

Summary

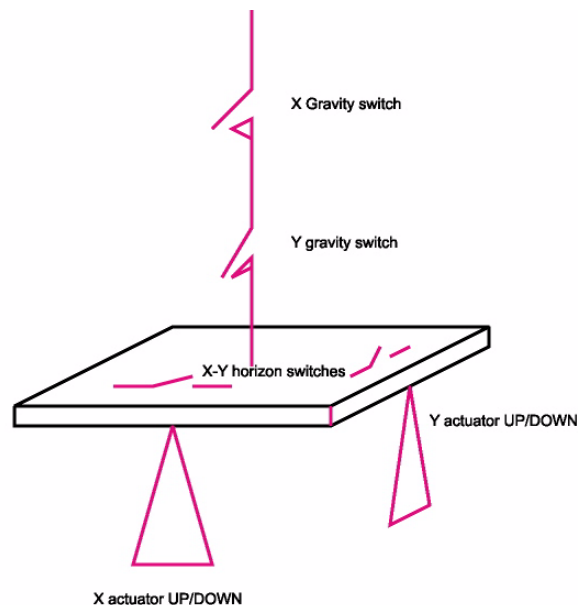
A common application of motion control consists of driving an X-Y platform until it becomes horizontal with respect to the line of gravity. This is typical of off road vehicles where it is desirable to level the seat of the driver or a work-area bed carrying tools and equipment, or level the vehicle itself.

The sensor utilized in these cases is the inclinometer, a device which measures its deviation with respect to the line of gravity. There are many varieties of inclinometers for stationary or vehicular applications. In this case the low cost version equipped with contact switches is suitable to the purpose. Usually this type of inclinometers have at least two contacts (or switched transistors), each one preset to trigger at a specific angle. As an example, in a off-road vehicle one switch is used to warn the driver that a dangerous inclination has been reached (warning angle) and the other to cut off power altogether to prevent overturning (emergency angle). Inclinometers are available with two switches per axis (X-Y) and this is what we will refer to.

Being these outdoor applications, the circuitry must be simple and robust.

Platform setup

The sketch below represents a platform moved by two actuators, equipped with a dual switch inclinometer (for each axis), and two horizon switches indicating if the platform is above or below the horizontal line. The last ones are similar to the traditional mercury switch, where a drop of mercury rushes towards or backs away from the contacts.



Controller setup

The Roboteq controller drives the actuators and is set in analog mode; only relay contacts are used for simplicity. The speed of the motor is proportional to a voltage between 0 and +5 Volt applied to its command pins (pin 10 or pin 11). The voltage at the control pin is so interpreted:

- 2.5 Volt: zero speed.
- 2.5 to 5 Volt: the motor spins forward and the speed increases with voltage.
- 2.5 to 0 Volt: the motor spins reverse and the speed increases as the voltage decreases.

Generating the control voltages

The inclinometer is set with two trip angles, (example: 15 and 5 degrees).

We have three switches for each axis:

- one switch set at 15 degrees (FAST / SLOW). Indicates approaching the HOME position.
- one switch set at 5 degrees (RUN / STOP). Indicates reaching the HOME position.
- one horizon switch indicating above or below the horizon (UP / DOWN).

The above contacts switch three resistor dividers for each axis (X - Y) correspondig to:

- zero speed (STOP).
- Slow speed (SLOW).
- Fast speed (FAST).

Two speeds are desirable to slow down the platform when approaching the HOME position, to avoid over-shooting it and hunting around it.

Putting it together

The figure below shows a possible implementation. The voltages are arbitrary and only the X axis is shown; the Y axis duplicates everything except it goes to pin 11 instead of pin 10.

