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Synchronizing Independent Cameras Using Time Offsets and Banding Detection

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This invention pertains to synchronizing overlapping, independent camera systems. There are use-cases where cameras have an overlap in illumination, such as security monitoring feeds. This overlap can cause problems, in particular when a strobe is necessary. Should the lights be strobing at non-synchronized times, this can impact quality or destructively interfere. A solution is to synchronize these systems by having one act as the primary, and the secondary adjusts its exposure trigger accordingly. Figure 1 shows how the destructive interference can occur without synchronization and how the secondary camera can automatically learn to synchronize.

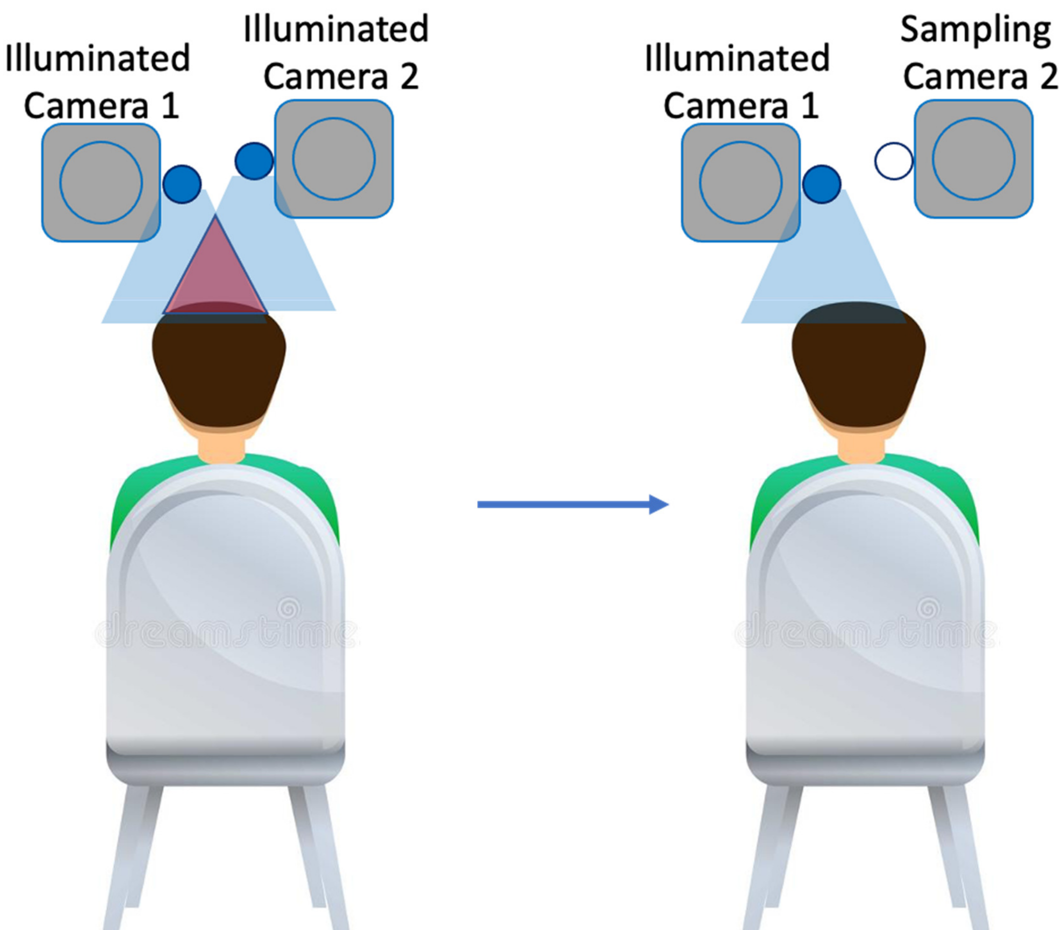

Figure 1. Managing illumination interference through synchronization.

Figure 2 shows the sampling methodology. the secondary camera system will shut off its own lights and employ time offset sampling to determine the strobing time offset. Once the time is known, it will adjust its own exposure time offset to synchronize acquisition, as well as adjust its own illumination to only cover passengers.

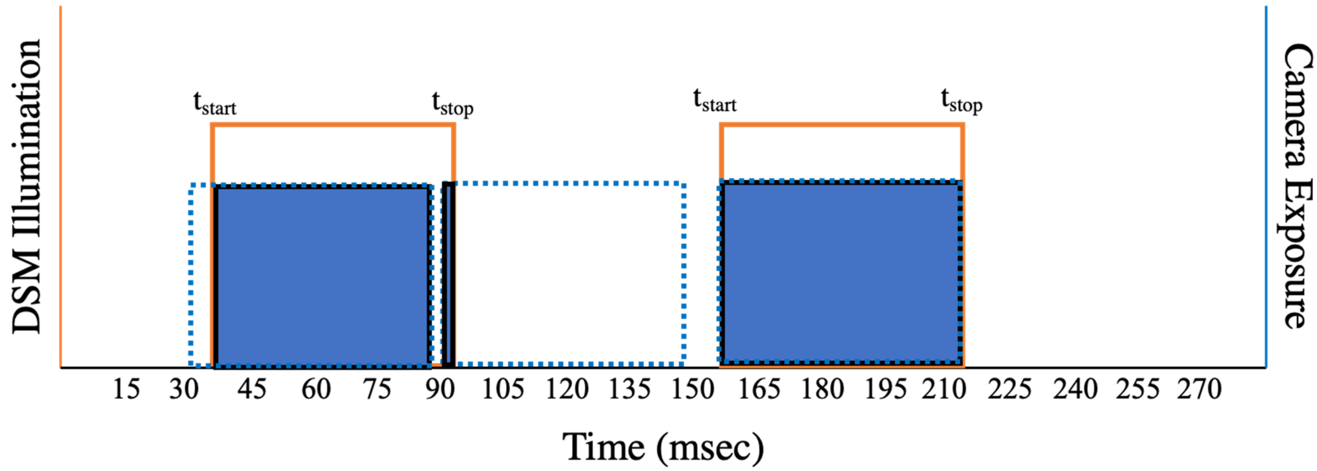

Figure 2. Varied Exposure Offset Sampling to Determine Illumination Offset Time.

Each time a frame is acquired, it is validated for banding. If there is banding, the time offset is increased from the prior amount. If no banding is detected, and it is a dark frame, no action is taken. If no banding is detected and it is illuminated, this implies perfect alignment (time offset is determined). In situations where the exposure time cannot meet the illumination time (saturation), the same methodology is applied but on analyzing the rise and fall frames. Similar to the super sampling approach, rise and fall frames can be determined based off of increases or decreases in relative intensity. The exposure offset is increased each time banding is detected on a rise or fall frame until perfect alignment is achieved.

Note that in some cases one or more illuminators will be continuously running (e.g., flood illumination). Each time flood camera services are run with conflicting illumination;, the secondary camera system will turn off the conflicting light to determine how much light is currently supplied (other secondary lights remain). This is done by measuring the average intensity for the primary camera illuminated pixels and the intensity for the other secondary camera illuminated pixels. The light output of the non-conflicting secondary illuminators is then adjusted to match the primary camera's illuminator, optimizing exposure. Equation (1) describes this.

$$L_{secondary} = L_0 \times \frac{I_{primary}}{I_{secondary}} \quad (1)$$