Abstract for a presentation at the IMAGO “Cinematography in Progress” conference in Brussels, 4-6 April 2019.

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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Breaking up movement in successive frames as is used in cinematography since 1895 can be seen as one of the first wide spread uses of sampling. It actually follows the rules of general sampling theorems spite these were written only after cinema was in commercial use. However, for the reconstruction of sampled motion in the cinema theatre, the projector lacks the mandatory low pass filter. Instead, the bandwidth limit of the human visual system is used. But this filter limits only from 30Hz onwards, not 24! As a result, traditional cinema, using the frame rates of 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. Two means are widely used to limit strobing both by actually removing movement information: limiting movement and/or removing sharpness, both of which the author considers to be contrary to the goals of the cinematographer. The quantity of movement is limited as per the (in)famous 5/7 seconds rules, but most importantly the systematic use of excessively long per-image exposure times of 1/48th of a second, limits sharpness through motion blur, conveniently destroying movement information, proportionally to the quantity of movement. What seems to be less known is that image resolution is destroyed equally in the process, as this motion blur is also 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 simultaneously, moving cinema images are rarely sharper than 1K, regardless the resolution of the camera sensor. This can be demonstrated by freezing almost any image of a movie and measuring resolution. Also, testing cameras on fixed charts may not be that relevant as generally believed, as these tests do not actually relate well to the actual use of cinematography cameras, where subjects and cameras move.

A general reflection is suggested on how to have the spatial resolution of the cinematographic image (sharpness) progress at all, as long as the low frame rates of 24/25 make high resolution actually forbidden during any form of movement. Be it subject movement or camera movement, or both.

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 book about photography. However, this is not possible at traditional low frame rates, because at low frame rates sharp images cause strobing as soon as there is movement.

Presenting sharp images, also while they move, is only possible through the adoption of both higher frames rates like 50 fps or 60 fps, and short exposure times per image (narrow shutter angles).

However, as letting go of the traditional 24/25 rates, and creating high image resolution during movement, will cause changes in aesthetics and ‘feel’ of the moving images, research is needed to evaluate these changes and their consequences for storytelling.

In order to more gradually gain acceptance, solutions may need to be found to go half way in the beginning, 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 (Showscan Digital) and others. More and different approaches may be found and considered.

Over the past 15 years, with the author among the initiators, greatly supported by IMAGO and others, steps have already been taken towards world-wide implementation of higher frame rate presentation capabilities in cinema theatres. 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 higher frame rates.

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.