Giles and Ian got together an produced and ‘Ideal Model’ of the trifoiler in software.

It is aware of the dimensions, mass and moment of inertia of the 10 metre prototype.

It can be fired in a horizontal straight line with a given speed, propeller thrust and ride height. Ride height is specified as height of centre of gravity above the water line.

During flight you can watch what happens and change the thrust and rudder elevator angle.

<https://membershiplist.co.uk/trifoiler/trifoilerloop.html>

It’s important to note that the ride height of the vessel is controlled by the pitch of the vessel; pitch-up to gain height; pitch-down to lose height. Unfortunately, angular momentum is a side-effect of changing the pitch. When the target height is achieved and the elevator change is removed, the vessel will continue to rotate.

Initial attempts to control the ride height of the ideal model with proportional feedback failed badly.

A small improvement was achieved by defining the error as the deviation of the main foil leading edge depth from a set point. However, it never ever got past the first base of the tuning stage (integral and derivate gain set to zero)

Assuming that automatic control of the depth of the main foil is required, when a correction is needed, a sequence of rudder elevator changes will be required.

The sequence will start by initiating the climb or descent.

The sequence will end with an elevator setting that result in a vessel at the required height with zero angular momentum and zero vertical velocity.

My findings indicate that a PID controller using an error defined as above is not able to do this and will never work

If I continue with this thread, I intend to investigate the possibility of controlling the angular velocity of the vessel to a set point. I’m confident that this will be possible.

The end result will be a loop that detects a height error and outputs a required height gradient (dYbYdT or dYbYdX). This output is sent as input to another loop that detects the height gradient of the vessel and outputs a required angular velocity. This output is sent as input to the loop that controls the angular velocity.

All this can be programmed and tested using the ideal model.

It all all sounds complicated. I look forward to being proved wrong and being shown a simpler solution.

In real life, from the sensors, we can calculate

* The horizontal speed of the vessel
* The ride height
* The pitch angle

By observing changes in sensors value we can calculate

* vertical velocity (of centre of gravity)
* horizontal acceleration
* vertical acceleration
* angular velocity

Assuming that automatic control of ride height is required, the hypothesis is that, at any given time, we can load the ideal model with the current status of the trifoiler and get a good approximation of the elevator setting required on the real life trifoiler.