

What is Vision Control?

As we all appreciate, teamwork is a major part of being a camera professional. In the single-camera/drama/features environment, the 'camera department' is highly visible, as it beavers around the camera equipment. In the multicamera domain, a key section of the team is hidden away from the sharp end; whilst the vision engineer/s might be out of sight, their skills and efforts are vital in making images look their very best. Vision supervisor and GTC member **Richard Carroll** pulls back the curtain on the mysterious world of vision control.

Ever heard the word "RACKS!" being bellowed over talkback and wondered what all the fuss is about, perhaps mystified as to what those 'racks' people actually do? Often known as a 'dark art', the role of the vision engineer/vision control/vision supervisor/shader/live grader is one from which I have made a living for over 20 years now. It's how I've found myself working on everything from FA Cup finals to live TikTok streams, and almost anything multicamera in between. For those of you whose natural habitat is shooting single camera in the outer reaches of Mongolia or doorstepping the Prime Minister in a fridge in Yorkshire, then perhaps the concept of a vision controller is alien to you, but imagine having someone there to take care of your iris and colour balance for you – particularly handy any time you break out a second camera.

In this article, I'd like to demystify this mythical area known as 'racks' and, by taking you through both the processes and skills required, I aim to highlight quite how important vision control is.

What is vision control?

I don't know the exact history of vision control, but I would imagine it started around the time when productions first decided to use more than one camera to point at the same thing in the same place at the same time, and wanted to see pictures with the same colours at the same exposure when they cut to each camera.

It doesn't matter whether you're shooting with PSC or live/line cameras, all multicamera scenarios face the same dilemma: how do you ensure that the images from each camera all 'look' the same. For example, if a presenter is wearing a black suit, then you don't want it to appear black on camera 1, blue on camera 2 and brown on camera 3. Now, that potential headache gets multiplied considerably when you scale up to a major sporting event (such as my previously mentioned FA Cup final), where there can be 20+ cameras all looking at the same thing. Not only do you need the grass to be green, it needs to be the same green on all your cameras – and let me tell you, green is a tricky bugger!

Of course, it's not just about the green being rendered correctly, but the white needs to be white, the blue needs to be blue, the red needs to be red, etc., etc. As Tim Taylor, freelance vision engineer explains: *"It's about enhancing the pictures, either to make them look as close to what the eye sees (which happens when covering an event that doesn't call for any artistic input or interpretation), or to intensify the images by adding something extra to what the camera picks up, for an artistic reason."*

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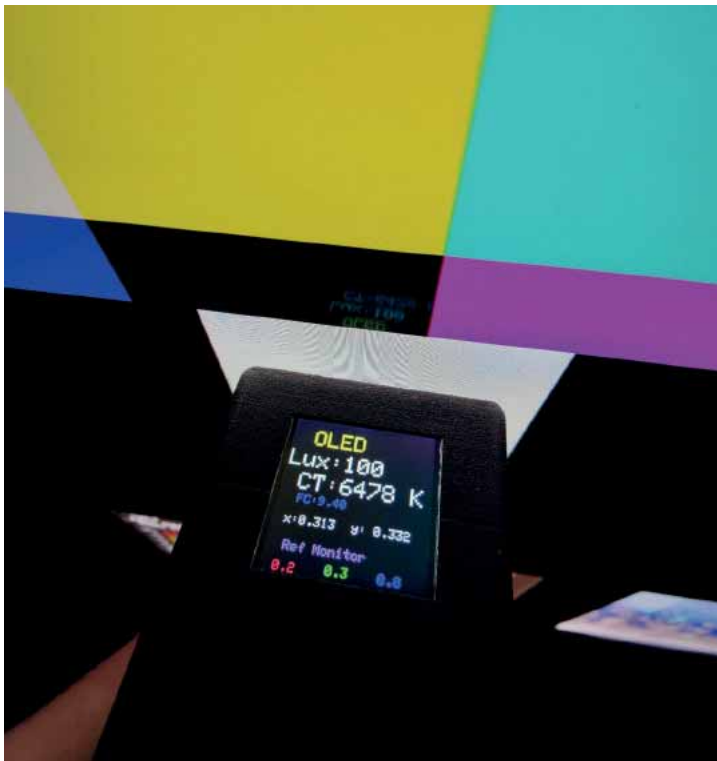
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First impressions don't count

Whilst I think it's fair to say that the true value of vision control is often under-appreciated, I can't deny that setting foot into our 'office' doesn't do much to challenge any misconceptions. The environment is understated and the work being done there will, arguably, appear fairly unremarkable to the casual observer. In fact, on many studio shows I've worked on, whenever behind-the-scenes crews visit vision, I've noticed how often they will remark that our gallery is the least dynamic operation on the whole production. Regardless of how 'lively' the programme itself might be, or whatever may be going on



The vision control gallery in one of NEP's fleet of OB trucks



Monitor calibration is essential to achieve consistent and correct results; an iPlug device is being used here to calibrate a Sony OLED monitor

in any other area, vision control is always a picture of calm, the engineer sitting quietly, usually in the dark, within arm's reach of a monitor as they make the smallest of adjustments to a boggling piece of equipment; there's nothing fast-paced about it and no frantic jumping up and down. Watching us work doesn't make great telly, I'd be the first to agree – but actually that work plays a large part in making telly great to watch. All those tiny adjustments, the constant checking and rechecking for exposure, colour matching and consistency are absolutely vital to the smooth look of a programme.

The person with their hands on the 'sticks' can totally alter the look and feel of the image – and, crucially, they have a very close working relationship with the lighting team. With the exception of outdoor daytime events (which come with their own potential pitfalls), the overall light level or f-stop as well as colour temperature are set by the lighting department, with the vision engineer working in tandem with them to create the desired look. As Dave Bishop, esteemed lighting director (LD) (*Strictly Come Dancing* and more) explains: *"Without good vision control, there can be no good lighting. The relationship between the lighting team, in particular the lighting director, and the vision team is paramount to the creation of great pictures."*

What is the desired look, and how is it achieved?

The modern-day system camera found across all OBs and studios is a complex beast. It's not just a case of stick it on auto iris, do a white balance and go put the kettle on... if only. Although tea *is* usually involved at some point! Each job is approached in the same way: the cameras need to be put into a base state, using a process that is often referred to as 'line-up'. For line-up, the engineer requires all the cameras to be framed up on a greyscale chart, which lighting will illuminate with a lamp matching the defined base colour temperature and then the engineer can make a start.



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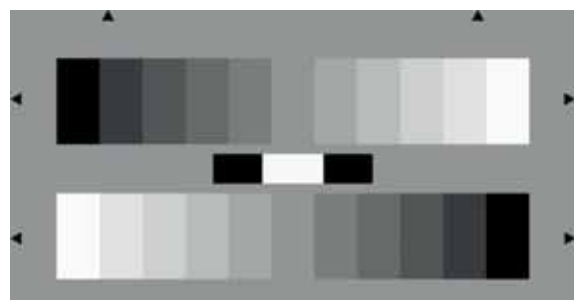
What is line-up?

The greyscale provides the engineer with an established reference to which they can set the white balance/colour temperature, adjust black balance and make gamma and flare corrections until the camera is 'seeing' what is a neutral perception of the chart – all aided by the use of the trusty waveform monitor for accurate measurements. This procedure is repeated across all the cameras, because setting this base state on the chart will put them all into the correct initial setup.

But, of course, you can't put a greyscale chart in the middle of Wembley Stadium's football pitch, so traditional line-up tends to be left for the realm of the studio environment. In the outside broadcast world, aligning the cameras to a base setting ultimately relies on the engineer's skill and experience to get it right. Luckily, modern cameras behave well and it can be easy to achieve the base setting without the use of a chart; sometimes a simple white balance will do the trick, but the cameras have a couple of other features to get the ball rolling. The first of these is an option to recall the 'standard' setup, which is a manufacturer-assigned setup, a bit like a mini factory reset. 'Standard' will set certain values to zero, turn some settings on, some off, etc., and can be deployed if you don't know, or trust, where the camera has come from. A second option is a process called Auto Set Up, which will allow the camera to black balance itself, undertake a white balance against an internally generated sawtooth test pattern, and finally, configure the deeper settings to be either on or off. From this point, the cameras can be adjusted individually to match one another, not just in exposure but colour balance too.

"Deeper settings?", I hear you ask...

Yes, as I say, these modern system cameras are beasts. The images from these cameras can be manipulated in so many



A greyscale chart is used for camera line-up – when the environment allows



A trio of remote control panels, from left to right: Sony RCP-1550, Grass Valley OCP-400 and Blackmagic Design Advanced Camera Control Unit

ways it can offer a realm of creativity but at the same time be daunting to the untrained. Anyone who has browsed through the 'custom' menu of a modern Sony camcorder (F5, FS7, FS9, A7s, etc.) will be familiar with the range of settings available, and many of these can also be found on system cameras too – although each manufacturer uses a slightly different 'language' and range of settings. Therefore, having a good knowledge of these settings is to the engineer's advantage when they're trying to achieve a certain look or simply balance the cameras to get the best pictures possible.

The lighting director, or DoP, will have planned and chosen a lighting scheme for the show. The defining factor for the vision controller is colour temperature (especially relevant in this era of LED light sources) and the follow spot or main key lights will often be the deciding factor here. There's no point running the camera colour temperature at 5600K when the key lights are running at 3200K – unless you're wanting to create a very particular effect (which in this example would mean all the pictures would be bright orange).

Controlling the vision

Most shows require the cameras to be set up to complement the lighting, to allow the image to be as natural as required. Sometimes though, the LD might be aiming for a certain style, perhaps to make the set or lighting 'pop', to reduce or exaggerate saturation, to highlight a particular colour, etc. – and the engineer has the tools to make this happen.

At the heart of this control is the remote control panel (RCP). Each camera will have its own dedicated RCP, from where the engineer can view and adjust almost every setting that is easily accessible. The current Sony RCP is great to use, as all the meaty settings are easily accessible, meaning the engineer can make any necessary adjustments quickly (previous incarnations of the unit have been less pleasing) – so it does far more than just control the iris.

Second in the engineer's trio of tools is a decent monitor; the monitor of choice these days is the robust Sony BVM OLED. Of course, the monitor needs to be calibrated, and a good engineer should carry the necessary equipment (for example, an iPlug device or light meter) to do a basic monitor line-up. With this they can set the brightness, contrast, saturation and colour temperature.

The third and final tool is the waveform monitor, which provides an electrical representation of the picture. The two favoured displays are: the waveform, which usually shows the luminance voltage of the image (sometimes in its red, green and blue individual elements); and the vectorscope, which presents purely the colour signal. The engineer constantly relies on the information that both these displays provide through all the stages from line-up to final picture control, so a sound understanding of waveforms and how to use them is a fundamental part of the role. Without such knowledge, the task of matching multiple cameras would become reliant on external factors, such as ambience, monitor and eyesight, all of which can be very variable from control room to control room:

- **Ambience:** ideally the vision control room's lighting should be a calibrated 6500K and there should be no extraneous light that spills or is reflected onto the monitors (although this isn't always the case in the real world).
- **Monitor:** as explained already, this needs to be calibrated correctly – if the monitor is set too warm, then the pictures will be cool on a calibrated monitor (and vice versa if it's set too cool) and that's what will go to air or be recorded.
- **Eyesight:** actually the vision controller's best tool. It can take some years for an engineer to 'get their eye in'. The ability to spot the tiniest colour differences across the cameras and correct them so that they all match one another and, of course, to balance exposure, black level and saturation are all really important. Being able to see accurately is the ultimate skill we all strive to master.

A broad skillset

But how is the vision engineer perceived by others? In my experience, productions rarely understand the importance of this role; all too often, the engineer is perceived as just someone who comes and fixes stuff. Well, that is true, in part at least. The knowledge base of the average engineer is actually very broad: from knowing which camera matrix to use and how to programme a vision mixer, through to how

to operate the hydraulics on the OB truck to pack it away at the end of the night! In fact, the job of the engineer isn't just vision control; I've repaired portacabins, fixed lenses, soldered triax cables, run the London Olympic stadium 100m (during pre-event lighting tests) and had access to some amazing locations beyond the public gaze.

Lights, camera, racks!

However, although the skillset is wide, it's the vision control aspect which can have the strongest influence on how a show looks. As LD Dave Bishop explains: *"I believe that the role is far more creative than the original 'engineer' term might imply. Camera technology today is such that a vision controller spends far less time fighting to keep the pictures technically acceptable, and should be offering ideas to the LD as to how the picture could be further improved."*

Vision control is absolutely necessary in a multicamera environment. The cameras have to match one another so as not to draw the viewer's eye or attention away from the content. Achieving a good and consistent image can be a balancing act of exposure, pedestal (black) level and colour adjustments, each of which can affect the others: sit the black level down and the picture will become more saturated; overexpose the image detail and colour can be lost – as well as burning out the image. Then multiply this process for each camera, whilst taking into account the different shots, lenses, lighting, age of camera, model of camera, sensor type, etc. Ideally, the cameras will all be of the same type; this will at least mean the method in which each camera is processing the light should be the same throughout. Tim Taylor (freelance vision controller) observes: *"When the scene contains more dynamic range than the sensor can handle, it's about altering the exposure to select which part or parts of*



Achieving the optimum ambience is not always possible – and Richard didn't find his position very 'convenient' on this corporate job for Balfour Beatty!

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The vision controller will also want to enable the camera operator to get the shots they want. It's a 'You frame it, we'll expose it' relationship... After all, what's the point in the operator trying to get the best shots if vision aren't doing their part and working the exposure to gain the best images possible?

the scene are correctly exposed, as well as adding something to what the cameras pick up when there's an artistic reason to intensify the images." A great example of this is the wide shot at an outdoor daytime stage event. The stage is likely to be underlit compared to the sky (for obvious reasons). The vision supervisor can either expose for the sky, leaving the stage dark, or expose the stage and bleach out the sky. Imagine that football match at Wembley Stadium, where the stands were built with what feels like a total disregard for the movement of the sun, creating a very harsh shadow right across the pitch. It's the vision engineer controlling the camera iris who is having to work the exposure to cope with the full range from the brightest sunlight to dark shadow. On fast-moving events like sport, a sunny day can mean a tough day at the office!

Setting the look

From the earlier line-up, the vision controller can then begin to manipulate each camera in turn to achieve the desired picture. My approach is initially to work on one camera, usually a wider shot. This allows me to see the most information possible – the set, lighting and on-camera talent, with their all-important flesh tone. Once I've settled on the look of that camera, I will then make whatever adjustments are needed to achieve this, with most of these being red and blue gain (or the 'white'/colour temperature element of the image) and other controls adjusted to suit. I will then aim to get the remaining cameras to match this camera, making similar adjustments across the settings to bring the pictures to a point where all the cameras match one another. There is a numerical readout of settings on the RCP but, unfortunately, just matching the numbers across the cameras doesn't do the trick (because of lighting, lenses, shots, etc.). So, each camera will require fine adjustments across gain, black level gain, flare and other settings to match the 'master' camera. The line-up will have got the cameras to a base state as explained earlier, but it is the final tweaking and adjusting that can really make the pictures shine. These adjustments can be tiny – to the untrained eye even imperceptible – but each tweak will get the camera to a better place in terms of colorimetry and overall satisfaction. It's this fastidious camera matching that makes the role of vision control so key. Dave Bishop explains his approach to crewing: *"I like to specify my vision engineers at the same time as my lighting programmers, as they form the last link in the chain – if they aren't at the top of their*

game we could be delivering the highest standard of lighting, only for it to be destroyed as it is seen by the camera."

Of course, one person's perception of the image can be very different from another's. A perfect example to demonstrate this is to watch *Match of The Day*; no doubt you'll find no two football grounds will look the same, even though they all contain grass as the majority of the image. OK, yes, there are a lot of external factors here, but the principle of having the pitch not look too brown/red/blue/luminous stands! So, when working on a large multicamera event, be it sport, an awards show or music festival, there should always be a vision supervisor to make the call as to how they want to set up the cameras and how the images should look. This person will be responsible for the vision output of the cameras as a whole, sometimes asking colleagues (on a multiple engineer job) to make certain adjustments to their own cameras in order to help their images match the 'master' shot.

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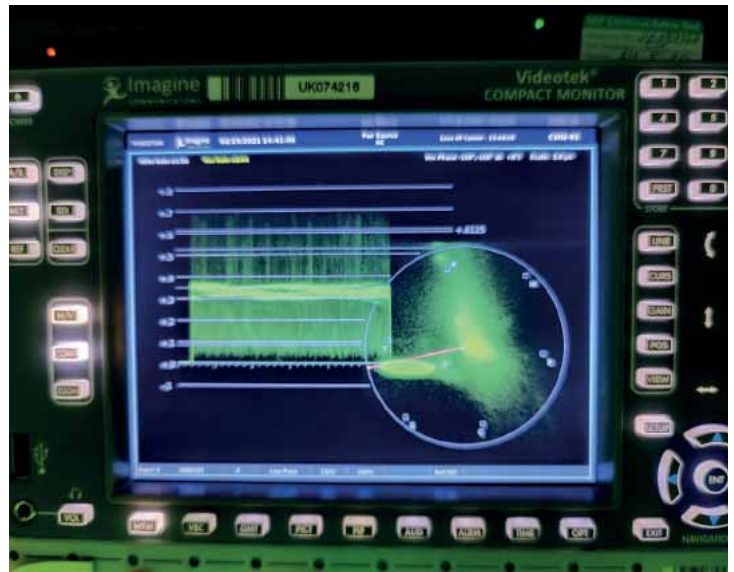
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The vision controller will also want to enable the camera operator to get the shots they want. It's a 'You frame it, we'll expose it' relationship. Some shots will require a hefty change of exposure, but a good vision person will be aware of what the operator is trying to do and work with them to achieve it; usually a quick rehearsal of the shot should get the attention. The vision person will be willing to help the camera op by adding or removing ND filters, or introducing a touch of extra detail here and there. After all, what's the point in the operator trying to get the best shots if vision aren't doing their part and working the exposure to gain the best images possible? But remember, the vision controller could be busy working on other cameras at the same time – potentially 8 or more – so their attention may well be diverted elsewhere.

On top of complementing and enabling the camera ops with their input, the vision controller also has to have their eye on the bigger picture too. *"When it's done well, the subject is exposed well so the viewer can see what's happening in a scene,"* says Tim. *"In theory, pictures look 'natural' in natural situations, or enhanced in a positive way for artistic reasons."* The possibility for creativity is immense, and can be deeply satisfying when some free rein is allowed.

Why didn't I want to do this when I started my career in TV?

I simply didn't know it existed! Has any kid ever uttered the words, *"I want to be a broadcast engineer when I grow up?"* I doubt it very much. I certainly didn't set out along this path



A waveform and vectorscope can be an engineer's best friends

originally; I fell into it when a new job also involved expert vision control (having only dabbled before). This was live on Channel 4, doing T4 continuity links (and my apologies to Roger Williams – the very patient LD!). I soon loved the work and the creativity it offered.

We vision engineers currently find ourselves in short supply, with the vision controller seemingly a dying breed. Twenty years ago, when I became freelance, there appeared to be more engineers on the circuit, but numbers have dwindled in the last few years. Some have retired, some passed away, and others have progressed their careers up the ladder. There are some new folk coming through the ranks – but not all engineers are interested in the vision control side of the job.

But what if someone does fancy a career in vision – what are the options? The most obvious route in is to become staff, either with an outside broadcast facility or a studio. This path will likely also have included gaining some background engineering knowledge as well as some vision control experience. Ravensbourne University has a number of broadcast engineering courses, specialising in different areas of TV production.

So, the next time you hear *"RACKS!"* yelled across talkback, or you wonder why your shot hasn't been exposed instantly, spare a thought for the engineer sitting in the dark, tweaking and adjusting, because they are probably concentrating on one of the multiple other cameras they're controlling, and will get to you shortly!

FACT FILE

Richard Carroll is a freelance broadcast engineer and vision controller. He has worked on a wide variety of jobs from the one-shot extravaganza that was broadcast live for the handover of the Birmingham Commonwealth Games, to a Beyoncé concert, where he handled the output from 13 f55s, 2 Phantom high-speed and 4 system cameras plus a handful of minicams!

In 2021, Richard built a colour grading suite to complement his live grading skillset. To find out more about Richard's colour grading suite and services, visit: thecolourspace.co.uk

