Movement and image sharpness are mutually exclusive at usual cinema frame rates, practically putting a halt on progress of image quality in cinema. Research is suggested in aesthetics related to the use of high frame rates (HFR) in cinematography storytelling.

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The human visual system is known to be capable of assessing up to 70 frames per second. As a result, traditional cinema using much lower frame rates, like 24 or 25 fps, has a high risk of strobing. While a slight judder may be associated with pleasing aesthetics, strong strobing is disturbing and hinders storytelling. Only two means are known to combat judder/strobing at these low frame rates: limiting movement and/or diminishing sharpness, both of which the author considers to be contrary to the goals of cinematography. Practical examples of this are limiting the quantity of movement (as by the famous 7 seconds rules), defocusing moving backgrounds and most importantly the systematic use of long per-image exposure times of 1/50th of a second or longer, to limit sharpness through motion blur, conveniently proportional to the quantity of movement. What seems to be less known is that this motion blur is seriously impeding on the recording of spatial resolution, or sharpness. Indeed, the benefits of modern 4K cameras and projectors can often be enjoyed exclusively on (parts of) images that are fully static, while the goal of cinematographers is storytelling through images that move. Due to this ‘conflict’ between movement and sharpness, of which only one can be had, moving cinema images are rarely sharper than 1K, regardless the resolution of the camera. This can be demonstrated by freezing almost any moving image and measuring resolution. Test images on fixed charts may not be that relevant after all, as they are too different from the actual use.

A general reflection is suggested on how to have image sharpness progress at all, as long as sharpness is actually forbidden during any form of movement. Be it subject or camera.

For better spatial resolution it is needed that the exposure time per image is significantly shortened. This is a basic rule that can be found in any beginner’s book on photography. However, this is not done because at low frame rates, sharp images are unwanted during movement, forbidden actually, as sharp images cause strobing as soon as they move.

Presenting sharp images, also while they move, is actually physically possible, through adoption of higher frames rates like 50 fps or 60 fps, both in capture and presentation.

However, as letting go of the traditional 24/25 rates involves changes in aesthetics and ‘feel’ of the moving images, research is needed to evaluate these changes and their consequences for storytelling. Solutions need to be found and researched, for example like applying different frame rates in a same movie or even applying different frame rates within a same image like suggested by Douglas Trumbull and others. More and different approaches may be found and considered.

Over the past 15 years, and with the author among the initiators, greatly supported by IMAGO and others, steps have been taken towards world-wide implementation of higher frame rate presentation capabilities in cinemas. Such has now been achieved in practice, which makes the proposed research also potentially widely applicable.

It will also be noted that other upcoming cinema technologies, like stereoscopic 3D and even greater so High Dynamic Range (HDR), amplify the human sensitivity to strobing, and therefore may form additional incentives to focus on this issue.

About the author:

Kommer Kleijn SBC is a Cinematographer and Stereographer who is also active in perception research, technology development and standardisation. He was the first to shoot images digitally for a large format movie, after he shot the first digitally captured clay animation short. He worked as a 3D cinematographer and stereographer for 20 years, in LBE, features, commercials and multi camera live captures. He initiated the first short exposure on a (3D HFR) feature (1/100th of a second per frame) in 2011. He teached many years in Belgian film schools RITCS and INSAS, and also for 3D workshops for professionals internationally. He chaired the IMAGO technical committee for a decade, served as an SBC, UP3D and EDCF board member and chairs SMPTE 21DC Digital Cinema Standardisation Frame Rates groups since 2006. He is a regular speaker on international image technology and 3D events and was awarded the "Bert Easey Technical Achievement Award" by the BSC for his contributions to implementing the 60 frame rate proposal as an addition to the International Standard for Digital Cinema projection. He received an IMAGO Tribute Award and was given the 2017 Lumiere Award - Europe, Best European Stereography. His interests extend into research on human hearing and he participates in a team lead by John Watkinson that creates a new kind of loudspeakers. His web site is at www.kommer.com.