The cockpit of an A380 and, below, a *Star Wars* BB-8 toy that combines an accelerometer and a gyroscope.

GETTING INTO A RIGHT OLD SPIN WHEN WE TAKE TO AIR

Following my previous column on drones friends asked me to try and explain the inner workings of a gyroscope.

For a start let's borrow Newton's wisdom.

Newton's first law of motion tells us any moving object will continue on its path by momentum unless some other force changes its state of motion. Even if you do not apply a stopping force an object will eventually slow down until it stops as there is air resistance and surface friction that counteract its motion.

It is natural that the bigger the applied force the more momentum there is, with the result the object will need a stronger counteracting force to stop its motion.

The same phenomenon applies to objects in rotation.

When a rotational force is applied to a free object it creates rotational inertia, called angular momentum, that causes the object to spin until there is counteracting force to stop the rotation.

It is interesting to note that, like an object under linear force that will not change its direction of movement, a spinning object will not change its direction of rotational axis.

The greater the angular momentum, the more rigid will be the direction of the turning axis.

That is why a perfectly balanced spinning top will not fall since the vertical rotational axis will keep it upright as long as it is spinning fast enough.

Similarly, a moving bicycle will not fall as the rotational axis of the spinning wheels will remain horizontal and stability will be enhanced by increasing speed.

We can also enjoy a stable helicopter ride as the axis of the spinning rotor will remain vertical, thus minimizing any rocking motion caused by disturbances in the air.

That rotational setup is called a gyroscope, especially when the mass of the spinning object is concentrated at the turning circumference like a flywheel to allow for higher angular momentum.

Its rigid axial direction has wonderful applications.

For instance, by installing gyroscopes horizontally and vertically in aircraft their continuous spinning by pneumatic or magnetic means will provide very rigid vertical and horizontal axial directions that are unaffected by plane movements.

With instruments referencing these rotational axes, the degree of movements such as pitch, roll and yaw can be identified and shown on meters for pilots.

The attitude and heading indicators and turn coordinator that pilots rely so much on in controlling planes are some examples.

Similar applications are also common in rockets, spacecraft and satellites as gyroscopes can provide very reliable references for automatic directional control.

The laws of physics are fascinating when we make the effort to analyse them.

They are with us all the time, though we are often not aware of their existence.

Engineers are able to harness these natural forces and apply them to do useful work for us.

Veteran engineer Edmund Leung Kwong-ho casts an expert eye over features of modern life