

Why do non-electrical engineers need to know about electrical engineering?

Electronic and electrical systems are becoming common place in many industrial processes, consumer products, automotive and aerospace industries, medical applications to name but a few.

Automotive Applications

- A typical family saloon car of 30 years ago had maybe 5 electrical motors/actuators. Present day luxury models may have 200+ motors and actuators leading to increased weight and power consumption**
- “Drive-by-wire” removal of many of the mechanical linkages and replace with sensors and localised actuation e.g. gear lever replaced by paddle switches and electric actuators on gearbox**
- Emergence of electric or hybrid vehicles to comply with emissions - regeneration**
- Multitude of sensors and electronic management**
- Electric valve actuation allows better control over the combustion process**

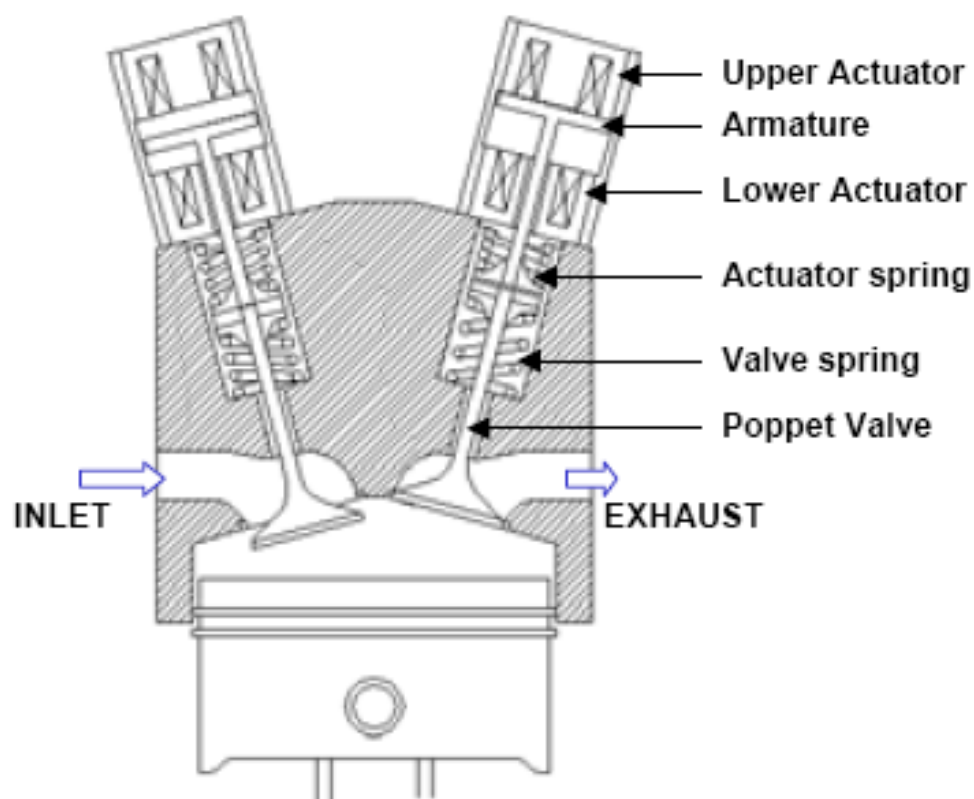
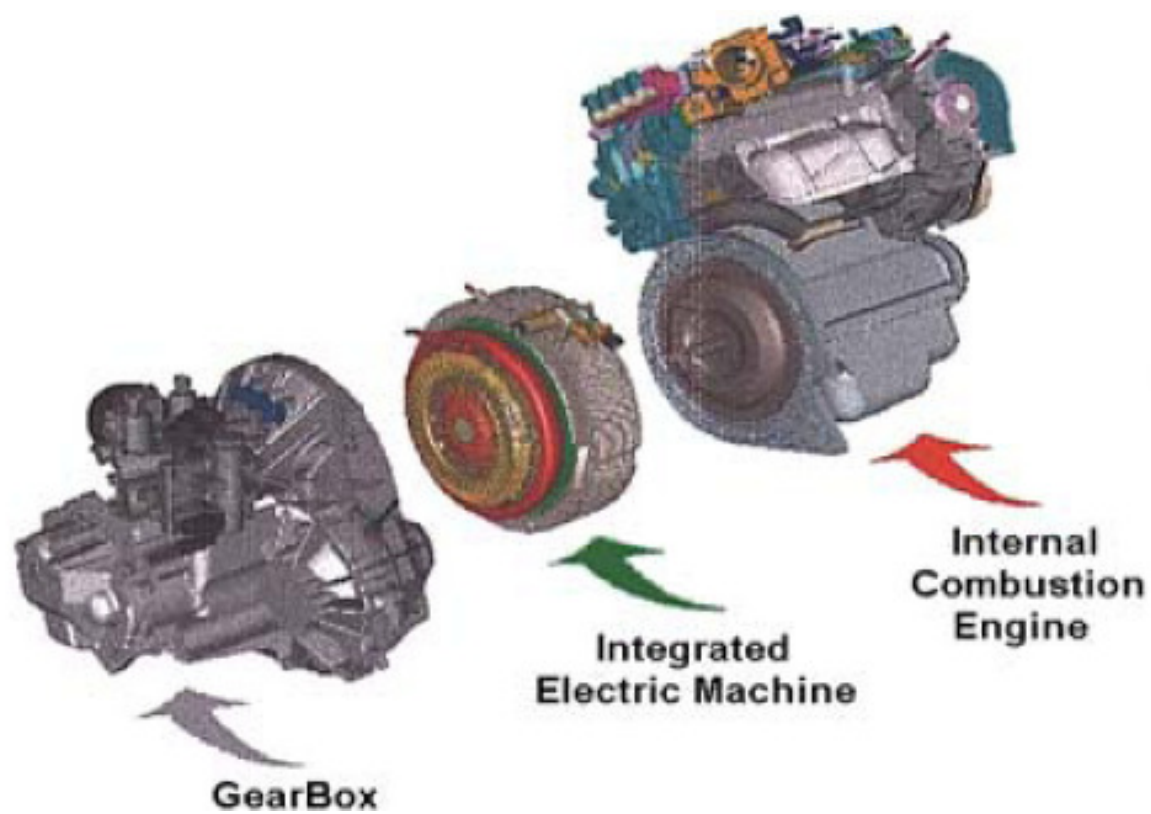
F Range Battery Electric Road Vehicle



Average speed 14mph Range 18miles



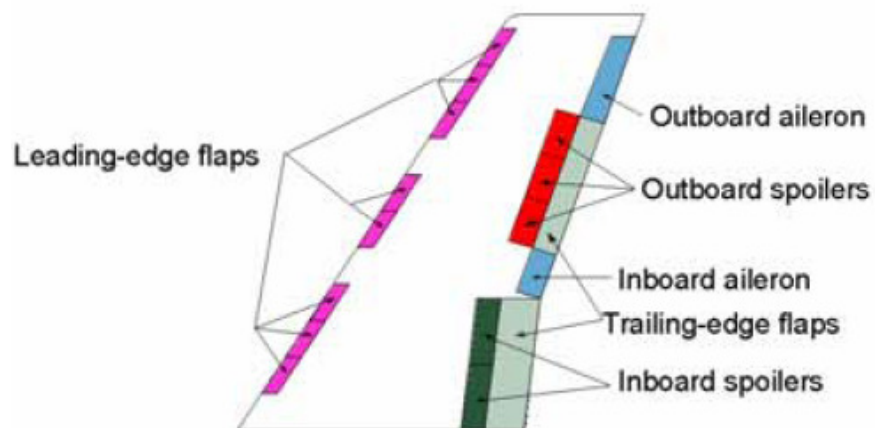
**Winner 2010 Isle of Man TTXGP (Green TT)
Max lap speed 135mph Average lap speed 96.8mph
Lap distance 37.7miles**



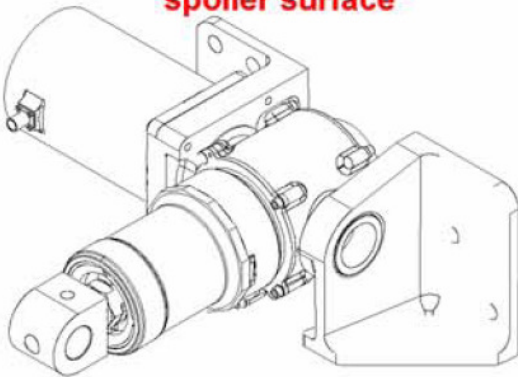
Aerospace Applications

- **“Fly by wire” - Desire to replace large hydraulic systems in aircraft, which are costly in terms of weight and maintenance, with localised electric or electro-hydraulic actuation**
- **Increasing demand is hence put on the electrical supply system requiring on-board generation with generators embedded in the main jet engines**

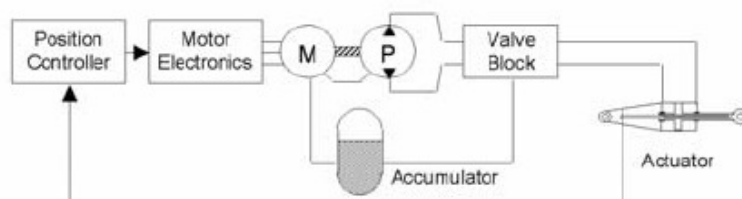
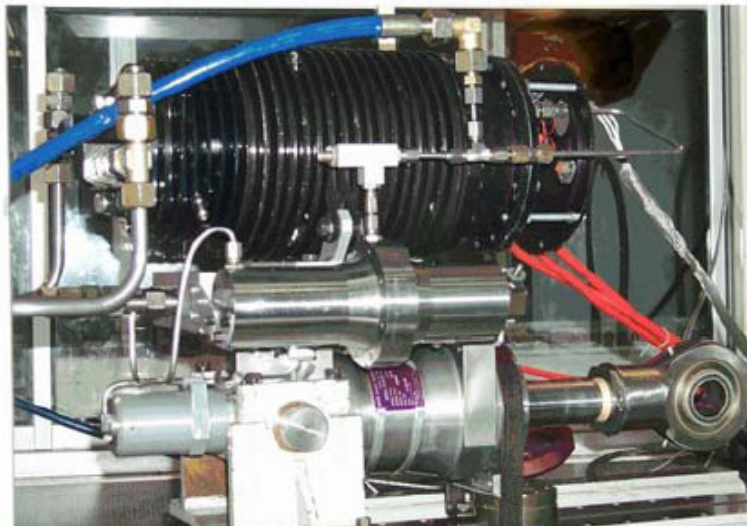
Typical surfaces on an aircraft wing that EMAs would be suitable for



Proposed EMA alternative for a spoiler surface

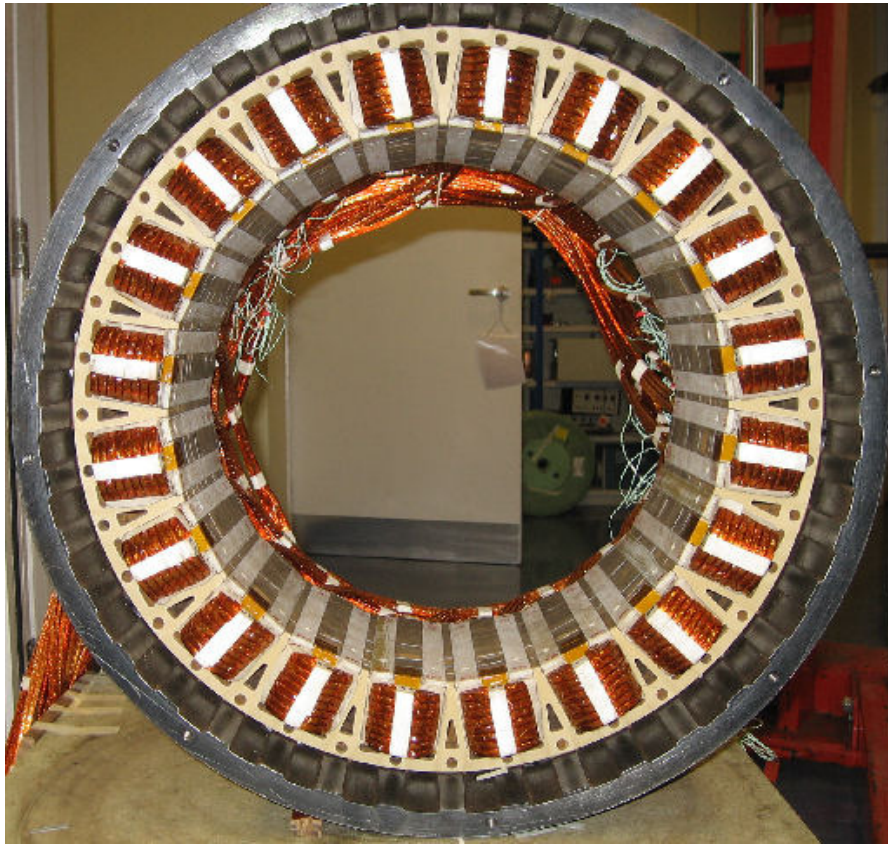


EHA for rudder control



Rolls-Royce University Technology Centre

Electrical LP-Generator



**1000-3000rpm
250kW
200kg active weight**



Consumer Applications

- Many applications that traditionally used mechanical systems such as cams, linkages and levers are turning towards electronic and electrical systems e.g. mechanical timer on a washing machine

Industrial Applications

- Modern industrial processes require accurate control to maintain product quality. Increased use of electrical sensors, data processing, feedback control systems etc.

Medical Applications

- Patient monitoring, non-intrusive scanning, heart pace maker, pressure area care etc.
- Development of a pressure area care system is a good example of how many different branches of science and engineering converge to develop a final product

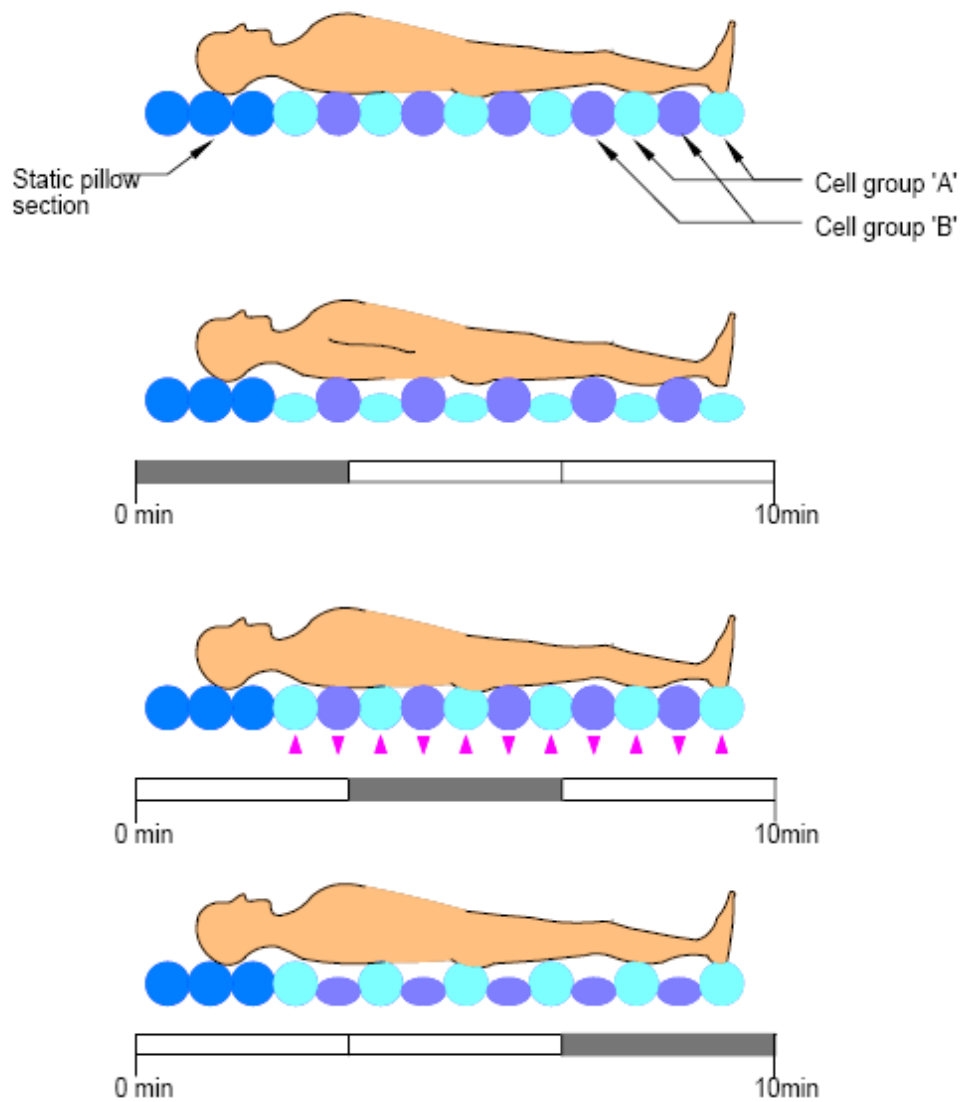
Medical – effect on patient

Mechanical engineering – air-pump & pneumatics

Electrical engineering – design of actuator

Materials engineering – design of pump bellows

Control engineering – pressure sensing & control



Mattress for long-term bed-ridden patients



Leg garments aimed at preventing DVT

Engineers and Engineering is about exploiting energy and converting it from one form to another. Energy may come from a variety of sources e.g. chemical, biological, mechanical, electrical etc. Some examples of energy conversion are:

Car

- Traditional internal combustion engine burns fuel to produce heat and hence mechanical energy. When brakes are applied the kinetic energy of the vehicle is converted into heat energy which dissipates to the surroundings. Modern hybrid and electric vehicles driven by electric machines can recover much of this braking energy and convert it back into electrical energy which can be stored in batteries, super-capacitors etc.

Radio/ MP3 player / Mobile phone etc.

- The chemical reaction in the battery produces electrical energy to power the circuits in the device

Power Station - Non-renewable energy

- Fossil fuels are burnt to produce heat and hence to generate steam. This is then used to drive turbines and produce mechanical energy which is then converted into electrical energy by the generator.

Power Station - Renewable energy

- Uses “free” energy such as solar, geothermal, wave power, wind power, hydro power etc. Conversion is usually directly from mechanical to electrical (wave, wind, hydro).

Biological

- Energy obtained from chemical reactions in digestion and breathing

Most forms of energy are readily stored, e.g. coal, oil, gas, even hydro pumped-storage schemes, but electrical energy can only be stored in limited quantities, e.g. batteries, capacitors or as mechanical energy in flywheels.

Electrical energy is somewhat different as it is usually generated at the instant it is required.