Starlight Xpress USB Filter Wheel

A Review for First Light Optics by Steve Richards

Introduction

Anyone who has tried swapping filters in and out manually by screwing each one into a suitable receptacle in the light path during an imaging session will soon realise the joy of a filter wheel! These devices are available in three guises, manual, electro-mechanical and software controlled with prices increasing in the same order.

For many applications, a manual filter wheel is perfectly adequate and it normally has the advantage of a robust physical detent to locate each filter in exactly the right position in the light path. To allow you to rotate the filter wheel within its housing, it is necessary for the edge of the wheel to protrude through the outer casing and this can be a source of both light leakage and dust ingress, both of which are highly undesirable!

Electro-mechanical versions have a built in motordrive to rotate the wheel which is actuated by a small handset controller to advance the wheel one filter slot at a time. This design allows the filter wheel casing to be entirely enclosed and because no physical contact is made with the equipment by the user, there is no risk of inadvertently moving the camera.

Using a software controlled filter wheel means that changing filters during an imaging session can be carried out automatically leading to unattended operation but there is a caveat to this. Even with so called parfocal filters, there is no guarantee that the focus position for each filter will be the same as the focal plane for each colour may differ depending on the quality of the other optics in the chain. This issue can be resolved by the use of an auto-focusing system that checks focus either between frames or between filter changes.

Specification of the review sample

Filter Type:	1.25” threaded	
Filter Capacity:	7	
Weight:	Filter wheel	742gm
	Off Axis Guider	101gm
Dimensions:	190mm x 190mm x 29mm (with T adapters)	
Interface:	USB 2.0	
Power:	Via USB port	
Price:	USB Filter Wheel	£299.00
	Off Axis Guider	£169.00
Supplier:	First Light Optics	

The subject of this review is the software controlled Starlight Xpress (SX) USB Filter Wheel. Starlight Xpress are well known and respected for their excellent CCD imaging cameras and guide cameras so this product is a departure for them but a natural one at that. I own two of their CCD cameras, a one shot colour SXVF-M25C with an APS ‘C’ sized sensor and a mono SXVF-H9 with a smaller sensor 8.98mm x 6.71mm in size. The SXVF-H9 is ideal for use with 1.25” filters so the unit submitted for review came with the 7 x 32.5mm (1.25”) filter carousel option. Other carousel options include 5 x 50.8mm (2”), 7 x 36mm unmounted and 5 x 50mm unmounted filters.

What's in the box?

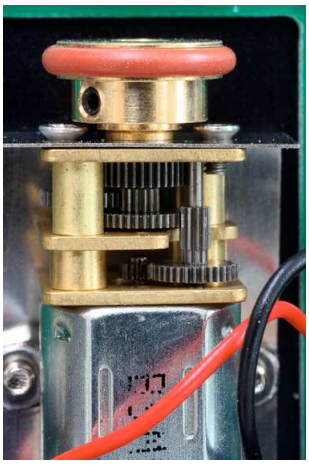
The Starlight Xpress filter wheel is supplied in a bright red Hofbauer hard carry case with a fitted foam interior. Included in the kit is a 3 metre USB cable and a CD-ROM containing utilities and PDF manuals covering installation and setting up. Rotatable female and male 'T' thread adapters are supplied installed on the front and rear faces of the wheel using three small pan head bolts.

Description

The 21mm deep filter wheel casing comprises a 6.0mm thick, 17.0mm deep aluminium ring with two rebated aluminium face plates of 3.0mm thickness making for a substantial, well engineered casing which, with the bare filter wheel installed weighs in at 742gm. All the aluminium parts are nicely anodised in black and the unit has a purposeful look although the edges do have a rather sharp feel to them – bevelling would have given a much 'softer' feel. The supplied male and female 'T' adapters add another 8mm to the back focus.

A small printed circuit board is neatly installed in a machined recess in the front faceplate and this contains the control electronics, USB port and an RJ12 socket that supports serial port control or manual control via an optional hand controller. The two ports exit conveniently through the side of the unit.

The motordrive is installed on the front faceplate in a small cut-out in the circuit board mounted on a sprung steel base to ensure an even pressure on the underside of the carousel using a rubber wheel drive. The tiny motor connects to a nicely made reduction drive that reminded me of the movement in a fine clock.



The carousel has the filter numbers stamped on its surface and these are visible through the rear faceplate. There is a set of three bolts associated with each filter position which are used to trigger three 'Hall-effect' magnetic sensors on the circuit board to encode the exact position of the filter wheel. This system has an advantage over optical sensing as there is no risk of stray signal light being detected by the imaging camera.

The male (rear faceplate) and female (front faceplate) 'T' thread adapters install in matching CNC machined holes in the faceplate and are held in place by three small cross pan head bolts. Three slots in the mounting flange of each adapter allow for rotation through 60 degrees but by removing the adapter, rotating it by 120 degrees and re-fitting it a full 360 degrees of rotation is covered, allowing any orientation of either the wheel or the camera to be achieved. Although this system worked well,

the fixing bolts on my sample just touched the faceplate of the camera at the rear and the focal reducer at the front before it seated against the mounting flange. This is not a good situation and lower profile mounting bolts are required here.

The SX is unique in that it derives its power from the USB port so no additional power supply is required. The filter wheel uses a simple Human Interface Device (HID) protocol which means that a suitable driver is already part of the Windows operating system so you don't have to install a special driver. Connecting the filter wheel to your PC's USB port causes the wheel to complete two revolutions as it auto-calibrates, determining the number of filter slots installed and then positions itself at filter position one.

The latest versions of AstroArt and MaximDL include the command sets to control the filter wheel but I use an older version of MaximDL so I installed the ASCOM driver which had to be downloaded from SX's website as surprisingly, it was not included on the CD supplied with the wheel. Installation was simple and straightforward and there were no issues, it all worked straight from the box on my Windows 7 laptop. However, I had real problems trying to get it to run under Windows XP on my observatory PC and despite numerous uploads of net.framework and ASCOM drivers I never did get it to be recognised as an ASCOM device. I am assured by Terry Platt from Starlight Xpress, whose opinion I would value, that this is a local issue and that the wheel operates fine on other XP systems.

Included on the CD was a basic console program that actually worked very well despite its simple interface which comprises seven buttons labelled 'Filter 1' to 'Filter 7' plus a 'Reset' button and a 'Query' button which confirmed the filter number selected. There was also a tick box intriguingly labelled 'Reverse'. A rather nice feature of this filter wheel is that as well as moving from filter to filter serially, the wheel can also be set to take the 'shortest path' in whichever direction is the quickest. In my speed tests with 'reverse' turned off, it took just 5.2 seconds for the wheel to move from position 1 to position 7 and considerably less with reverse set to on. This console program worked absolutely faultlessly on both Windows 7 and XP equipped PCs. Repeatability of the filter position in the light path was good if the wheel rotated in the same direction each time. However, when incrementing the filters, I noted that in every position, the wheel had not rotated quite far enough so it was not exactly centred in the light path. This was not sufficient to affect smaller sensors but could be an issue if you are operating right on the margins with 1.25" filters using a larger sensor like the KAF-8300. Decrementing the filters resulted in excellent centring of each filter. All filter positions were the same for a given direction of rotation so it is possible that an adjustment can be made to correct for this error.

Gaining access to the carousel itself is very easy and quick. The filter wheel case's rebated rear face plate is held in place by a central thumb screw and five additional thumb screws around the periphery of the casing so it is a simple matter to remove the plate. The aluminium carousel has a central nylon bush that forms a support bearing with a 10.0mm diameter brass bush installed on the front plate. The carousel felt stable with no apparent tilt visible. Installing the 1.25" filters was simple although they are installed from the opposite side of the carousel to the side on which the numbers are stamped. Although this is no big deal, it would have been more convenient to have been able to see the numbers pertaining to each slot whilst inserting the filters.

Conclusion

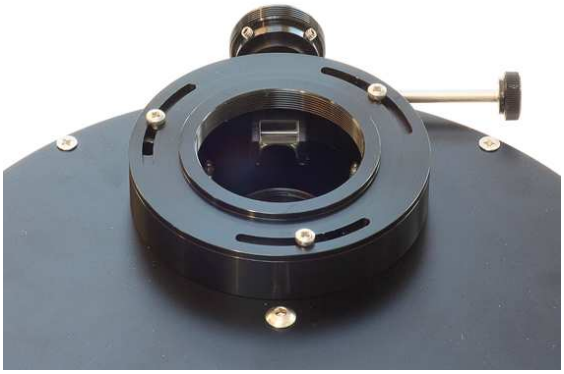
The Starlight Xpress USB Filter Wheel performed faultlessly during the review period and was a joy to use. The projecting mounting bolts spoilt the otherwise superb production quality of the unit and this needs to be addressed by the company as users will not appreciate having their equipment mounting surfaces scratched!

Even though I couldn't use the wheel automatically with my XP machine, this was not a major problem as I always re-focus between filter changes so using the console program was absolutely fine – automatic operation using MaximDL with my Windows 7 equipped laptop was performed perfectly.

If you run Windows 7, or the XP problem is resolvable, I'd thoroughly recommend this filter wheel.

Starlight Xpress Off Axis Guider Add-on

The test filter wheel unit was also supplied with Starlight Xpress' matching off axis guider (OAG). This very slim (13mm) OAG bolts directly to the front of the filter wheel housing and the original 'T' adapter is then bolted to the front of the OAG. A 10.0 x 8.0mm pick-off prism diverts a portion of the off axis light through a conduit and into a turret mounted on the outside of the housing. The housing itself is a nicely machined black anodised ring 75.0mm in diameter with 12.5mm thick walls. The quality of construction is again excellent and is designed for use with Starlight Xpress' own CCD imaging and guiding cameras. With this in mind, the guide camera turret has a male 'C' mount thread designed to allow the direct attachment of an SXV, EX or Lodestar guide camera.



Installation on the filter wheel casing was simple using the three cheese-head M2.5 x 5mm bolts supplied and the whole construction felt very secure indeed.

By a pure stroke of luck, I had assembled the whole unit with my SXVF-H9 and SXV guider parfocal with one another but focus is relatively easy to achieve by sliding the turret head up and down the turret and securing it in position using two set screws. The whole turret assembly which includes the prism and light conduit can be adjusted in and out of the outer ring to clear the light cone of the imaging camera and to assist in locating suitable guide stars although this movement will, of course, affect focus of the guide camera.

I am not a great fan of OAGs but I have to be honest and say that using this unit was a revelation in that I was spoilt for choice with my guide stars and I achieved excellent results with well formed stars. With my SXV guider running 2 second exposures, my test run consisted of 14 x 300 second exposures and the total star centroid creep from the 1st to the 14th frame was 0.924 of a pixel (2.57 arcsec.) in RA and 1.218 of a pixel (3.3 arcsec) in DEC. The SX OAG produced considerably better tracking results than my side by side mounting and separate guide scope arrangement.

The additional back focus using the filter wheel and OAG is 42.0mm which creates a problem with older Starlight Xpress CCD cameras like mine that have the standard 17.5mm sensor to mounting face distance. The total back focus becomes 59.5mm whereas most focal reducers, field flatteners and coma correctors are designed for a total back focus of 55-56mm and this can be quite critical. Using the popular William Optics FR IV would not be a problem as this is adjustable but a fixed distance optic like the Hotech field flattener or Baader MPCC coma corrector would be operating outside its optimum range. However, the latest Starlight Xpress CCD cameras have a tilt-adjustable front mounting plate and this can be removed to allow the imaging camera to be bolted directly to the rear face of the filter wheel.

This makes for not only a very secure mounting but reduces the back focus at the same time. Atik and other CCD users would not have a back focus problem as they have a shorter sensor to mounting face distance although a small extender may be required to achieve the correct spacing.

Conclusion

The combination of the SX USB filter wheel and matching OAG make for a very useful imaging tool at a very realistic price and I would be happy to recommend them both. I am sorely tempted to not return this unit to First Light Optics!

Steve Richards is the author of '*Making Every Photon Count*' and writes for The Sunday Times, BBC Sky at Night Magazine and BBC Focus Magazine.