

Seeing is believing: **ARRI 4k+** Study



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"What do we really mean when we say 2K and 4K resolution?" asks Dr. Hans Kiening, head of the Image Analysis Department at ARRI, Inc. He asked that question both in a written report and during a recent presentation for members of the American Society of Cinematographers.

The report titled 'ARRI 4K +' summarizes an in-depth study that compares how 35mm film coupled with both 2K and 4K hybrid workflows affects subjective perceptions of resolution and sharpness. It describes the information content stored on individual frames of 16mm, 35mm and 65mm film and how it can best be transferred to digital files.

The 'ARRI 4K +' report also examines how various steps in digital intermediate (DI) workflows influence perceptions of images captured on 35mm film with both analog and digital projection. Tests were shot with an ARRI SR camera mounted with an HS 85mm lens at stop T2.8. Images were recorded

on EASTMAN EXR 50D 5245 color negative film at a distance of 1.65 meters. The test was repeated in 16mm format with an ARRI 416 camera with the same HS 85mm lens at stop T2.8 and the same 50-speed negative.

One phase of the tests was designed to measure subjective perceptions of the distance between boards in a picket fence recorded on 35mm film when they are projected after digital workflows at 2K and 4K resolutions.

"Seeing is believing," Dr. Kiening says. "The images illustrate that the lower resolution workflow diminishes your ability to differentiate between the boards in the fence and the spaces in between them. The same would pertain to conducting this test with a true 4K digital camera, but there is a distinct difference between capturing image data with pixels in rectangular rows and vertical columns and on light sensitive silver halide crystals that are randomly distributed on frames of film that records images."

Dr. Kiening notes that the difference affects the capacity of film for recording more nuanced contrast, which enhances how audiences perceive sharpness. He notes that a hybrid 4K workflow will record more nuanced contrast than a 2K workflow.

"It doesn't matter whether it is 16mm, 35mm or 65mm film, because the image structure is independent of the frame size," he says. "What frame size does determine is the amount of detail a frame can hold. A 35mm frame captures image information that converts to four times the number of pixels as a 16mm frame.

Dr. Kiening explains that an advantage of film is the grain, which is distributed randomly from frame to frame rather than being on a digital grid.

"Artifacts caused by aliasing are a problem with digital still

photography that becomes significantly worse with motion pictures because it changes from frame to frame," he says. "Aliasing also affects the MTF (modulation transfer function) in ways that affect perceptions of sharpness. One solution is the use of a higher scanning rate with more pixels, but the price for that is more noise."

Dr. Kiening deduces that a 4K workflow in DI will be truer to the intentions of filmmakers who are working in 35mm format than a 2K workflow. He says that the 4K+ study concludes that it would take a 6K resolution scan to transfer the maximum amount of image information recorded on frames of Super 35 film with minimal aliasing and noise. He adds that a 4K digital projector will only come close to delivering image quality on a par with a 35mm film projector if the negative is scanned at 6K.

For more information about the 4K+ study, visit www.arri.com