# Removing Flicker in old Movies

By François Pitié, Rozenn Dahyot and Anil Kokaram

http://www.mee.tcd.ie/~sigmedia/

## 1. What is Flicker ?

The effect of *flicker* is perceived as a temporally random, and spatially varying luminance change in images. This is a typical degradation observed in archived film and video. For movies shot in the silent era, this effect was due to the different exposure times of the film as it was hand cranked through the film camera. More modern material can also be affected by luminance changes due to poor lighting.

**Figure 1** shows this intensity fluctuation in a sequence.
The flicker displayed on this figure is really strong and the visual perception is even worse when the movie is played in real time.

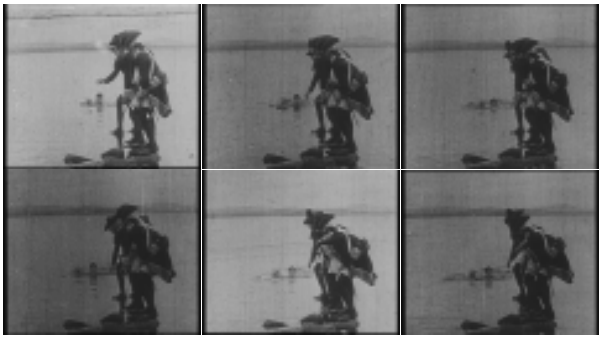

**Fig 1:** *Frames from the Movie Rory O'More altered by strong flicker*

## 2. Distortion of the intensity correspondances

The first aspect of the flicker is the distortion between the gray levels of the frames. A level of gray may seem more whiter in the other frame.

**Figure 2** shows these correspondences. Images are divided into 256 levels of gray. The vertical axis corresponds to the intensity levels of the current frame, $I_{(n)}$ and the horizontal axis to the intensity levels of next frame, $I_{(n+1)}$.

The first step of the flicker removal process is estimate all these equivalence between intensity levels.

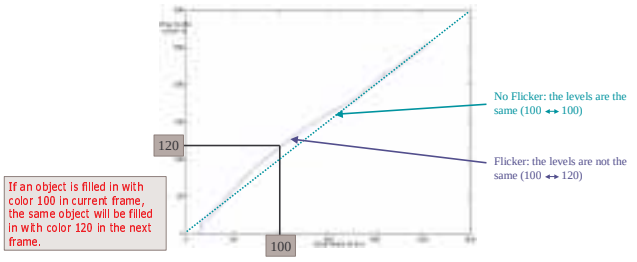


**Fig 2:** *Correspondence between the gray levels distorted by flicker*

## 3. Localization of the flicker.

The second aspect of the flicker is its localization. Unfortunately the effect of the flicker may not be the same over the whole image.

**Figure 3** shows the effect of the localisation of flicker. Some regions seem to be darker and others brighter, while the rest of the image stays the same.

The second stage of the flicker removal process is to estimate these localizations.

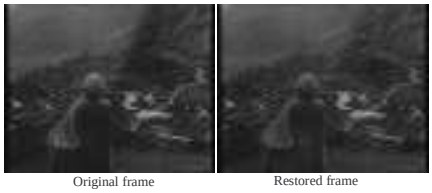


**Fig 3:** *Example localisation of the flicker.*

## 4. Restoring the frames.

Similar to the deshaking process, we aim to remove the unwanted flicker from the video AND to keep the wanted effects, like a fading.

**Fig 4:** *Example of restored frames.*

## 5. Speed.

The deflickering process was quite time consuming. It took us 30 hours on 10 PC's (P4 2GHz) to restore the 12000 frames. But this speed can be improved with more clever programming.

## 6. For those who really love maths J

The correspondence of the gray levels is performed by intensity histogram matching.

The Localisation of the flicker is modeled as a spatially low frequency gain function.

$$\underbrace{I_{n+1}(x,y)}_{\text{next frame}} = \underbrace{a(x,y,\boldsymbol{\theta})}_{\text{gain function}} \cdot \underbrace{I_n(x,y)}_{\text{current frame}} + \underbrace{\varepsilon(x,y)}_{\text{noise (Blotches,...)}}$$

The gain function $a(x,y,\boldsymbol{\theta})$ is found through a robust framework by weighting out the part of frames that are due to outliers, local motions, blotches... (with big values of $\varepsilon$ )

Signal Processing Media Applications Group
Electronic and Electrical Engineering Department, Trinity College, Dublin, Ireland