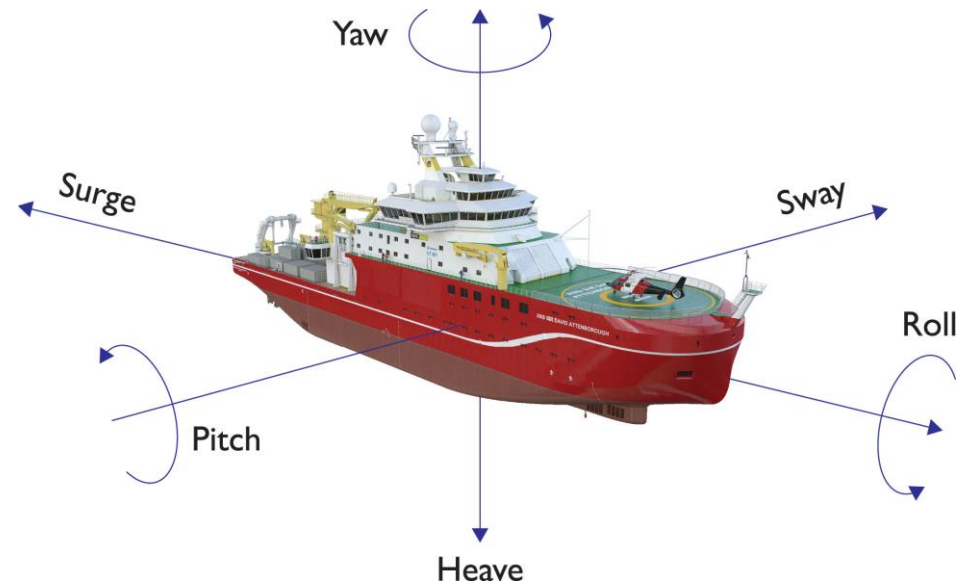


Monitoring pitch and roll

Helping keep the RRS Sir David Attenborough upright!

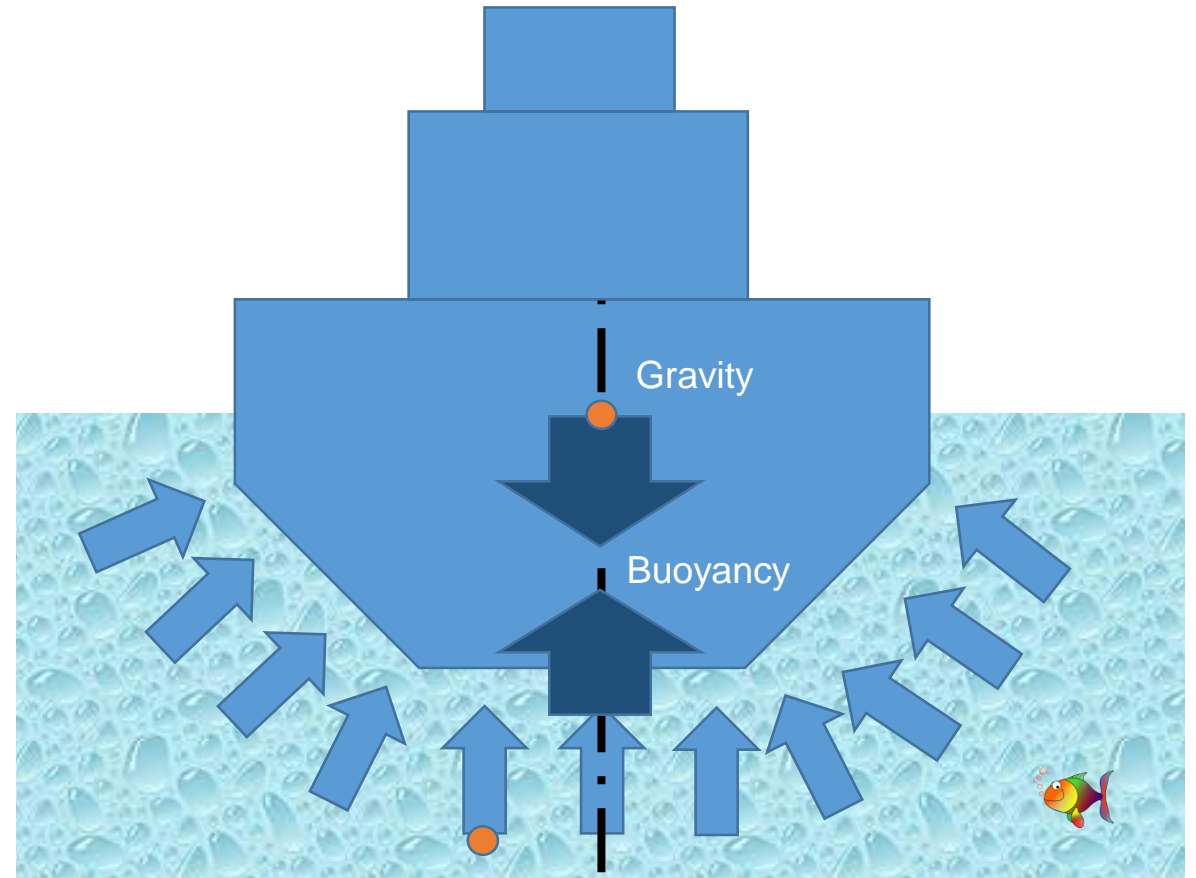


Archimedes Principle

A ship floating in a water is supported by a force equal to the weight of water it displaces. This is Archimedes Principle.

In this example it is STABLE.

If it rolls too far to one side – water comes in and its becomes UNSTABLE, its STABLE position can then be when its upside down!

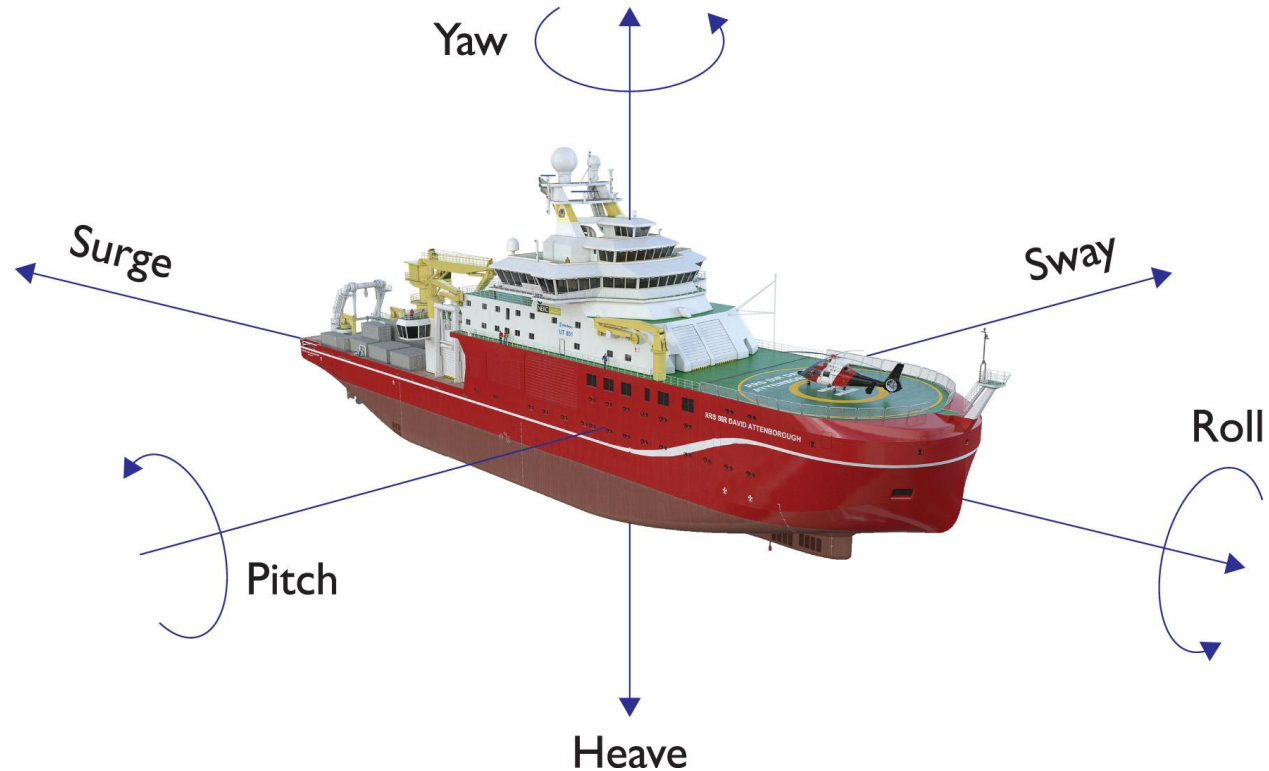


Forces of gravity and buoyancy and their centres

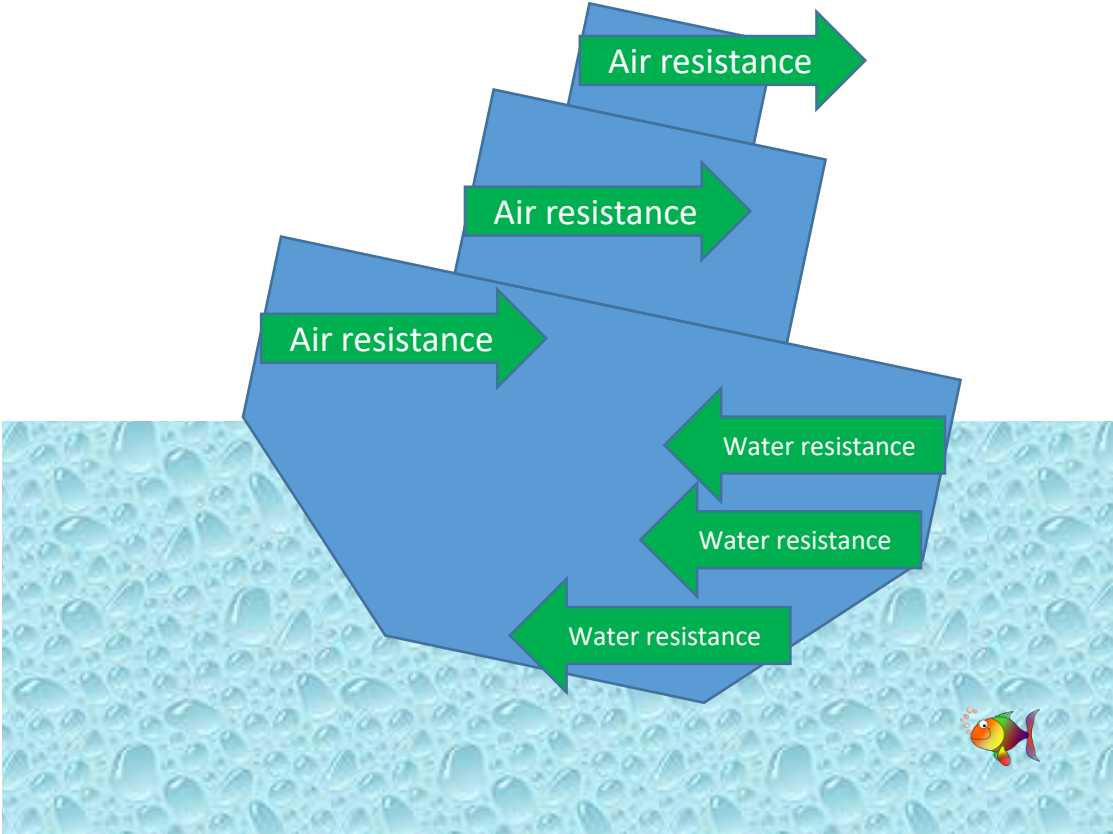
All ships have 6 degrees of movement

Surge, sway and heave are in straight lines.

Yaw, pitch and roll are angular movements.



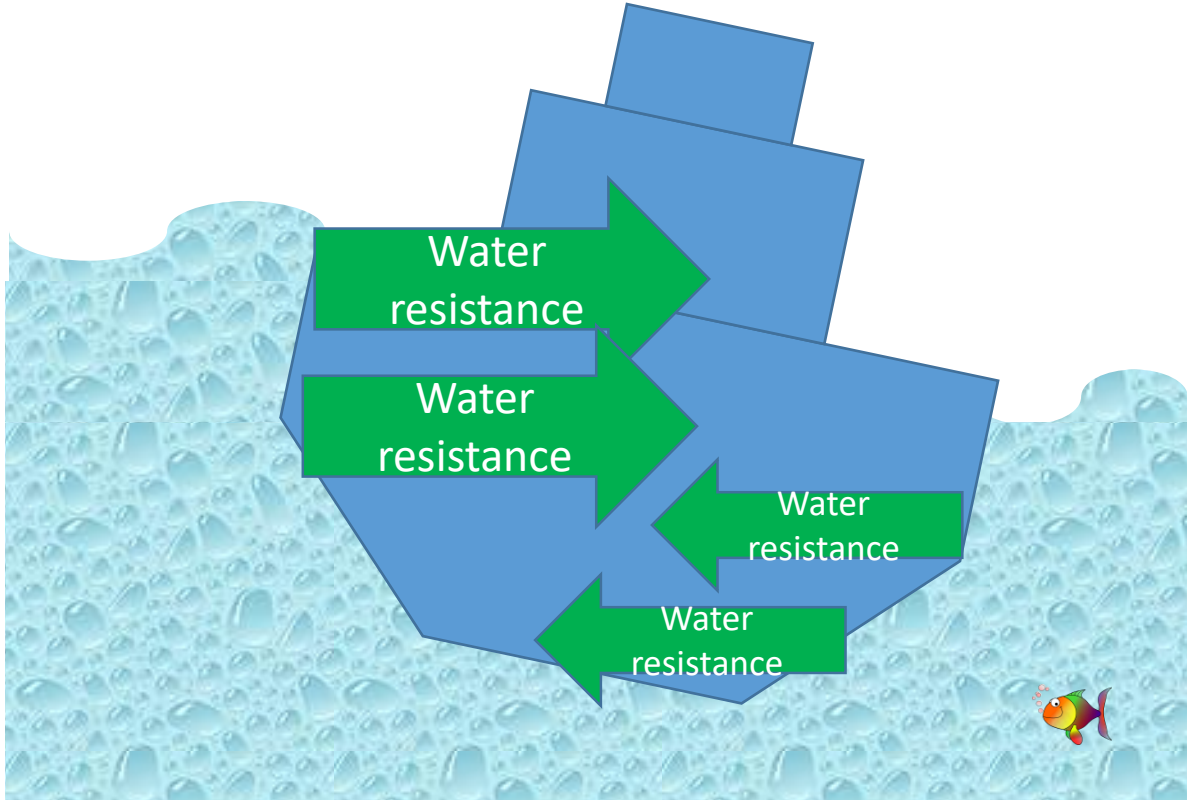
Wind on the ships beam (side) can cause a ship to roll



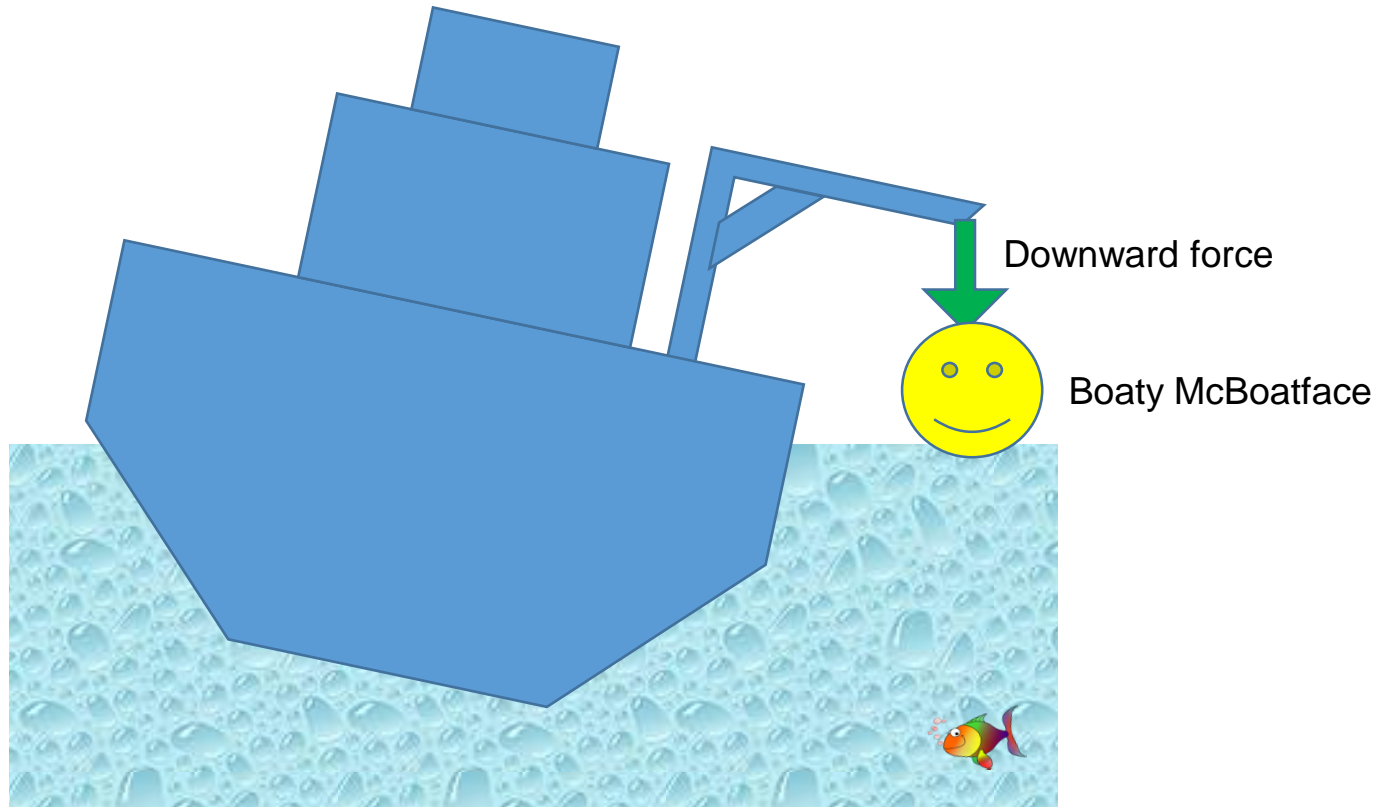
Large waves can affect cause both pitch and/or heel affecting roll depending on the direction of waves



Picture Credit British Antarctic Survey

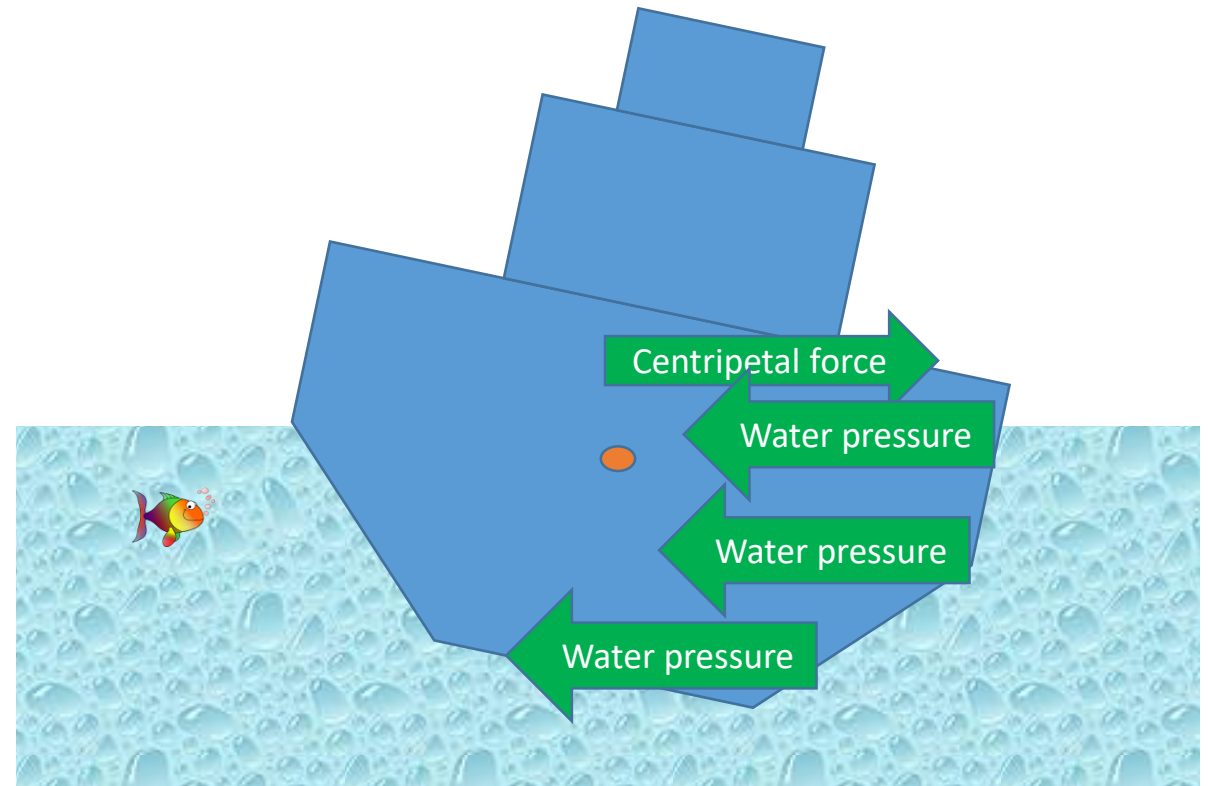


Uneven loading and unloading about the centre line will cause list, increasing its angle of roll



Picture Credit British Antarctic Survey

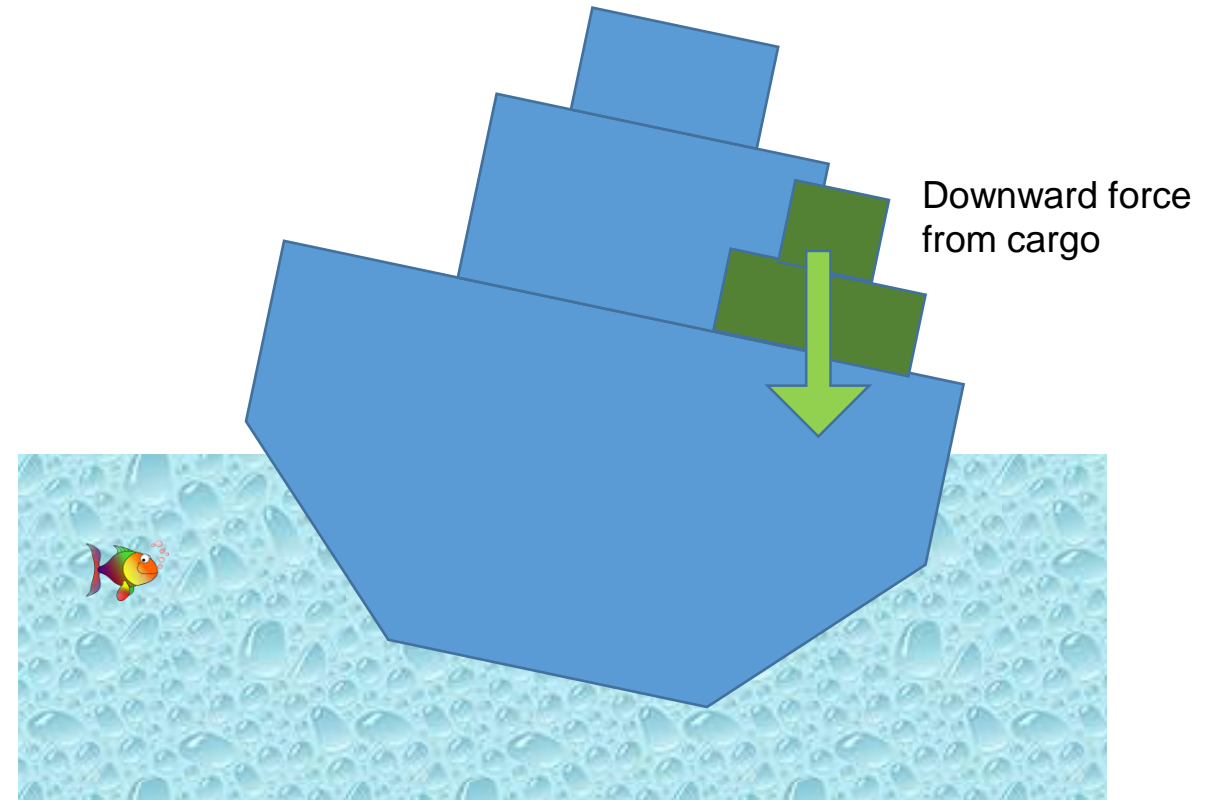
When ships turn this affects its heel angle affecting it's roll



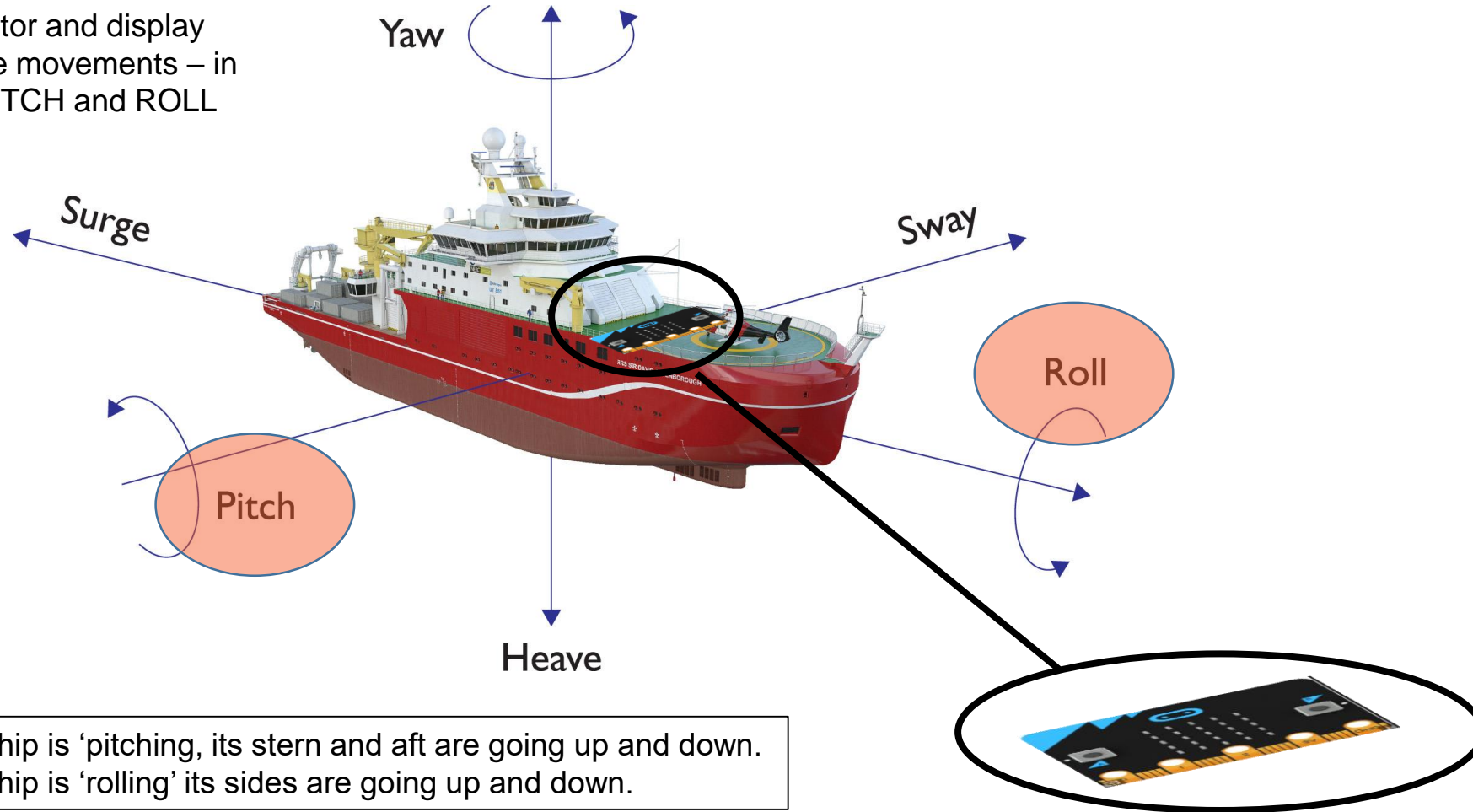
Off centre loading can also cause the ship to list, again increasing its list angle



Picture Credit British Antarctic Survey



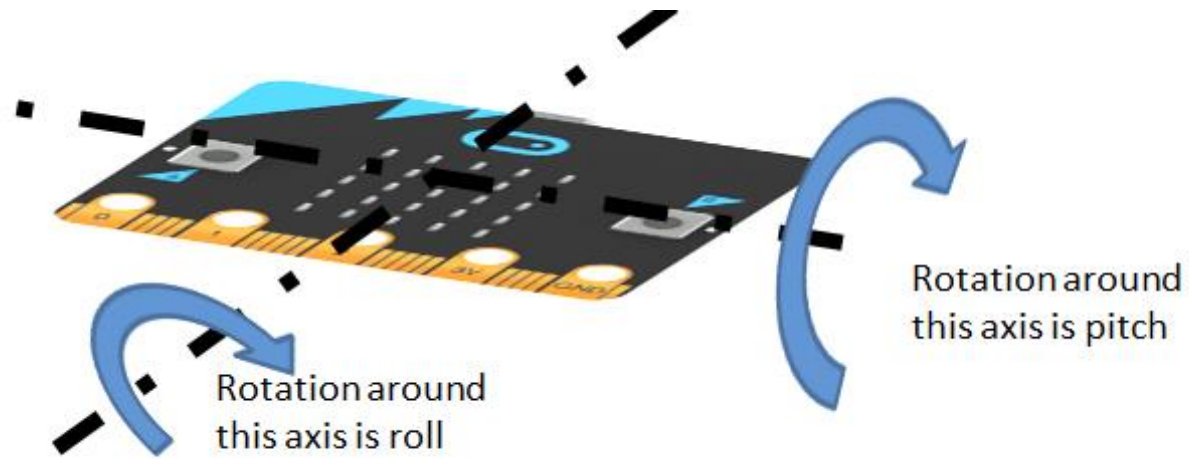
The BBC Microbit is an idea tool to monitor and display two of these movements – in this case PITCH and ROLL



The coding task

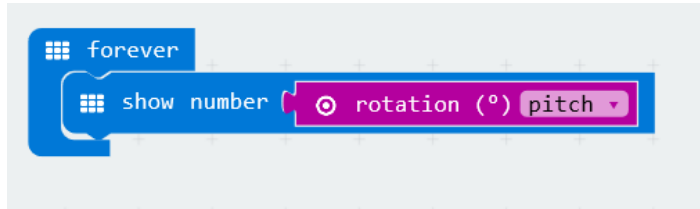
- Write code for your microbit so it can work as an indicator to show angle of roll, angle of pitch and set off a visual alarm when over 6° is reached in either direction
- Challenges:
 - Level 1. Display the angle of roll.
 - Level 2. Display the angle of roll when A is pressed and pitch when B is pressed.
 - Level 3. Create a visual display using the matrix board rather than displaying the angle.
 - Level 4. 3 plus a visual alarm when over 6° is reached in either direction.

Getting started

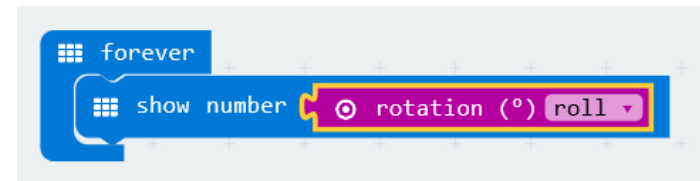


Displaying PITCH or ROLL

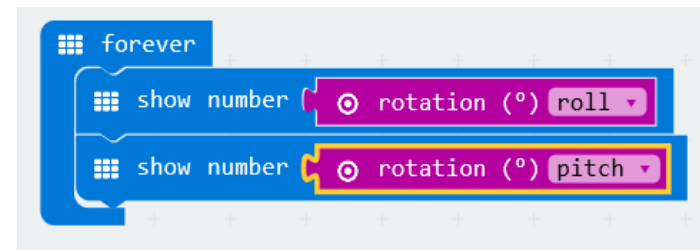
Stage 1 – Shows either PITCH or ROLL angle on your Microbit matrix display



Displays PITCH and:



Displays ROLL

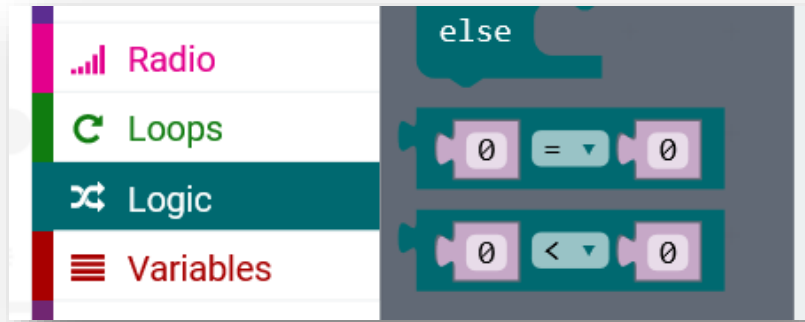


Displays both, one after the other

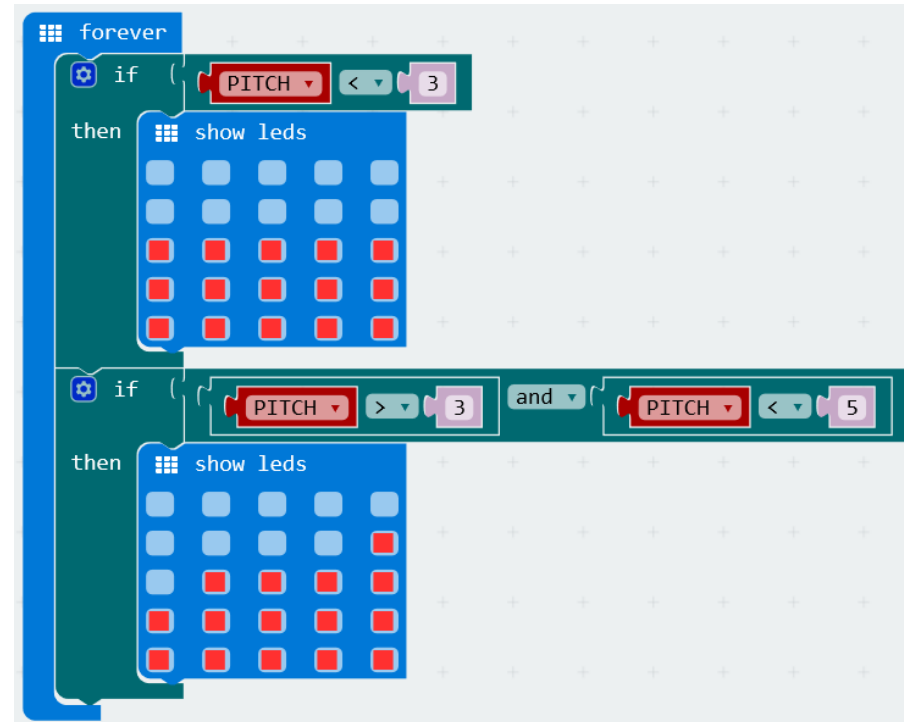
Adding in extra strings makes it clear which one is being displayed next:

```
forever  
  show string "ROLL"  
  show number rotation (°) roll  
  show string "PITCH"  
  show number rotation (°) pitch
```

Next steps



Using logic to set ranges



So the LED display can be used as a Human Machine Interface (HMI)

Evaluating your Human Machine Interface

- Is it clear which is being displayed- PITCH or ROLL?
- Is the information displayed easy to interpret?
- When switching between PITCH and ROLL on buttons A/B does it work reliably?
- It is clear when the alarm is going off and can it be reset?
- What are the limitations to the system?