral force. This may result in the loss of vehicle stability.
2. The basic purpose of a conventional ABS system is thus to prevent any wheel from locking and to keep the longitudinal slip in an operational range by cycling the braking pressure.

Steerability:

1. Good peak frictional force control is necessary in order to achieve satisfactory lateral forces and, therefore, satisfactory steer-ability.
2. If an obstacle appears without warning, emergency braking may not be sufficient. When the wheels are locked, car no longer respond to the driver's steering intention.
3. With ABS car remains steerable even during emergency braking, and thus the obstacle can be safely avoided.

## COMPONENTS OF ABS

The primary components of the ABS braking system are:



**Working of Anti Lock Braking System**

### • Electronic control unit (ECU)

1. It receives signals from the sensors in the circuit and controls the brake pressure at the road wheels according to the data analysed by the Unit.
2. ECU assists the vehicle operator to prevent wheel lockup by regulating the wheel slip.

### • Hydraulic control unit or modulator

1. It receives operating signals from the ECU to apply or release the brakes under ABS conditions.
2. It executes the commands using three solenoid valves connected in series with the master cylinder and the brake circuits- one valve for each front wheel hydraulic circuit, and one for both of the rear wheels. Thus brakes can be actuated by controlling hydraulic pressure.

### • Power booster and master cylinder assembly

1. It is activated when the driver pushes down on the brake pedal. The master cylinder transforms the applied pedal force into hydraulic pressure which is transmitted simultaneously to all four wheels.
2. It provides the power assistance required during braking.

### • Wheel sensor unit

1. Speed sensors are comprised of a magnet wrapped in a coil and a toothed sensor ring. An electrical field given off by the contact between the magnet and the toothed ring creates an AC voltage.
2. The voltage frequency is directly proportional to the wheel's rotational speed.
3. It monitors the rotational speed of the wheel and transmits this data to the ABS control module.

### WORKING OF ABS

- If a wheel-speed sensor signals a lock up - the ECU sends a current to the hydraulic unit. This energizes the solenoid valve. The action of the valve isolates the brake circuit from the master cylinder. This stops the braking pressure at that wheel from rising, and keeps it constant. It allows wheel velocity to increase and slip to decrease.
- When the velocity increases, ECU re-applies the brake pressure to restrict the wheel slip to a particular value.
- Hydraulic control unit controls the brake pressure in each wheel cylinder based on the inputs from the system sensor. This in result controls the wheel speed.

### Advantages

1. Anti lock braking system helps in reducing the braking distance as the wheel does not waste skidding distance.
2. This prevents the wheel from locking up and therefore allows for precise braking on wet gray surfaces.
3. ABS allows the car to steer around objects, as you still hold onto the wheels under intense braking.
4. Since it is a safety device with a track record of effectiveness, insurers often give specific discounts to customers for having an ABS on their vehicle.
5. The traction control system has the highest potential in ABS.
6. It makes better use of brake pads and brake discs.





### Disadvantages

1. The cost of ABS brakes is high as it adds to the total cost of a vehicle.
2. Maintenance costs are also high because the sensors on each wheel are expensive.
3. Since the ABS system uses footed braking, this results in inconsistent stopping distances on different surfaces under variable conditions.
4. Well-experienced drivers can manually brake more often than ABS brakes.
5. ABS involves using an additional sensor and a controller, which makes the system complex.

### IV. CONCLUSION

In Mechanical braking system lots of efforts required due the mechanical linkages, high wear and tear occurs which reduces durability, Stability, Steerability these problems are overcome by using Anti-lock braking system. The anti-lock braking system (ABS) restores traction to your tires in emergency situations. In slippery and dry conditions, it offers advanced vehicle control, while in loose, snow-covered conditions, it offers better stopping distance.

### REFERENCES

- [1] Kartik Bhasin, "A Review Paper on Anti-Lock Braking System (ABS) and its Future Scope" Volume 7, Issue VIII, Aug 2019, Page-372-375
- [2] Dr. Deepak Kumar, Shivam Sharma, Shubham Singh, "A review paper on Anti-lock braking system and its advancements" Volume 8, Issue V, MAY/2018, Page: 6-10
1. <https://www.spilasers.com/application-cutting/how-laser-cutting-works/>
  2. <https://www.southernfabsales.com/blog/principles-of-sinker-edm-machines>
  3. <http://www.justscience.in/articles/applications-of-mechatronics/2017/07/11>
  4. <https://www.ecpi.edu/blog/application-of-mechatronics-in-advanced-manufacturing>
  5. [https://esmvision.eu/cognex/wp-content/uploads/2018/09/Introduction\\_to\\_Industrial\\_Barcode\\_Reading\\_EN.pdf](https://esmvision.eu/cognex/wp-content/uploads/2018/09/Introduction_to_Industrial_Barcode_Reading_EN.pdf)
  6. [https://esmvision.eu/cognex/wp-content/uploads/2018/09/Introduction\\_to\\_Industrial\\_Barcode\\_Reading\\_EN.pdf](https://esmvision.eu/cognex/wp-content/uploads/2018/09/Introduction_to_Industrial_Barcode_Reading_EN.pdf)
  7. <http://www.motricity.com/6-important-uses-for-computer-aided-manufacturing/>
  8. <https://www.technicalfoamservices.co.uk/blog/what-is-cam/>



**INNO**  **SPACE**  
SJIF Scientific Journal Impact Factor

**Impact Factor:  
7.512**

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
**INDIA**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



[www.ijirset.com](http://www.ijirset.com)

Scan to save the contact details