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Energy recovery system optimisation in automotives

### Original Citation

Wang, R., Gu, Fengshou and Ball, Andrew (2012) Energy recovery system optimisation in automotives. In: Proceedings of The Queen's Diamond Jubilee Computing and Engineering Annual Researchers' Conference 2012: CEARC'12. University of Huddersfield, Huddersfield, p. 161. ISBN 978-1-86218-106-9

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## Background of Research

To limit the associated increase in fuel consumption and exhaust emissions, smart strategies for the generation, storage/retrieval, distribution, and consumption of electric power will be used in automotives. Research on energy recovery systems for modern vehicles complement and supply the vehicular electric power system to reduce the fuel use and emissions, by generating and storing electrical energy only at the most suitable moments and subsystems.

## Aim of Research

The aim of this research is to develop and optimise energy recovery systems in automotives. Especially, the focus will be on systems to recovery energy from braking and vibration processes in which the energy density is high.

## Energy Recovery Systems

### 1. Regenerative braking system

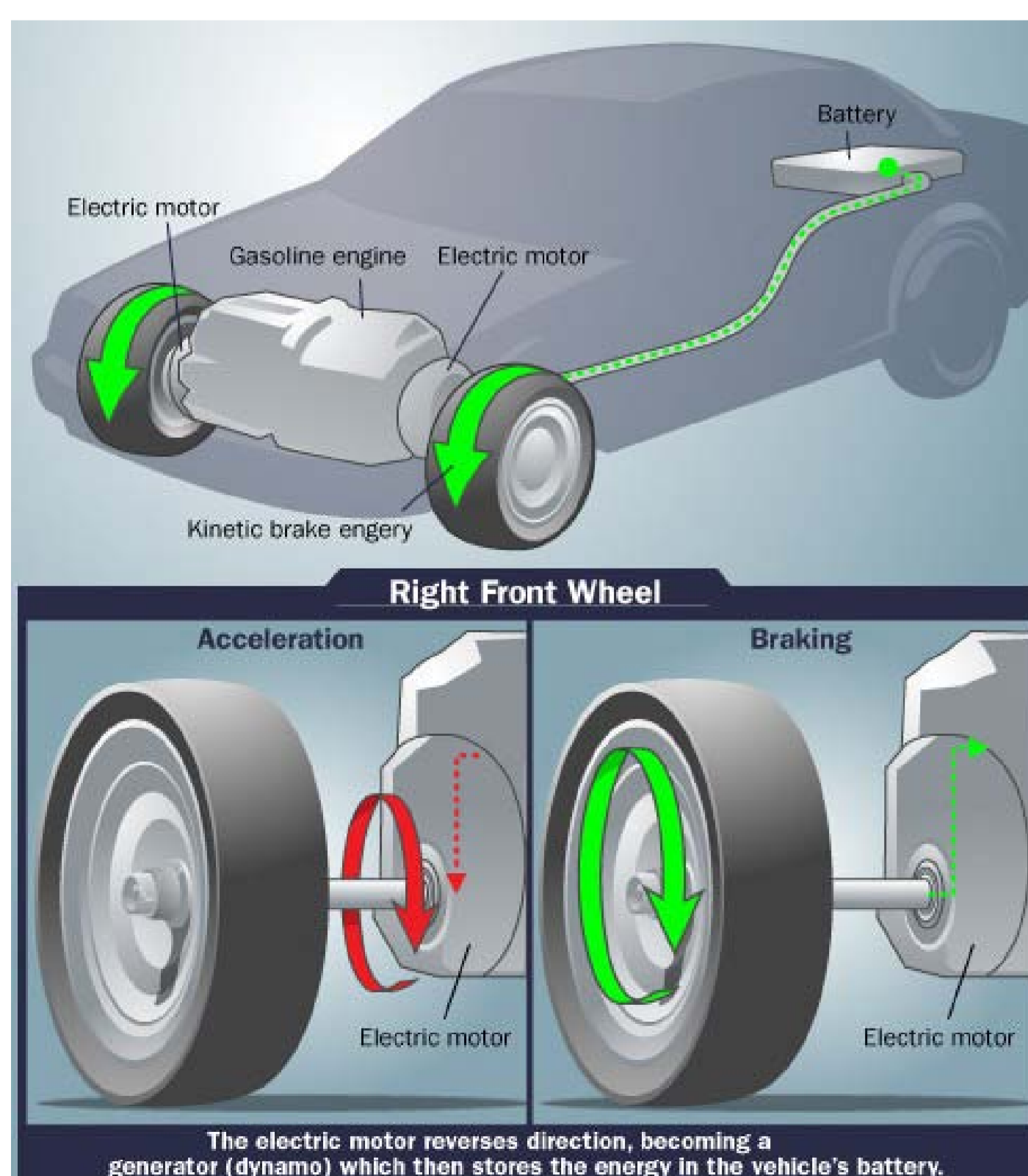


Figure 1. The basic principle of regenerative braking

A regenerative braking system is to recover energy as the vehicle slow down or stop by depressing the brake pedal and convert vehicular kinetic energy into electricity and to recharge the vehicle's batteries.

### 2. Exhaust energy recovery system

The exhaust recovery is recycled heat from vehicular exhaust system.

### 3. Suspension energy recovery system

Energy recovery suspension can achieve damping function and energy recovery by changing the damper vibration produced by road roughness into electrical energy.

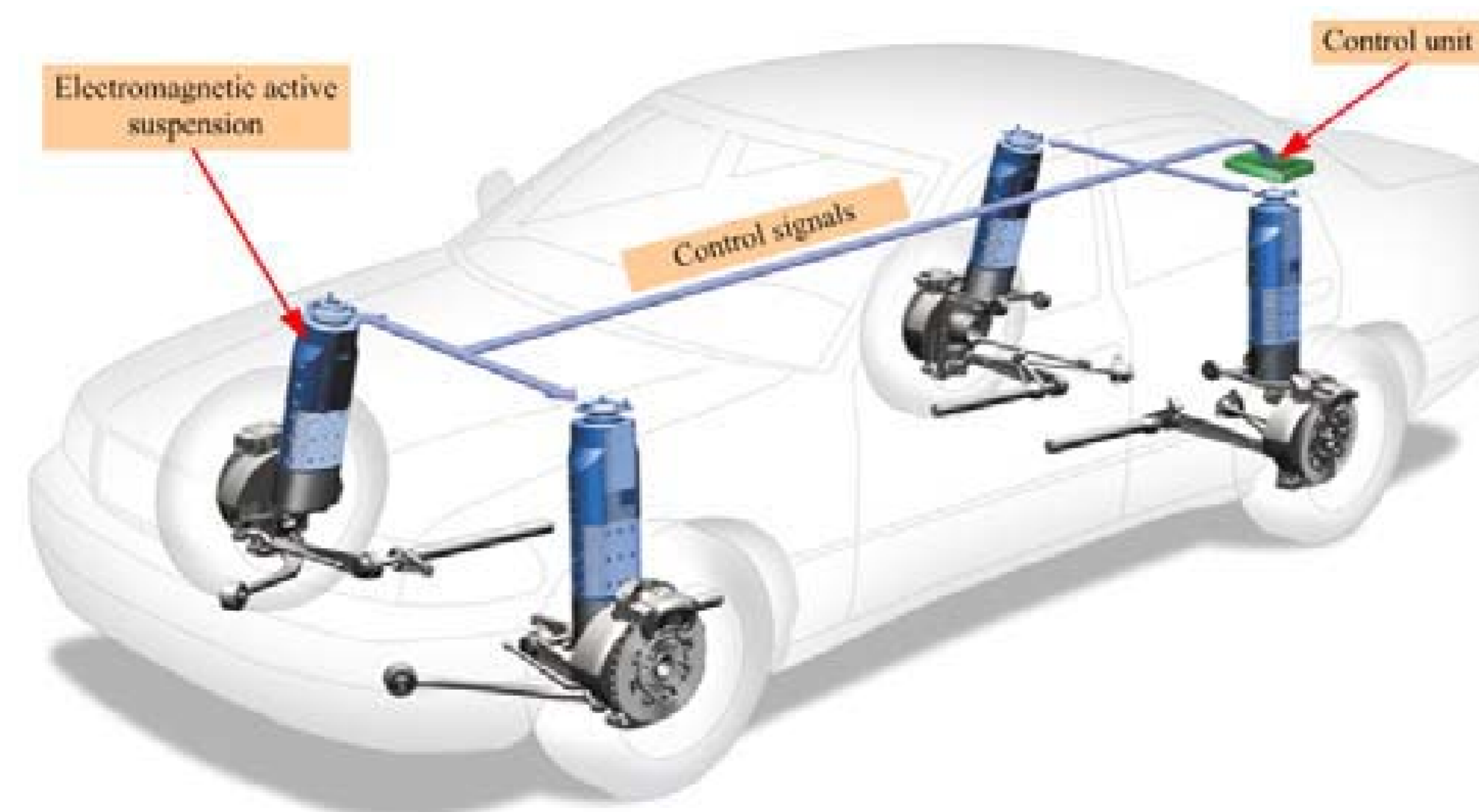


Figure 2. The diagram of electromagnetic active suspension.

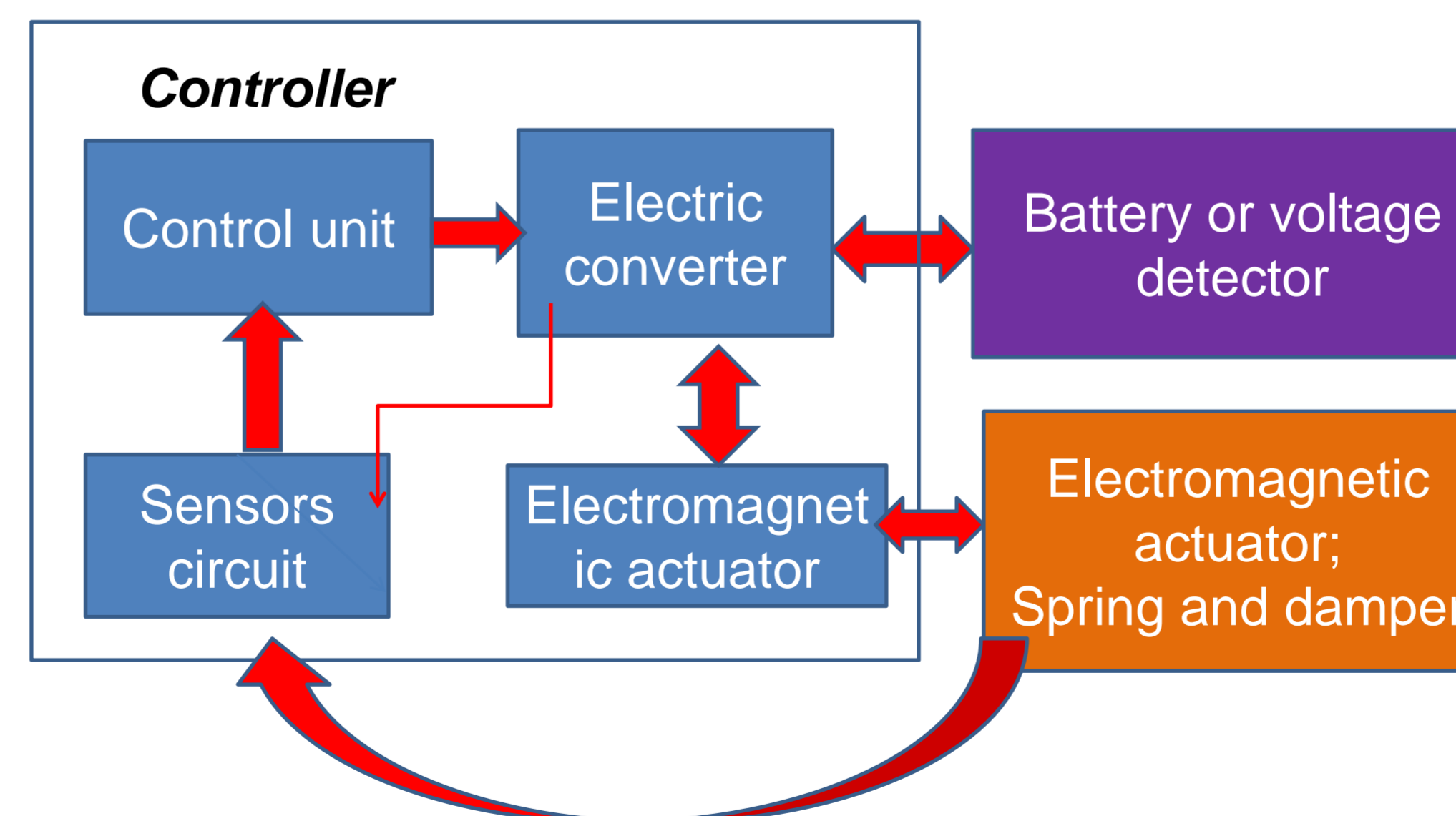


Figure 3. Block diagram of control for an electromagnetic suspension

## Regenerative Shock Absorber

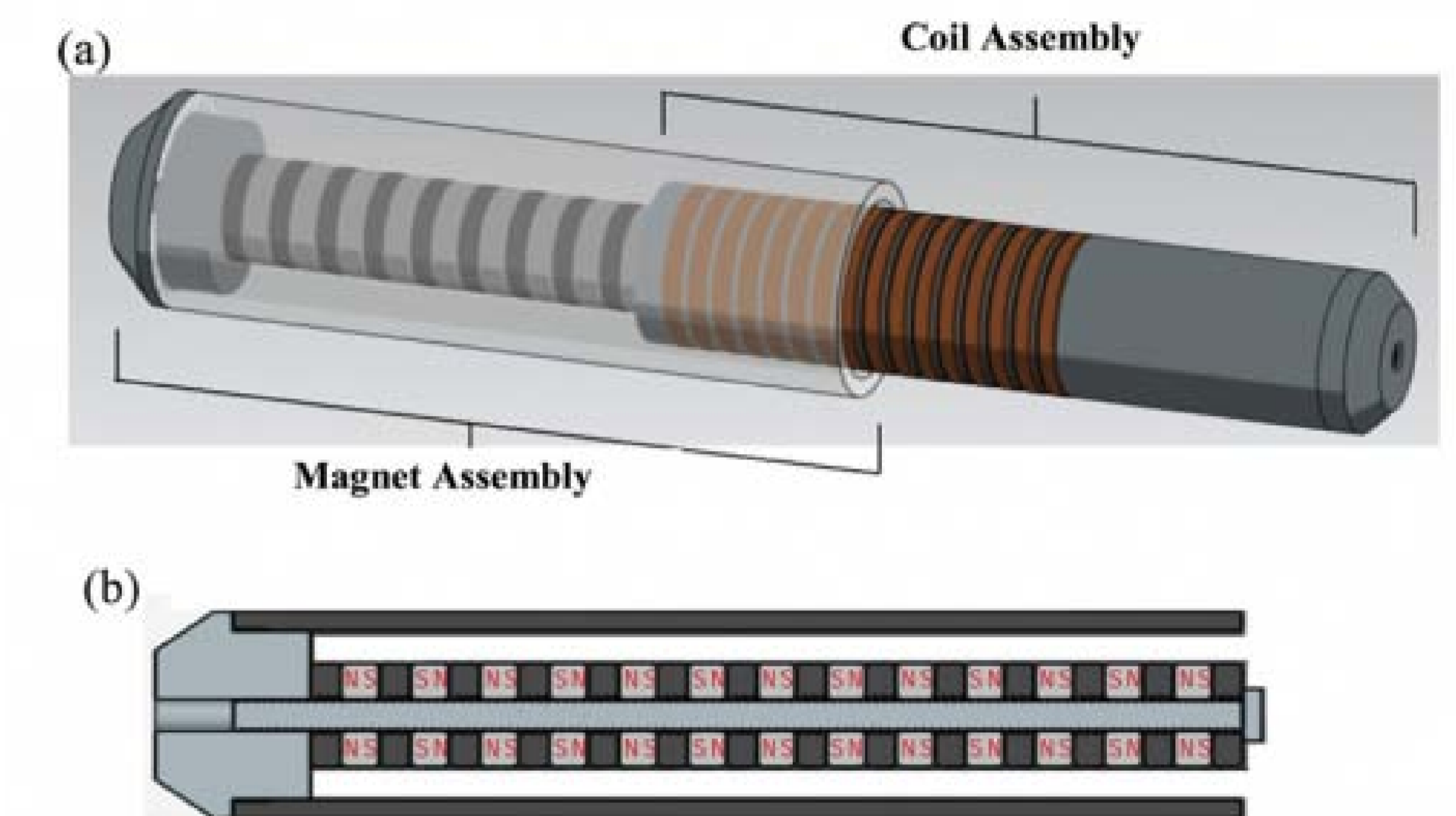


Figure 4. (a) Diagram of the linear electromagnetic shock absorber and (b) the cross section of the magnet assembly.

The regenerative shock absorber is in the configuration of a linear generator, as shown in figure 1(a). The magnets are arranged with like-poles of adjacent magnets facing each other to redirect the magnetic flux in the radial direction, as seen in figure 1(b). The energy harvester is modelled as a linear induction generator that incorporates shock absorber functions.

## Future Work

- Design new mechanisms in both braking and suspension systems for maximising energy recovery.
- Improve the energy density and efficiency by taking the harvesting electrical circuit and the harvester output resistance into account.
- Combine with vibration energy harvesting techniques, electromagnetic to improve the energy recovery test rig facility.