How OptAcquire can optimize the iXon camera for different experimental acquisition types

OptAcquire is a unique control interface, whereby a user can conveniently choose from a pre-determined list of set-up configurations, each designed to optimize the camera for different experimental acquisition types, thus removing complexity from the extremely adaptable control architecture of the iXon.

The control architecture of the iXon is extremely tunable, meaning the camera can be adapted and optimized for a wide variety of quantitative experimental requirements. They range from fast single photon counting through to slower scan, 16-bit dynamic range measurements. However, successfully optimizing EMCCD technology is not a trivial exercise, with various set-up parameters directly influencing different camera performance characteristics. OptAcquire has been designed as a unique interface whereby a user can choose from a pre-determined list of nine camera set-up configurations. A variety of set-up parameters are balanced behind the scenes through the OptAcquire menu. Furthermore, advanced users may wish to create their own additional OptAcquire modes to aid future set-up convenience.

iXon control parameters include:

- **EM gain** - this parameter has a direct bearing on both sensitivity and dynamic range.
- **Vertical clock speed** - flexibility in this parameter is critical to optimizing the camera for lowest noise, fastest speed, minimal frame transfer smear or maximum pixel well depth.
- **Vertical Clock Amplitude** - can be employed to help 'over-clock' the sensor to achieve faster frame rates and can also be used to reduce charge leakage into the image area when there is saturated signal in the frame transfer storage area (e.g. when combining very short exposure with a slow readout speed).

- **Horizontal readout speed** - ranging between faster frame rates and best dynamic range.
- Pre-amplifier gain - trading off reduced digitization noise versus accessing full pixel well depth.
- **EM / Conventional amplifier** - to choose between ultrasensitive EMCCD operation or traditional high dynamic range CCD operation, the latter recommended for relatively 'brighter' signals or when it is possible to apply long exposures to overcome read noise floor.
- **Frame Transfer (overlap)** - overlap readout is used to achieve 100% duty cycle, ideal for fastest frame rate measurements without switching exposure time between frames. This mode should be deselected for time-lapse experiments

Pre-defined OptAcquire modes include:	
Sensitivity and Speed (EM Amplifier)	Optimized for capturing weak signal at fast frame rates, with single photon sensitivity. Suited to the majority of EMCCD applications.
Dynamic Range and Speed (EM Amplifier)	Configured to deliver optimal dynamic range at fast frame rates. Moderate EM gain applied.
Fastest Frame Rate (EM Amplifier)	For when it's all about speed. Optimized for absolute fastest frame rates of the camera. Especially effective when combined with sub-array/binning selections.
Time Lapse (EM Amplifier)	Configured to capture low light images with time intervals between exposures. Overlap ('frame transfer') readout is deactivated.
Time Lapse and Short Exposures (EM Amplifier)	Configured to minimize vertical smear when using exposure times < 3 ms.

EMCCD Highest Dynamic Range (EM Amplifier)	Combines EMCCD low light detection with the absolute highest dynamic range that the camera can deliver. Since this requires slower readout, frame rate is sacrificed.
CCD Highest Dynamic Range (Conventional Amplifier)	Optimized for slow scan CCD detection with highest available dynamic range. Recommended for brighter signals or when it is possible to apply long exposures to overcome noise floor.
Photon Counting	Configuration recommended for photon counting with individual exposures <; 10 sec.
Photon Counting with Long Exposures (> 10 sec)	Configuration recommended for photon counting with individual exposures > 10 sec.