===’’’Chair: Paul Thomas, Univ. East Anglia’’’===

Also present at the break-out session: ’’’’’Andrew Vaughan, UCL; Mark Jepson, Univ. Bristol; Matthew Preston, Photometrics; Erik Laloum, Photon Lines; Iain Carson, Laser 2000; Ellen Barker, Hamamatsu; and 2 others.’’’’’

The small group (listed above) met to discuss the use and development of detectors (more specifically cameras) for use in microscopy. Below are the major points that arose out of the break-out session:

* The main discussion centred around comparison of CCD, EM-CCD and sCMOS cameras; and in particular, the use of these cameras for image quantification. The ability to convert grey-scale values back to photons was clearly much easier for CCD cameras. The presence of the gain register in the EM-CCD, and the fact that in sCMOS cameras each pixel has its own A-to-D converter, means that converting grey-scale values to photons with these camera is not trivial. Indeed, EMVA (European Machine Vision Association) has adopted the use of the Photon Transfer Curve (PTC) method as a means of standardization. Both CCD and sCMOS cameras can be evaluated in this way; however, this method has not been adopted as a standard method of evaluating EM-CCD cameras. Nevertheless despite the difficulties created by the gain register, it was agreed that as long as one understood the properties of EM-CCDs it was possible to use them as quantitative instruments.

* Another point raised about EM-CCDs was the variability of the scale used to impose the gain on the sensor. In older models this scale was a 12-bit scale (0-4095) and, in general, no significant gain was achieved until a value >3000 was used. This led to some confusion for users. Now, in more modern EM-CCDs, the vendors have moved to more meaningful scales actually related to the gain that is applied, and consequently easier to use and interpret.

* A point raised about sCMOS cameras was the use of the “Global” (simultaneous image acquisition over the whole of the chip) and “Rolling” (line-by-line readout) shutter modes of acquisition. Rolling shutter mode allows higher frame rates but can lead to image smearing and wobble; whereas the global shutter mode removes movement artefacts but has inherently more read-out noise. Of the new GenII sCMOS cameras the Andor and PCO cameras have both modes, but the Hamamatsu Orca Flash4.0 only has the rolling shutter mode.

* Although, the GenII sCMOS (Fairfield) cameras are a great improvement over the GenI (Sony) sensors, and will replace EM-CCDs in a large part of the market, it should always be borne in mind that because of the individual A-to-Ds there are an awful lot of things going on on the chip to generate a usable image. This also raised the issue of literature that is often produced by the vendors to support the sale of their cameras. For example, it was suggested that QE curves were merely reproduced from the sensor manufacturer’s literature, and might not be representative of the sensor in the camera that you buy. So, buyer beware – “TRY BEFORE YOU BUY”!