



<b>Project ICAROS</b> <b>Report Code</b>	<b>FR-STEX-2016-DEC-07</b>
<b>Title</b>	<i>Flight controls</i>
<b>Start/End Date</b>	15-DEC2016/ 16-DEC-2016
<b>Coordinator name and email</b>	Marc Garrigou – marc.garrigou@ac-toulouse.fr
<b>Name of teachers</b>	Patrice SUIN – patrice.suin@ac-toulouse.fr
<b>Number and age of students</b>	24 students / 16-18 years old
<b>Description of activities</b>	<p><i>During this session, our students in first year of MEI (industrial equipments maintenance) discover flight controls.</i></p> <p><i>The aim is to understand how every action on the radio control permits to adjust the speed of the motors.</i></p> <p><i>They describe separately what motors should increase their speed of rotation in relation to the others in the different intended motions:</i></p> <ul style="list-style-type: none"> <li>➤ <i>to gain or lose altitude, acting on the throttle</i></li> <li>➤ <i>to fly forward or backwards , acting on the pitch</i></li> <li>➤ <i>to turn right or left, acting on the roll.</i></li> <li>➤ <i>to rotate to the right or the left, acting on the yaw.</i></li> </ul> <p><i>Then they draw in every cases, without scale, the lift force due to each motor.</i></p>
<b>Learning outcomes</b>	<p><i>During this teaching sequence the exam skills practised by the students are :</i></p> <ul style="list-style-type: none"> <li>• <i>Appropriating</i></li> <li>• <i>Analysing</i></li> <li>• <i>Carrying out (Implementing)</i></li> <li>• <i>Communicating</i></li> </ul> <p><u><i>The different abilities associated to the degree framework are :</i></u></p> <p><i>HS1.1 listing the mechanical actions applied on a solid. Drawing and characterizing a mechanical action by a force. Experimentally checking the equilibrium condition of the solid submitted to several forces.</i></p> <p><i>HS1.3 Using the torque formula. listing the torques applied on a solid .</i></p>

Photos or other  
relevant material

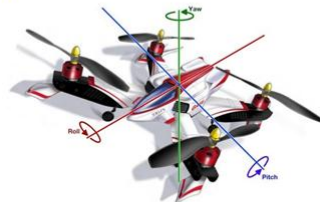


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## Flying a quadcopter

Flying an aircraft consists in rotating it on its 3 axis X, Y et Z (pitch, roll, yaw).  
But since there are no aerodynamic rudders like ailerons, elevators or vertical tail fins which can be found on a plane, it's necessary to vary the propellers speed either in a synchronized manner or not, depending on the targeted motions and direction of the craft.



Therefore every action on the radio control is transmitted to the flight controller that will adjust the speed of the motors.



The four controls available on the radio control are described separately in the following exercise.

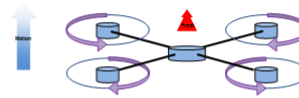


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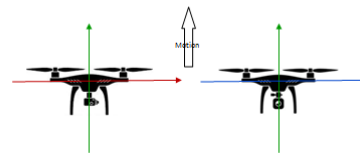


## How to gain or lose altitude? The throttle.

To gain altitude which motors should increase their speed of rotation in relation to the others?  
Highlight their direction of rotation on the diagram.



Draw on these two views, without scale, the lift force due to each motor.

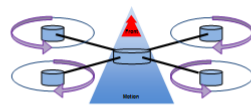


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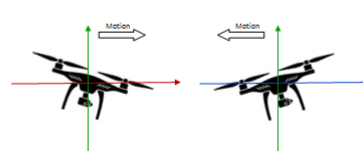


## How to fly forward or backwards? The pitch.

To go forward, which motors should increase their speed of rotation in relation to the others?  
Highlight their direction of rotation on the diagram.



Draw on these two views, without scale, the lift force due to each motor.

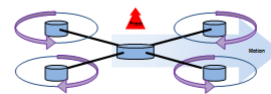


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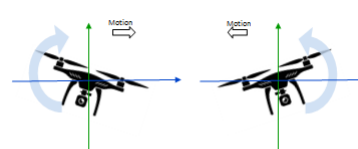


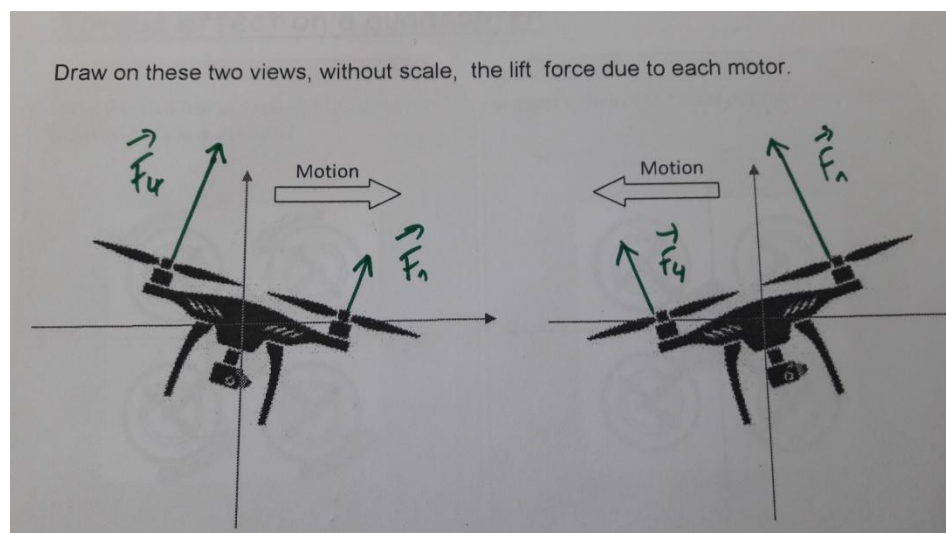
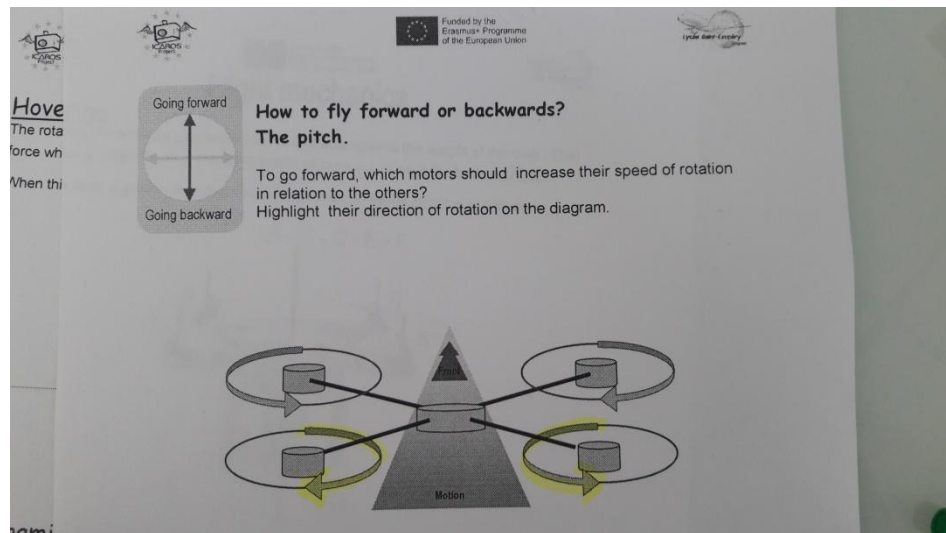
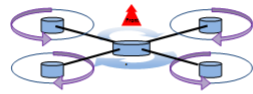
## How to turn right or left? The roll.

To go right which motors should increase their speed of rotation in relation to the others?  
Highlight their direction of rotation on the diagram.



Draw on these two views, without scale, the lift force due to each motor.







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