



ADVANCED APPLICATIONS GUIDE

MotoCrane ULTRA + FlowCine Tranquilizer + Freefly Systems MoVI XL



MOTOCRANE

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DISCLAIMER: The information in this guide is based on real-world scientific testing data of the MoVI XL in order to achieve the highest levels of stabilization performance possible using MotoCrane ULTRA, FlowCineTranquilizer, and Freefly Systems MoVI XL. MotoCrane is not responsible, and does not guarantee the performance, specifications, or service issues relating to third-party products. You must read all technical text from Freefly Systems, FlowCine, and MotoCrane before consulting this guide.

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SUMMARY

This guide provides expert-level insights, tips, and recommendations for the purpose of optimizing the MoVI XL for use with MotoCrane ULTRA. Users may choose to observe and execute some, all, or none of these recommendations. By observing all of these recommendations, our tests have returned nearly unshakable footage (<.01° deflection), at telephoto focal lengths (>85mm), on off-road terrain. For the sake of illustration and explanation, we will focus solely on the pan axis of the MoVI XL.

REQUIRED EQUIPMENT

Freefly Systems MoVI XL + camera mounting accessories (*Testing performed on v1.5 Firmware*)
FlowCine Tranquilizer Standard + Passive Plates + Pan 70 Barrels (*Contact MotoCrane for ordering*)
MotoCrane M6 Standoffs, QR Eliminator, Battery Relocator Cables (*Contact MotoCrane for ordering*)

REQUIRED READING

[FlowCine Tranquilizer Manual V1.0](#)
[MoVI XL Operation Manual](#)
[MotoCrane ULTRA Operation Manual](#)

KNOW YOUR TERMS

Deflection- Angular error, measured in degrees. This is the rotational error that a gimbal corrects for. Deflection is measured in degrees (°), and is more apparent at long focal lengths.

Translation- Linear error, measured in feet/meters. A gimbal *cannot* correct for translation, this is what the ULTRA Isolator does, or the Black Arm. Translation is more apparent at wider focal lengths.

Moment of Inertia- a quantity expressing a body's tendency to **resist** angular acceleration. It is the sum of the products of the mass of each particle in the body with the square of its distance from the axis of rotation.

FLOWCINE TRANQUILIZER PREP

Your Tranquilizer should be prepared with the appropriate Shore O-rings, based on your anticipated weight range. It may be helpful to read through this guide to understand the recommended use of Passive Plates so before choosing the O-Ring quantity and hardness. We recommend the use of non-standard Pan 70 Barrels for the MoVI XL, which can be ordered from MotoCrane directly.

MoVI XL WEIGHT MANAGEMENT

The MoVI XL is the heaviest head compatible with ULTRA, and can easily consume a disproportionate amount ULTRA's payload capacity (55lbs/25kg) if weight is not strategically managed. For this reason, MotoCrane has created two accessories which shed ~13lbs of mass from the XL. Without these accessories you are likely to exceed ULTRA payload capacity.

Contact us for ordering.

- 1) **QR ELIMINATOR**- allows for direct mounting of the MoVI XL to the FlowCine Tranquilizer instead of using the Freely Quick Release, Male Mitchell and Female Mitchell.

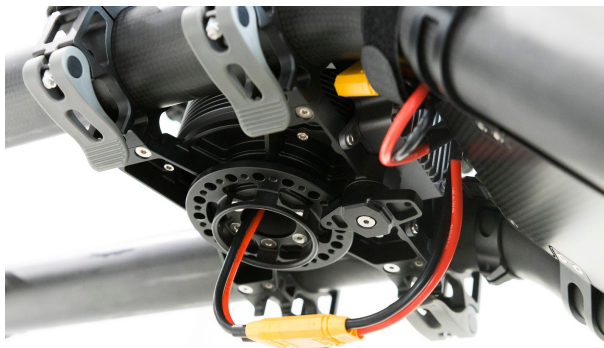
LIGHT (.3lbs)



HEAVY (6.62lbs)



- 2) **15' BATTERY RELOCATOR CABLES**- allows for relocating a single XT90 power source (Freely Battery) up to the Fulcrum. The cable is routed through the hollow Pan axis motor, so operators must be cognizant of cable wrap/twist-up as the XL does not have a sliping for power/video through the Pan Axis.



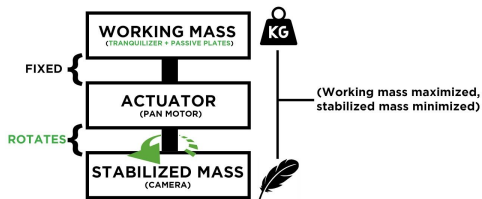
INTRO TO TORQUE, STABILIZED MASS, and WORKING MASS

Fundamentally, all stabilized systems operate similarly. A *stabilized mass* (camera, in our case) is connected to a gyroscope which reads angular error, and an *actuator* (pan motor of the XL) moves to correct for incoming deflections against a *working mass* (Tranquilizer, ULTRA, etc.) Illustrations below will help us further understand how these systems work, and how we can optimize the MoVi XL for ULTRA.

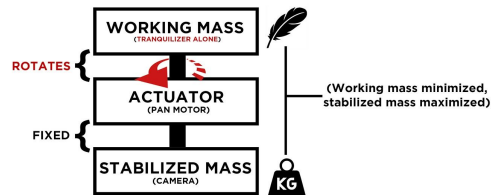
The MoVi XL is the heaviest of all heads compatible with ULTRA (25lbs dry), and uses the most powerful brushless motors of any compatible stabilized head (600+ watts on each axis) to provide lots of torque along each axis. While ULTRA's lightweight construction is beneficial for transport, setup, and reducing all-up weight, the XL pan motor is capable of reaching higher stiffness values when it has more working mass to accelerate and decelerate against. We can add working mass to the XL Pan motor by using the standard Flowcine Tranquilizer and Passive Plates. **As working mass is maximized, and stabilized mass minimized, the XL Pan axis is able to be tuned to the higher Stiffness values required at longer focal lengths.**



In a proper mechanical configuration, the working mass provides adequate inertia so that when the actuator rotates, the torque is predominantly applied to the stabilized mass, and the working mass remains stationary.



In a poor mechanical configuration, the working mass provides inadequate inertia so that when the actuator rotates, the torque is predominantly applied to the working mass, and stabilized mass remains stationary.



The illustrations above explain how working mass (The Tranquilizer + Passive Plates) and stabilized mass (Camera Payload) inertia must be strategically balanced so that pan motor torque is applied predominantly to the camera, instead of backwards to the Tranquilizer and ULTRA.

MAXIMIZE PAN STIFFNESS

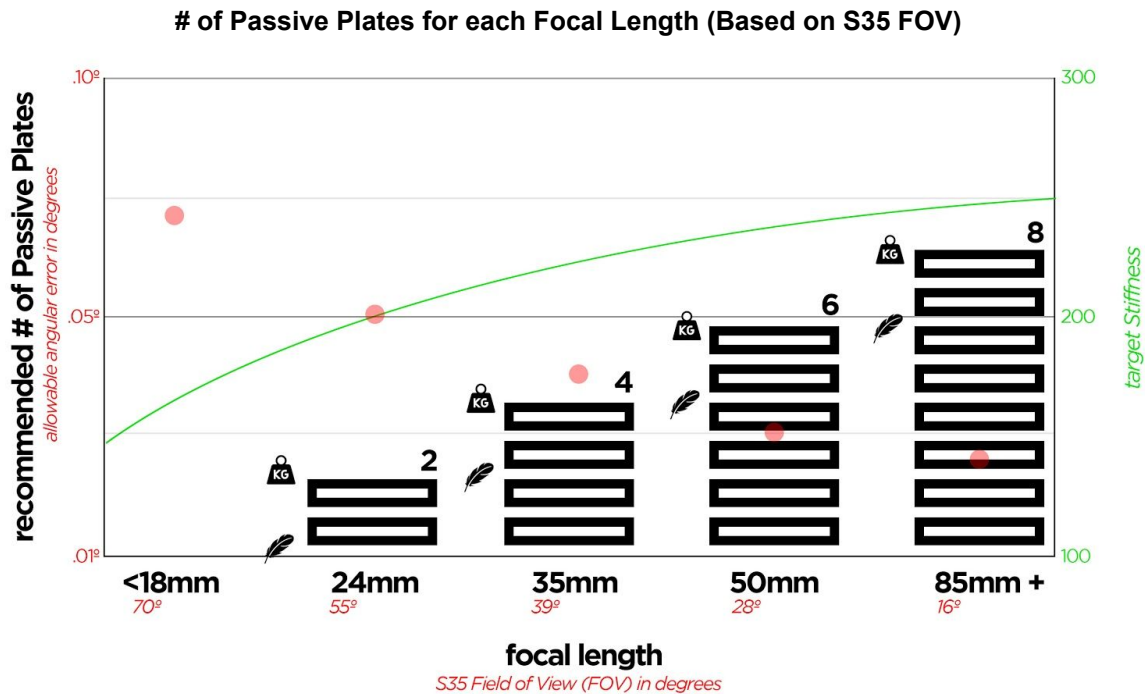
“The primary parameter in the GUI that will need to be adjusted is the Stiffness value for each axis... The “Stiffness” setting needs to be set as high as possible without creating unwanted oscillations.” - MoVi iOS app

Step 1) Configure your Flowcine Tranquilizer for using Passive Plates.

After installing the FlowCine Tranquilizer to the MoVi XL using the MotoCrane QR Eliminator, add **45mm M6 standoffs**, which create sufficient gap for adding Passive Plates underneath the Head Adaptor Plate.



Step 2) With your Tranquilizer prepared to add passive plates, use the chart below as a **general guide** for how many passive plates should be added vs. focal length. As we learned earlier, working mass (passive plates) should be maximized so that pan motor torque is used most effectively to stabilize the camera.



The chart illustrates that shooting at wider focal lengths (18mm) likely does not **require** adding passive plates in order to reach target stiffness (~120), because the Field of View (FOV) is larger, and so is the allowable error. If shooting at a wide focal length, and you're still unable to achieve adequate Stiffness, **Passive Plates should be configured for the longest available focal length when using a zoom lens (e.g. When using the Cabrio 19-90, 6 passive plates are added)**

The chart also illustrates that using a heavy () 85mm lens like our 11lbs 18-85 will likely require the full stack of 8 Passive Plates, while a lighter () 85mm lens like a 2.5lbs prime may require 6 or fewer Passive Plates to reach target stiffness.

WARNING: The 55lbs/25kg payload capacity of ULTRA is inclusive of ALL mass hanging from the ULTRA Isolator, including Passive Plates. The weight of each Passive Plate configuration is listed below for convenience.

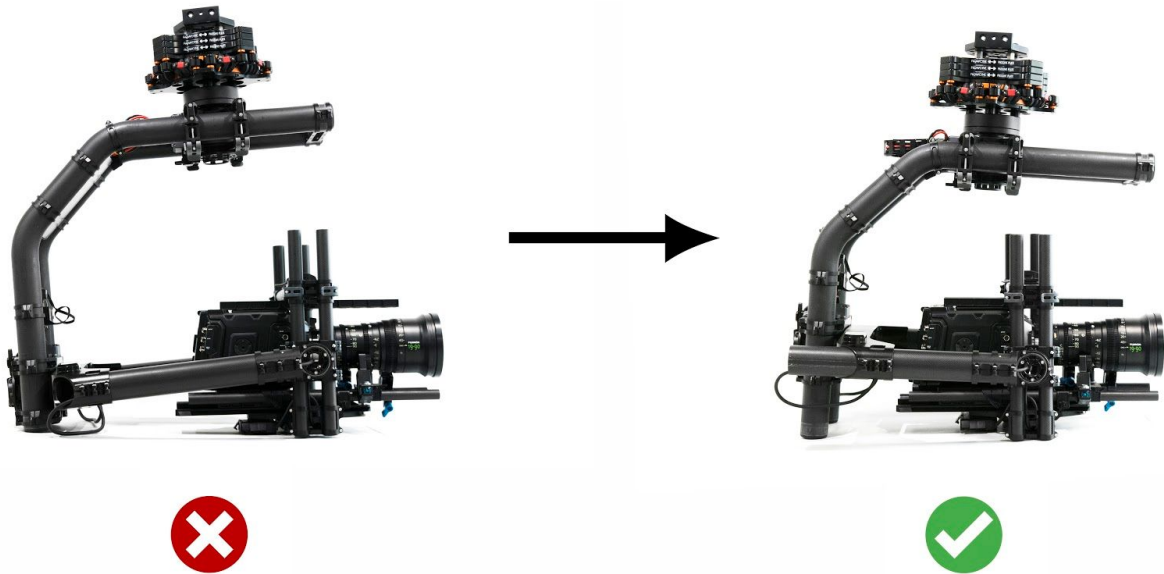
Weight plates:	2 pcs : +1.2 kg / +2.6 lbs	4 pcs : +2.5 kg / +5.5 lbs	6 pcs : +3.8 kg / +8.4 lbs	8 pcs : +5.1 kg / +11.1 lbs
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Failure to observe the payload capacity of ULTRA could result in death or serious injury or damage. Refer to the NOTES section for recommended cameras and lenses based on weight.

NOTE: Passive Plates not only add working mass to the Tranquilizer for maximizing stiffness, they also decrease the amplitude of incoming deflections. This is explained in detail in the FlowCine Tranquilizer Operation Manual.

MECHANICAL OPTIMIZATION

The next two procedures optimize mechanical construction of the MoVI XL for the nominal camera packages used with ULTRA. These optimizations reduce lengths of unsupported material, which reduces the required Filter values during MoVI tuning, and also reduces the moment of inertia of the camera package for more effective use of torque. These optimizations should be done with the XL sitting on a flat, clean work environment with all **power/batteries disconnected!**

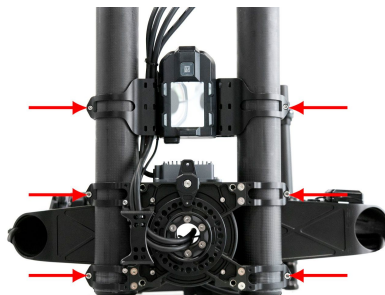


MINIMIZE TRANSLATION (ROLL MOTOR ADJUSTMENT)

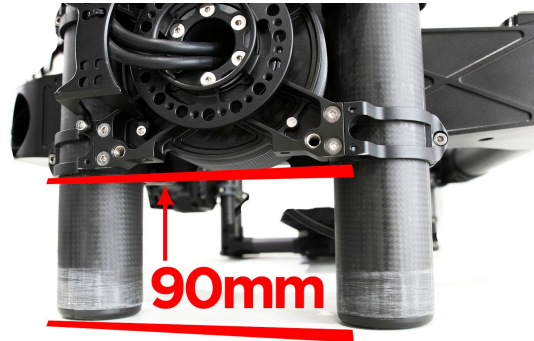
The MoVI XL is physically tall so that long camera packages can tilt 90° down and maintain clearance. While this extra space is convenient for other applications, the typical camera packages used on ULTRA leave large gaps above and behind the camera. This excessive “pendulum length” manifests itself as translation (*see terms above*), as the XL swings underneath the Tranquilizer.

By adjusting the Roll Motor position upwards on the XL cage, the 45mm pendulum length added by the M6 standoffs is offset, and reduces the net pendulum length of the XL by over ~50mm (depends on camera package)

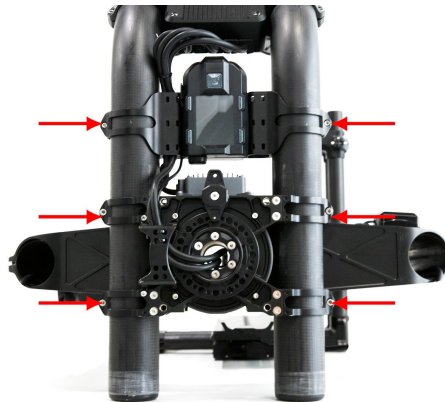
Step 1) Loosen the 2 bolts on the GCU Mount, and the 4 bolts on the Roll Motor Mount (6 total)



Step 2) Slide the GCU Mount and Roll Motor Mount Upwards on the XL spine ~90mm. Make sure your camera package can still look +/- 90° freely without making contact with the XL spine or pan motor. If more room is needed, slide the GCU and Roll Motor Mount downwards on the XL spine.



Step 3) Finally, re-tighten the 2 bolts on the GCU Mount, and the 4 bolts on the Roll Motor Mount (6 total). Even with the addition of the M6 Standoffs for the Passive Plates, we've reduced the pendulum length of the camera package by almost 2 inches.



MINIMIZE PAN FILTER (ROLL ARM RETRACTION)

Roll Arm Retraction eliminates excessive gap behind the camera package. This optimization minimizes pan axis filter by reducing the length of unsupported material along the Roll Arms, and maximizes MoVI XL Tuning Stiffness by reducing the *moment of inertia* (see terms) of the Stabilized Mass. This ultimately means that for the same torque applied by XL pan motor, the angle of the camera package can be accelerated and decelerated more quickly, resulting in more precise angular correction along the pan axis.

This process requires re-routing your TSU Cable, and Tilt Motor ESC Cable, so that the arms can retract.

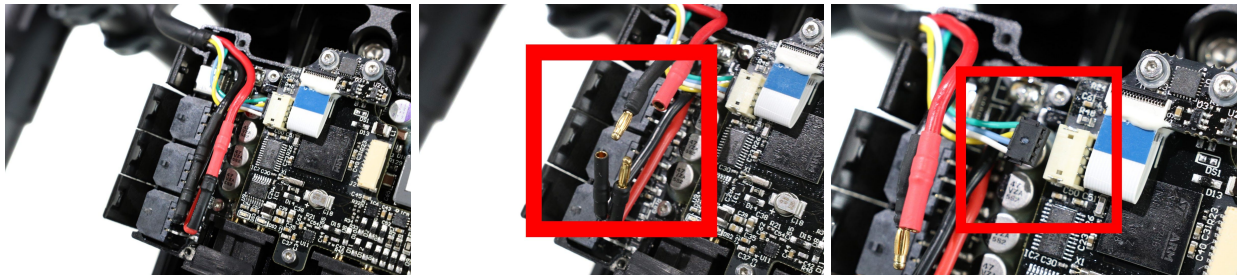
Step 1) Position your XL so that the TSU (Tilt Stage Unit) is facing outwards for service.



Step 2) Remove the 4 screws securing the TSU cover, and remove the TSU cover.



Step 3) Remove the white heat shield, disconnect the red and black bullet connectors, then **carefully** remove the small black data connector from the white receptacle to free the TSU Cable.



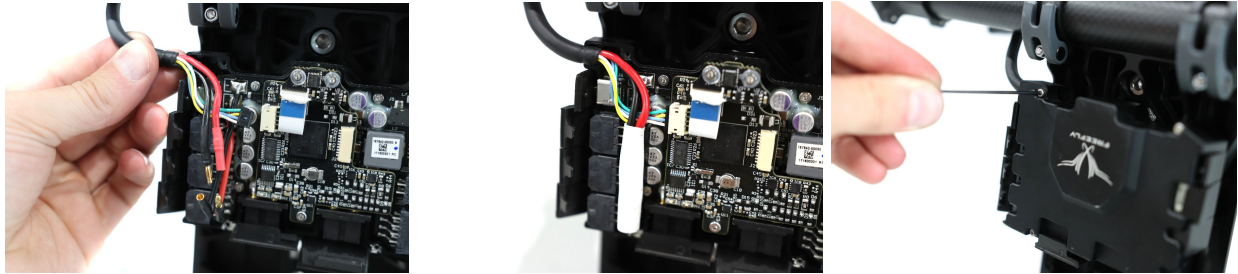
Step 4) Remove the front foam plug from the passive carbon fiber Roll arm, then remove the rear foam plug and **carefully** feed the TSU cable back through the Roll arm, finally remove the center carbon fiber plate to pull the TSU cable through the Roll arm (Cable should stay routed through the Roll motor.)



Step 5) Rather than feeding the TSU Cable back through the aluminum Roll arm, route the cable under or over (whichever is less likely to snag) the aluminum Roll arm, and then into the carbon fiber tube, and finally back through the Tilt cage down to the TSU.



Step 6) Reconnect the black data connector, reconnect the red and black bullet connectors, replace the heat shield, and finally replace the cover using the 4 fasteners originally removed. Make sure no cables get snagged or damaged, and check that all rubber connector covers can be properly seated around the perimeter of the TSU cover.



Step 7) Disconnect the cable guard from the Tilt Motor ESC, then carefully lift the power and data cables up through the gap between the ESC and the mount.



Step 8) Carefully disconnect the Tilt power and data cables, and push them back down into the CF tube.



Step 9) Remove the rear foam plug and route the Tilt ESC Cable back through the aluminum Roll arm.



Step 10) Just like TSU Cable, route the Tilt ESC under or over (whichever is less likely to snag) the aluminum Roll arm, and then into the carbon fiber tube, and finally up through gap between the ESC and the mount.



Step 11) Reconnect the Tilt ESC power and data cables, then carefully route them back into the tube, and replace the Tilt ESC cable guard.



Step 12) Remove both rear Roll arm stopper screws, and loosen the 6 Roll arm clamp fasteners.



Step 13) Retract your Roll Arms to the desired length, making sure the rear of your camera package still has adequate clearance for rotation, then tighten the 6 Roll arm clamp fasteners.



Step 14) Loosen the Pan Motor cable guide clamp, and slide it back, this will make room for the Pan Motor to slide further back for balancing.



Step 15) Ensure that all fasteners have been re-tightened, cables have been properly routed and connected, and the camera package is free to rotate without resistance or interference.



MECHANICALLY OPTIMIZED MoVI XL

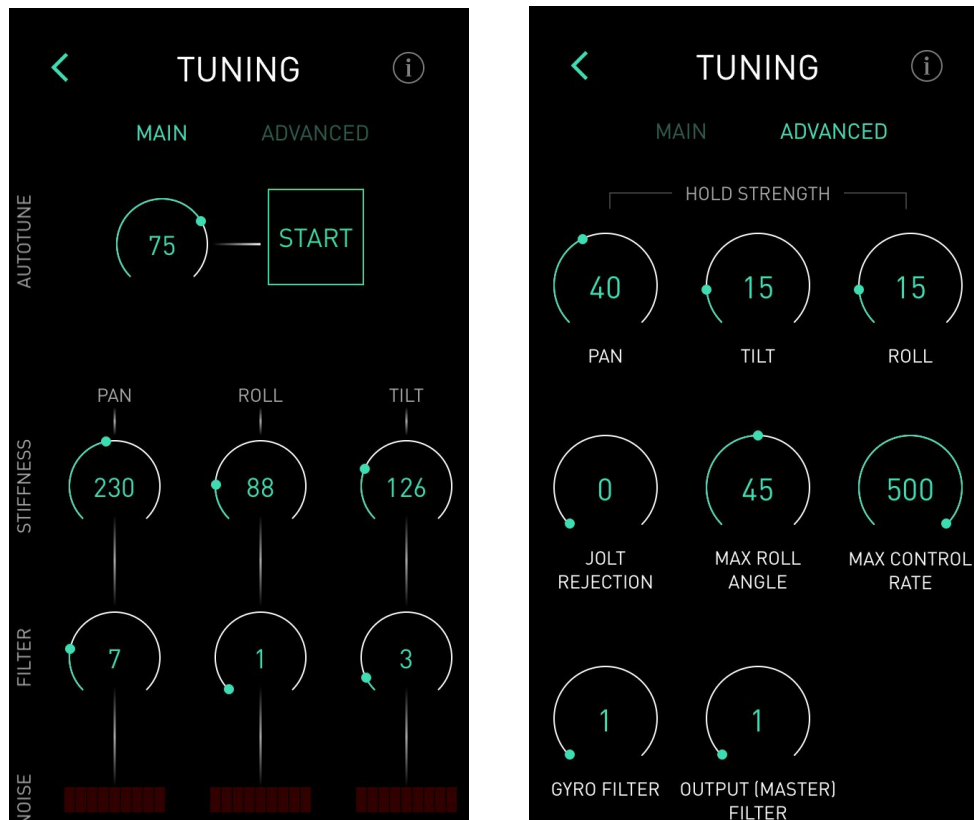
MoVI XL Tuning

Our recommendations for tuning are the same as those provided by Freefly Systems. Stiffness is the most important setting in the MoVI Tuning interface, and your goal is to maximize it without creating oscillation. High Pan Filter values (generally indicate mechanical resonance, or insufficient working mass). By adding the Passive Plates, and with mechanical optimizations, your XL should have no issues reaching adequate Stiffness values for optimum performance.

- 1) With MoVI Booted up, manually set Stiffness to **30** for all 3 axes, and Filter to **1** (including Gyro).
- 2) Position ULTRA at 12 o'clock, Activate XL motors, and point the XL forward.
- 3) Set Autotune to 75%, and run Autotune. Once complete, review your Stiffness and Filter.
- 4) We usually see that we can reduce Pan Filter by 1-2 values, and increase Pan Stiffness by 10-20.
(As you are adjusting, pan around 360, and tilt up/down to make sure no oscillations develop.)
- 5) Hold settings of 25-40 should be sufficient, we have not found benefits of higher hold settings.
- 6) Jolt Rejection we have not found a use for, due to relatively low Hold Values.

NOTE: In our experience, Blackjack firmware requires very high Hold settings of 90+ on Pan for optimum performance. As a reminder, all our testing was performed on v1.5 Firmware (not Blackjack).

Sample tuning values below from the pictured MoVI XL + URSA Mini Pro, Fujinon Cabrio 19-90, FI+Z.



In this example, we are tuning for 90mm- the longest focal length on the lens, which is relatively light so we're using 6 passive plates. Autotuning at 75% yielded Stiffness of 220 and Filter of 8.

We're able to manually increase Stiffness to ~230 and decrease Filter to ~7.

NOTES

RECOMMENDED CAMERAS *(based on low mass- list is not comprehensive)*

Arri Alexa Mini

Red Weapon

Sony Venice

Panasonic EVA-1

Blackmagic URSA Mini Pro

Canon C100, C200, C300, C500

RECOMMENDED ZOOM LENSES *(based on low mass- list is not comprehensive)*

Angenieux EZ1, EZ2, Optimo 16-42

Arri Alura 15.5-45, 30-80

Canon CNE 15.5-47, 30-105, 18-80 EF

Sigma 18-35, 50-100

Tokina 11-16, 11-20

Fujinon Cabrio ZK 19-90, XK 20-120

Zeiss LWZ.2 28-80, 15.5-45, LWZ.3 21-100

REVISION HISTORY

VERSION	DATE	DESCRIPTION
1.0	JULY 11, 2019	Initial release by Zachary Nelson