FlyPT mover

GUIDE TO SETUP NO LIMITS 2 (version 1.0)

I made this setup without testing it in the rig.
So be careful using it.
I higly recomend to use the rig gain. Start using the setup with a low gain and progressivelly increase the gain until it's enough for you.
Remember, that you can assign a joystick control or key to adjust the rig gain in the options.

The setups depend on:

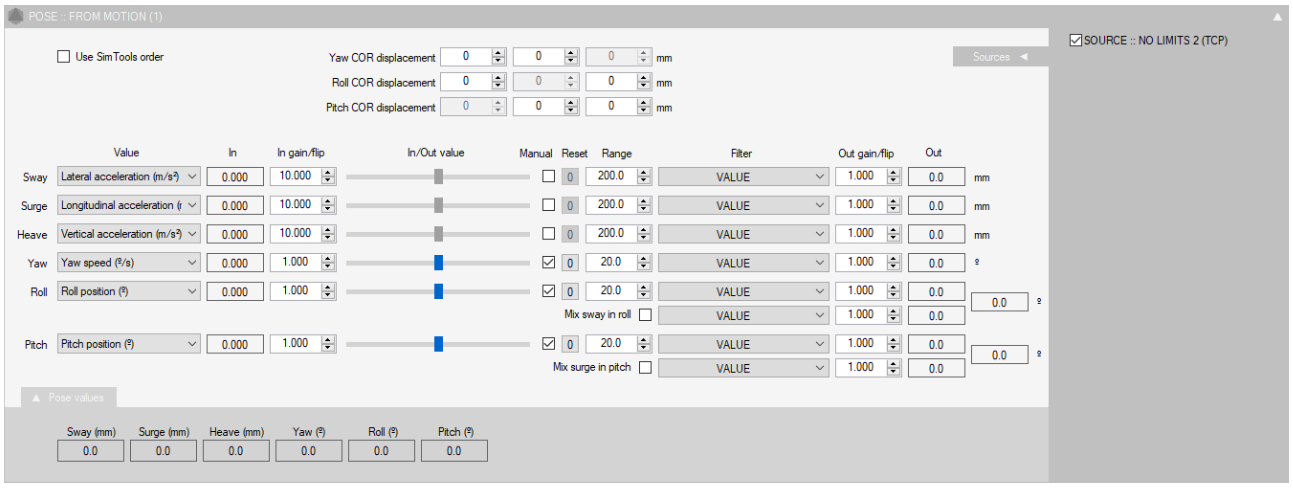
- Taste of the user
- Rig ranges for each degree of freedom
- Rig motors caracteristics (some are really fast, others slow ansering the requests, others smooth the values too much or are to harsh)
- Game and type of game in use

So, this guide is not to explain rigs, sources or outputs.
But remember this:

- Sources get data from games
- Poses create an orientation and position from the values of the sources
- Directs generate actuators that are positioned directlly by source values
- Rigs define the actuators positions on the rig and calculate the position of the actuators to reach the pose calculated in the pose modules
- Transducers drive audio outputs to vibrate or generate infoe about vibration to send to the actuators
- Outputs comunicate with the hardware
- Viewer allow us to preview the motion of the rig or see the values evolution in the graphics.
- Finally, you can have more than one module of each type, and use more than one module has input. Example, you can mix 3 poses in one rig.

Now, let's start with the setup.

The logic I usually follow is based on the traditional motion cueing alghorithm, and that is what is represented in the pose from motion module.
So add that module to Mover and check/uncheck the fields like we have in the image:



POSE :: FROM MOTION (1)

☐ Use SimTools order

☑ SOURCE :: NO LIMITS 2 (TCP)

Yaw COR displacement	0	0	0	mm
Roll COR displacement	0	0	0	mm
Pitch COR displacement	0	0	0	mm

	Value	In	In gain/flip	Manual	Reset	Range	Filter	Out gain/flip	Out		
Sway	Lateral acceleration (m/s²)	0.000	10.000	☐	0	200.0	VALUE	1.000	0.0		mm
Surge	Longitudinal acceleration (r	0.000	10.000	☐	0	200.0	VALUE	1.000	0.0		mm
Heave	Vertical acceleration (m/s²)	0.000	10.000	☐	0	200.0	VALUE	1.000	0.0		mm
Yaw	Yaw speed (º/s)	0.000	1.000	☑	0	20.0	VALUE	1.000	0.0		º
Roll	Roll position (º)	0.000	1.000	☑	0	20.0	VALUE	1.000	0.0	0.0	º
				Mix sway in roll ☐			VALUE	1.000	0.0		
Pitch	Pitch position (º)	0.000	1.000	☑	0	20.0	VALUE	1.000	0.0	0.0	º
				Mix surge in pitch ☐			VALUE	1.000	0.0		

▲ Pose values

Sway (mm)	Surge (mm)	Heave (mm)	Yaw (º)	Roll (º)	Pitch (º)
0.0	0.0	0.0	0.0	0.0	0.0

With those checks, we are going to start the setup just with the linear degrees of freedom (DOF).
I also decided to be courageous, and I want to use 200mm travel in each linear DOF and 20º in the rotating ones, so I adjusted the allowed ranges in the module (anything outside of those values is cropped).

So in the traditional motion cueing alghorithm, the logic is to use acceleration variations on the linear DOF's and the constant acceleration in the rotating ones.
What does it means?
It means that if you are accelerating a car with a constant acceleration, you feel a constant force, and the only way to achieve it in our rigs, is to tilt the rig up (pitch) to simulate that force in our back.
Any variation on the car speed uses the surge and is progressivelly transmited to the pitch while surge goes back to zero slowlly (in such way we don't notice) to be available for the next acceleration variation.

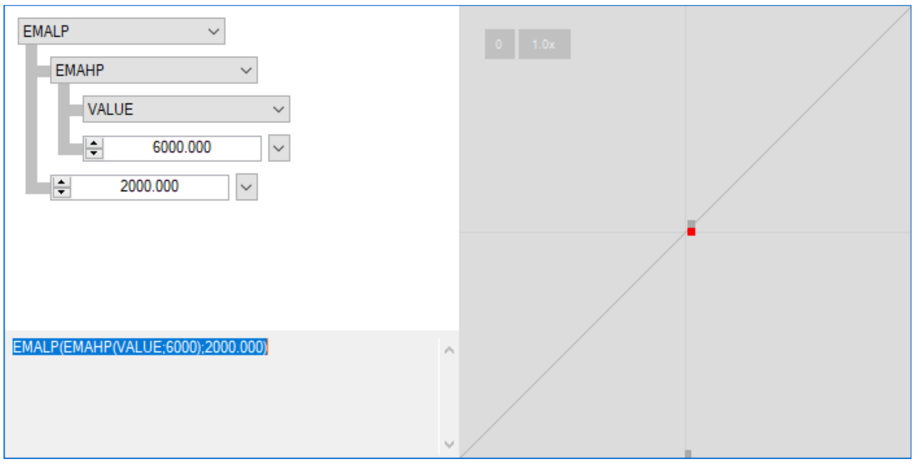
So let's setup our surge to achieve this.
To make the rig go back to zero we need to use the high pass filter (EMAHP).
This filter gives you the variations of the value. If there's no variation the result is zero. So it means the value goes back to zero if there's no variation.
This is exactlly what we want.
But since I want to go back to zero in a smooth way, above the EMAHP, we use an EMALP that smooths the values.
The result is:

EMALP(EMAHP(VALUE;x);y)

To understand better the filters, please look at the filters manual included in the download.

x and y depend on what we want.
Using a low x in the EMAHP, gives us small variations, while using a large value gives us more variation.
Since I want to use near 200mm of travel, I selected to use a value of 6000.
This gives lot's of motion and that lasts longer.

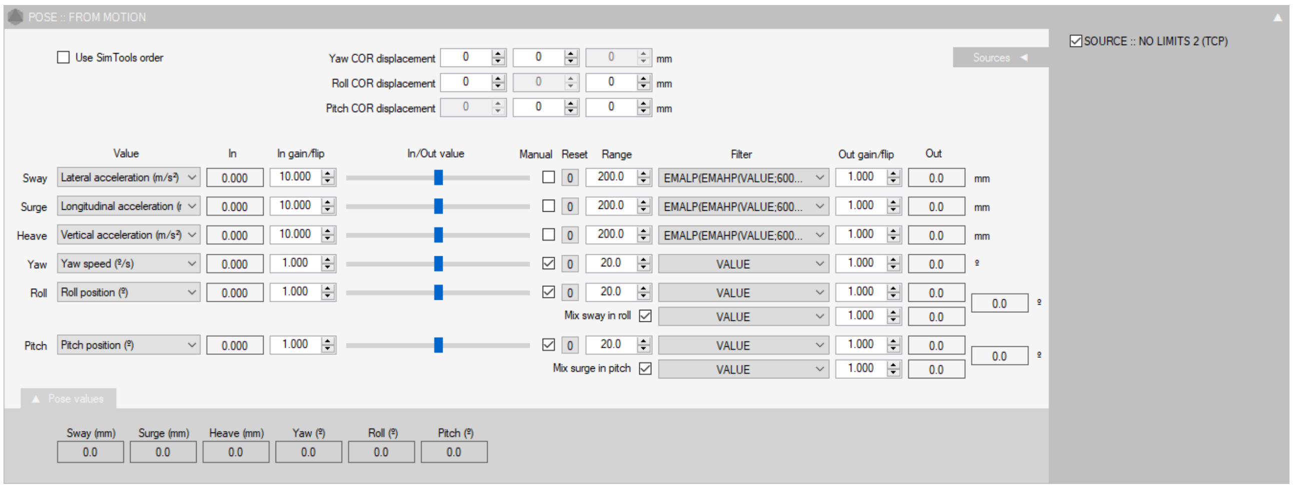
For y I decided to use 2000 to smooth the return.
The result of the filter is:


EMALP
EMAHP
VALUE
6000.000
2000.000

EMALP(EMAHP(VALUE;6000);2000.000)

Now try to move the slider.
The blue bar on the slider is the filter result. You can see the bar follows the slider button, and when you stop, she goes back to zero smootly.
Here we have the linear part of the traditional motion cueing.
Since I like it that way, I use the same filter for all linear DOF's.
That way we keep a relation 1:1 in all directions. 1G feels the same vertically and laterally.

Now let's do the other part of the motion cueing. Represent the constant accelerations in roll and pitch.
That's the mixes. So check them to use them:



POSE :: FROM MOTION

☐ Use SimTools order

Yaw COR displacement	0	0	0	mm
Roll COR displacement	0	0	0	mm
Pitch COR displacement	0	0	0	mm

	Value	In	In gain/flip	Manual	Reset	Range	Filter	Out gain/flip	Out		
Sway	Lateral acceleration (m/s²)	0.000	10.000	☐	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0		mm
Surge	Longitudinal acceleration (r	0.000	10.000	☐	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0		mm
Heave	Vertical acceleration (m/s²)	0.000	10.000	☐	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0		mm
Yaw	Yaw speed (º/s)	0.000	1.000	✓	0	20.0	VALUE	1.000	0.0		º
Roll	Roll position (º)	0.000	1.000	✓	0	20.0	VALUE	1.000	0.0	0.0	º
				Mix sway in roll ✓			VALUE	1.000	0.0		
Pitch	Pitch position (º)	0.000	1.000	✓	0	20.0	VALUE	1.000	0.0	0.0	º
				Mix surge in pitch ✓			VALUE	1.000	0.0		

Pose values

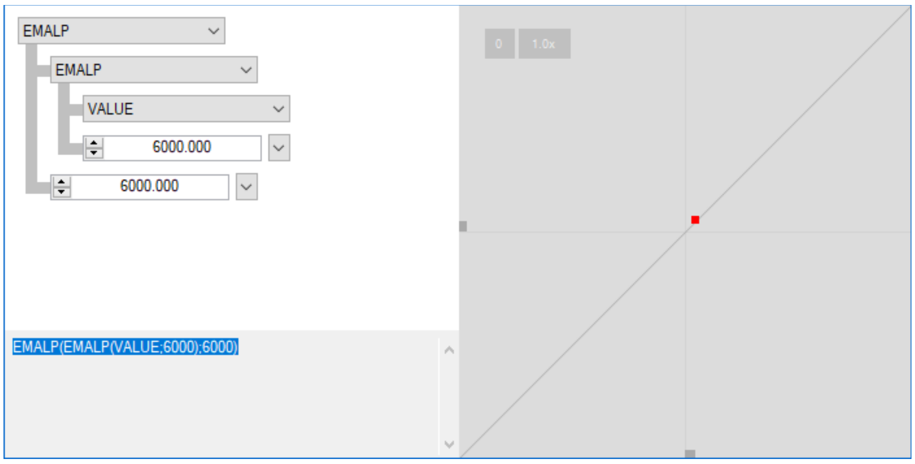
Sway (mm)	Surge (mm)	Heave (mm)	Yaw (º)	Roll (º)	Pitch (º)
0.0	0.0	0.0	0.0	0.0	0.0

☑ SOURCE :: NO LIMITS 2 (TCP)

This means we are using the received value in sway and surge to generate an angle in roll and pitch.
To get the constant value, let's use the EMALP instead of the EMAHP:

EMALP(EMALP(VALUE;x);y)

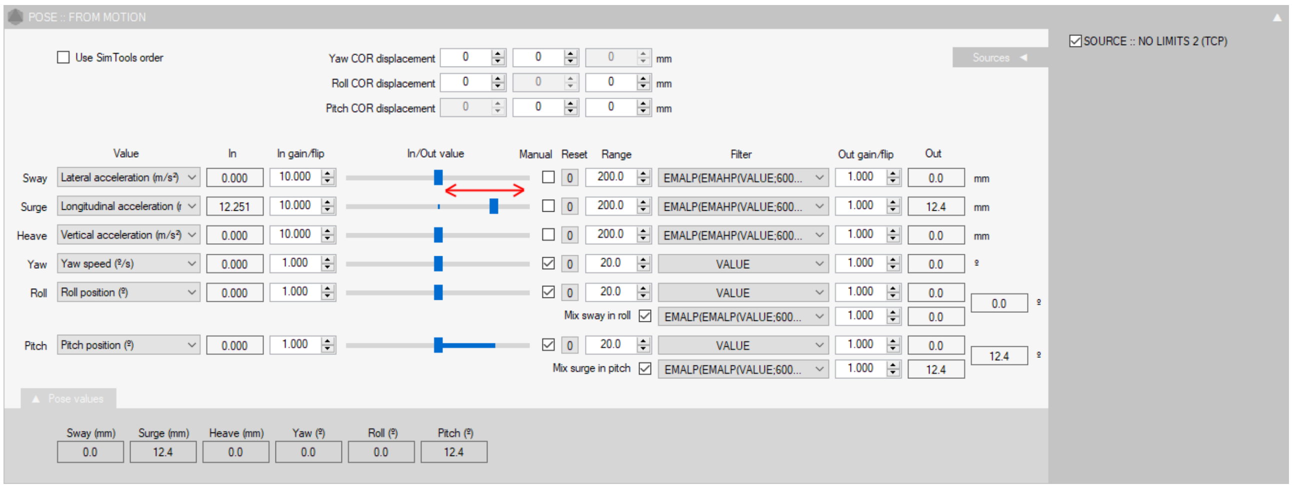
I ended up with this values:



```
EMALP
  EMALP
    VALUE
    6000.000
  6000.000
```

```
EMALP(EMALP(VALUE;6000);6000)
```

Why those?
Put this filter in the two mixes (mix sway in roll and mix surge in pitch).
Then move the surge slider and see what happens.
The surge goes back to zero while the pitch goe to a value (dpends on braking or accelerating).
To select a good value, I think the best way is for you to move the slider around a specific value like indicated in the image:


POSE :: FROM MOTION

☐ Use SimTools order

Yaw COR displacement	0	0	0	mm
Roll COR displacement	0	0	0	mm
Pitch COR displacement	0	0	0	mm

Sources

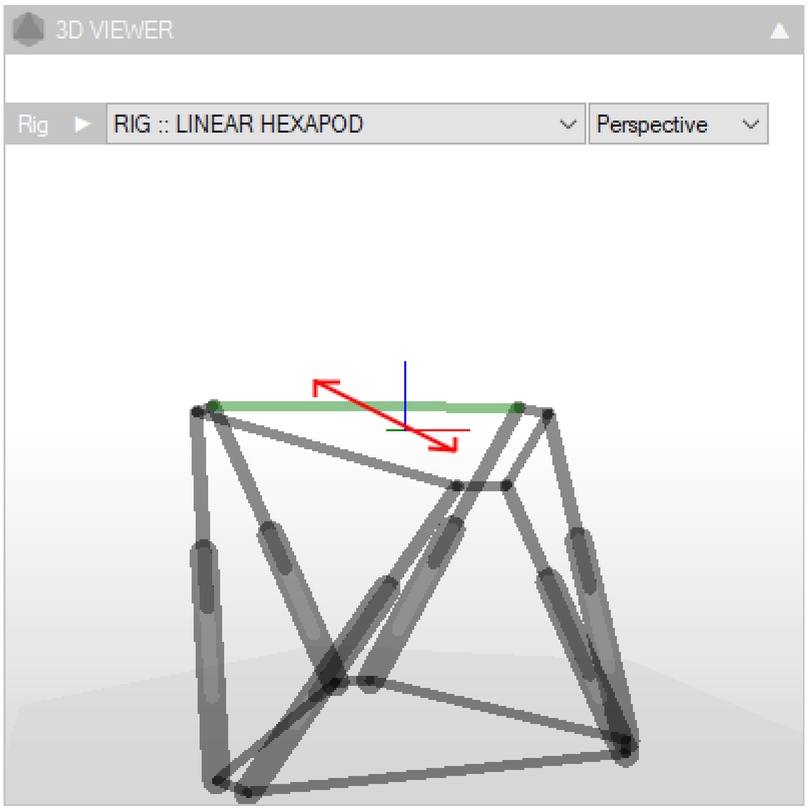
☑ SOURCE :: NO LIMITS 2 (TCP)

	Value	In	In gain/flip	Manual	Reset	Range	Filter	Out gain/flip	Out		
Sway	Lateral acceleration (m/s²)	0.000	10.000	☐	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0		mm
Surge	Longitudinal acceleration (r	12.251	10.000	☐	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	12.4		mm
Heave	Vertical acceleration (m/s²)	0.000	10.000	☐	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0		mm
Yaw	Yaw speed (º/s)	0.000	1.000	☑	0	20.0	VALUE	1.000	0.0		º
Roll	Roll position (º)	0.000	1.000	☑	0	20.0	VALUE	1.000	0.0	0.0	º
				Mix sway in roll ☑			EMALP(EMALP(VALUE;600...	1.000	0.0		
Pitch	Pitch position (º)	0.000	1.000	☑	0	20.0	VALUE	1.000	0.0	12.4	º
				Mix surge in pitch ☑			EMALP(EMALP(VALUE;600...	1.000	12.4		

Pose values

Sway (mm)	Surge (mm)	Heave (mm)	Yaw (º)	Roll (º)	Pitch (º)
0.0	12.4	0.0	0.0	0.0	12.4

If you move it fast, you seen in the 3D view, that the rig moves in surge, and pitch is almost constant.
If we stop the slider on one of the extremeties, the surge goes back to zero and we see the rig tilting.


3D VIEWER

Rig ▶ RIG :: LINEAR HEXAPOD | Perspective

So with this we have the most complicated part of the motion cueing done.

Let's deal with the rotations.

We can do it two ways.
With rotation speed or rotation position.
Problem in no limits 2 is the stability of speed. So we go with position.

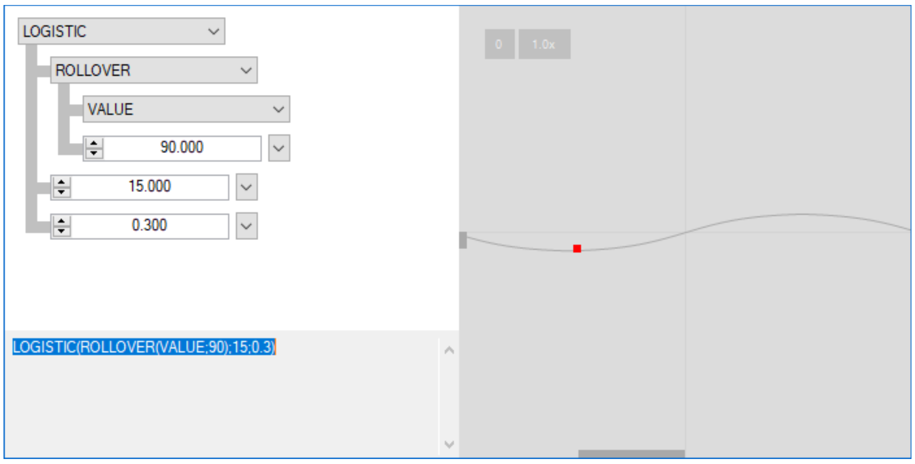
The problem of position is the rollover, when we go from -180º to 180º.
This happens in continuous roll or loops in the rollercoaster.

In the used values, select position for roll and pitch (default).
In roll and pitch, we want to use a range of 20º in the rig.
But since we have the mix, from those 20º, let's keep 5º for the mix, and use the other 15º for roll and pitch.

One way to limit the value to 15 is to use CROP, but then when we reach 15, the rotation stops abrubtdlly.
To avoid this, I recommend the LOGISTIC, that slows down the rotation when we are near or above the limit.

The resulting filter we are going to use is:

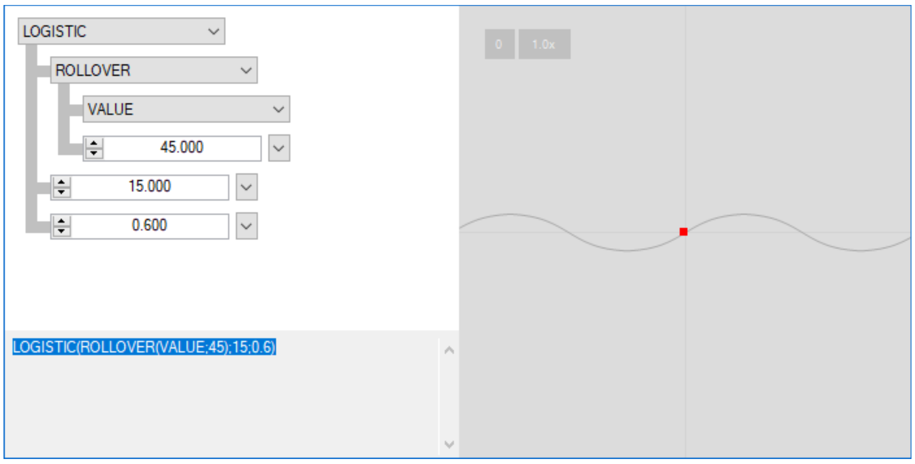
LOGISTIC(ROLLOVER(VALUE;90);15;0.3)



LOGISTIC(ROLLOVER(VALUE;90);15;0.3)

So what is ROLLOVER?
Since roll in No limits goes from -180 to 180, we use half that value.
This means that when roll reaches 90, it goes back to zero.
No limits is special here. While roll is between -180 to 180, pitch is between -90 to 90, so in pitch the filter is:

LOGISTIC(ROLLOVER(VALUE;45);15;0.6)



LOGISTIC
ROLLOVER
VALUE
45.000
15.000
0.600

```
LOGISTIC(ROLLOVER(VALUE;45);15;0.6)
```

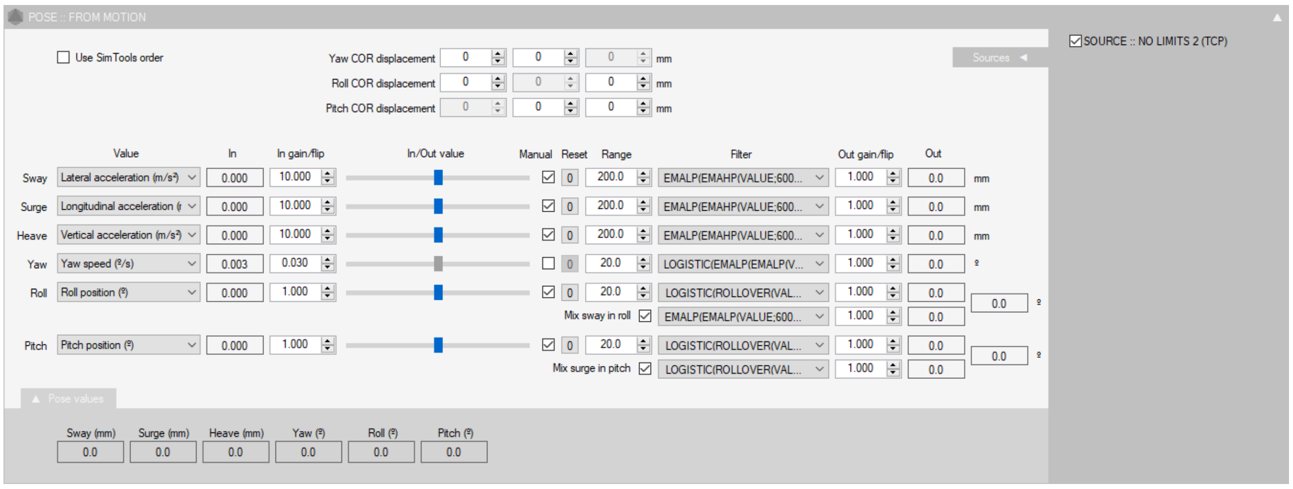
Notice the difference, we used 0.6 on the logistic to keep the wave smooth.

Now ww need to look at yaw.
We could ignore it, because here, it has almost no sense to use it, but if you want to, let's use it with yaw speed and a good snotthing double filter like:

LOGISTIC(EMALP(EMALP(VALUE;1000;1000);20;1)

The logistic, keeps it in the range.
I also use an entry gain of 0.03 because the value is to big.

Result:



POSE :: FROM MOTION

☐ Use SimTools order

Yaw COR displacement	0	0	0	mm
Roll COR displacement	0	0	0	mm
Pitch COR displacement	0	0	0	mm

	Value	In	In gain/flip	Manual	Reset	Range	Filter	Out gain/flip	Out		
Sway	Lateral acceleration (m/s²)	0.000	10.000	☑	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0	mm	
Surge	Longitudinal acceleration (r	0.000	10.000	☑	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0	mm	
Heave	Vertical acceleration (m/s²)	0.000	10.000	☑	0	200.0	EMALP(EMAHP(VALUE;600...	1.000	0.0	mm	
Yaw	Yaw speed (º/s)	0.003	0.030	☐	0	20.0	LOGISTIC(EMALP(EMALP(V...	1.000	0.0	º	
Roll	Roll position (º)	0.000	1.000	☑	0	20.0	LOGISTIC(ROLLOVER(VAL...	1.000	0.0	0.0	º
				Mix sway in roll ☑			EMALP(EMALP(VALUE;600...	1.000	0.0		
Pitch	Pitch position (º)	0.000	1.000	☑	0	20.0	LOGISTIC(ROLLOVER(VAL...	1.000	0.0	0.0	º
				Mix surge in pitch ☑			LOGISTIC(ROLLOVER(VAL...	1.000	0.0		

Pose values

Sway (mm)	Surge (mm)	Heave (mm)	Yaw (º)	Roll (º)	Pitch (º)
0.0	0.0	0.0	0.0	0.0	0.0

☑ SOURCE :: NO LIMITS 2 (TCP)