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Feeling sick from LED lighting?

Early fluorescent lights gave some people nasty headaches. Recent research on the adverse effects from artificial lighting found that not all LEDs produce quality light – flicker from some causes similar issues.

HAS ARTIFICIAL LIGHTING ever made you feel a bit queasy and maybe given you a headache? You're not alone.

Downside of artificial lighting

At Massey University, we are examining the unintentional adverse effects of artificial lighting. One of these effects is flicker - the rapid modulation of artificial lighting that occurs at high frequencies and may not be noticed as visible strobing yet has many detrimental effects.

Many years ago, fluorescent tubes were used in combination with a magnetic ballast - a device needed to keep the light output stable. A byproduct of magnetic ballasts was flicker, which caused headaches, fatigue and eye strain in some people.

Figure 1 shows a flicker profile for this type of source. The vertical axis indicates normalised light output - a fully on source produces a flat horizontal line at 1.0. The light fluctuates from full brightness to a third of that value every 10 milliseconds. This equates to 100 Hz flicker.

Aware of the issues magnetic ballasts caused for some people, the lighting industry fixed the problem by introducing electronic ballasts. These ran the fluorescent tubes at much higher frequencies, and the modulation is less intense (see Figure 2).

LEDs replace fluorescents

Fast forward to today, and fluorescent tubes have been overtaken by LED sources. LEDs can replace existing bulbs in their original sockets or completely replace an entire light fitting. Unlike fluorescent tubes, which use a gas discharge to produce visible light, LEDs use an array of light-emitting diodes.

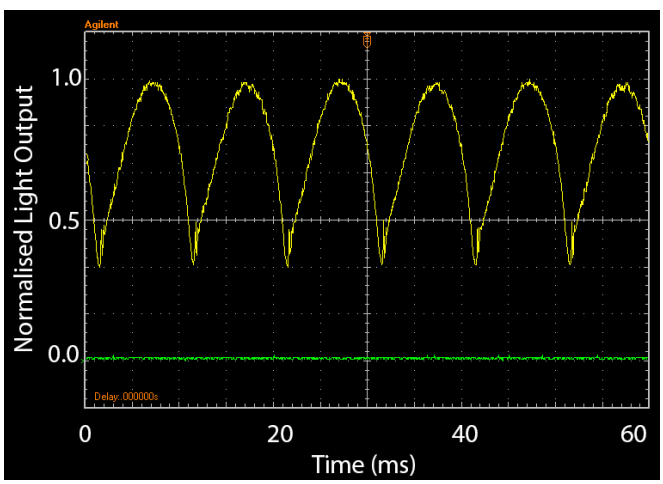

Figure 1: Flicker profile of a magnetically ballasted fluorescent luminaire.

These fast-acting semiconductors can turn on and off extremely quickly. Their output is regulated by a driver that keeps the light output stable like the ballast of a fluorescent tube.

Unlike fluorescent sources, however, LED drivers are not standard and vary significantly from manufacturer to manufacturer. This introduces variation in the quality of light output. While some LEDs

produce quality light, others do not. So the problem with flicker, which was resolved for fluorescent sources, has resurfaced.

Flicker often ignored

In recent years, Massey's researchers have recorded flicker profiles for many LED sources. One was provided by a householder who felt extreme nausea caused by the LED lighting above their ironing board. Its flicker profile (see Figure 3) shows that the source was off more than it was on. This caused a feeling of disorientation, especially when combined with the movement of the fabric on the ironing board. In contrast, many quality LED sources exist (see Figure 4).

Flicker is a topic that affects us all, as we're constantly in the presence of artificial lighting. However, it is under-reported and often ignored by the lighting industry.

When selecting a light bulb at the supermarket, the consumer is provided with information on colour (for example - warm white) power consumption in watts and output in lumens. Nothing is said about flicker.

Commercial customers may also have this issue. People are largely unknowingly ignorant about flicker though may suffer from its effects.

Detecting flicker

So how can you detect flicker? Massey University is fortunate to have a lab of sophisticated equipment, and this is the source of the images used for this article.

For the layperson, a simple initial test is to put your phone's camera onto slow motion and hold it up towards the light in question. (If you're sensitive to strobing light, it's best to leave this to someone else). Flicker will show up as a strobing light that flashes rapidly on and off. More flashing means more flicker.

Note If you're interested in learning more about a light source, testing a lighting product or understanding the issues further, contact Chris Chitty at C.Chitty@massey.ac.nz or Susan Mander at S.Mander@massey.ac.nz.

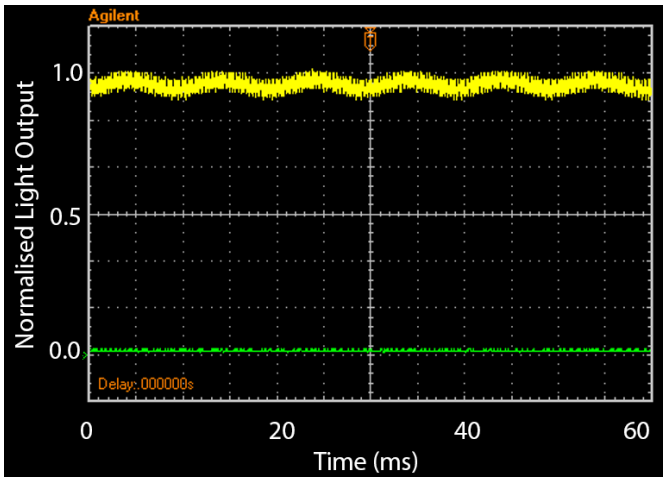

Figure 2: Flicker profile of an electronically ballasted fluorescent luminaire.

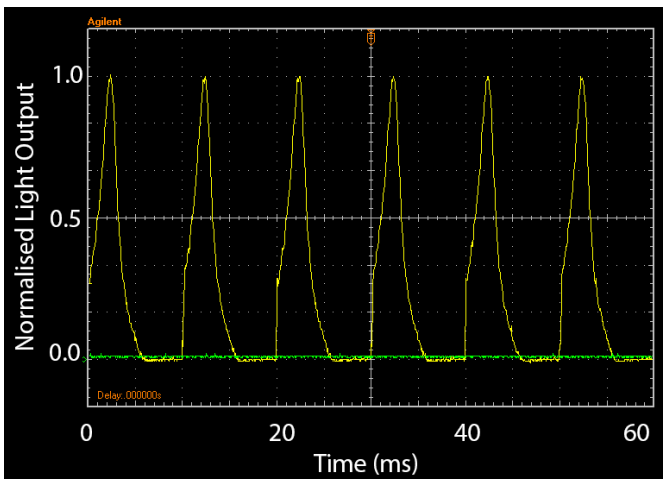

Figure 3: Flicker profile of a problematic LED source.

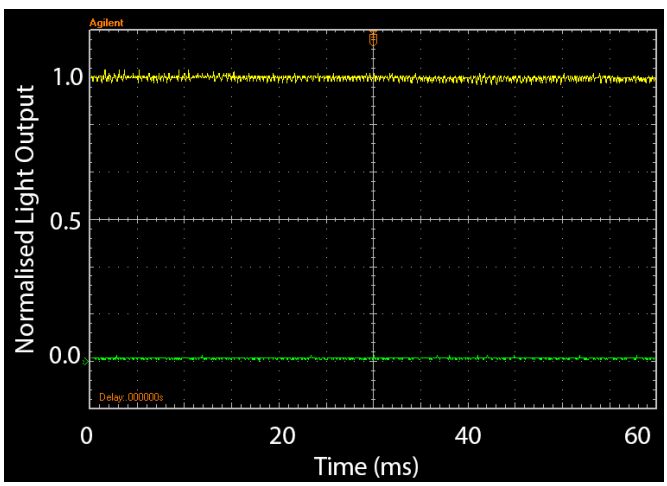

Figure 4: Flicker profile of a quality LED source.