Motion Compensated Interpolation (MCI) uses Motion Estimation (ME) followed by Motion Interpolation (MI) to create new frames for frame-rate up-sampling and slow motion video. Both ME and MI are fundamental problems in digital video processing and have been the subject of much research. Furthermore, image-plane motion estimation is an integral part of motion compensated filtering and compression (e.g., MPEG-2).

We know from Physics that an object in motion tends to stay in motion. This means that linear motion is more likely than oscillatory motion, and vectors that span a few frames may be better able to depict object motion. Although pixel-wise MCI was abandoned more than a decade ago, recent hardware advances make it an emerging viable alternative to conventional region-based techniques.

A small amount of motion can result in large differences in the pixel values of a scene - especially near the edges of an object. Also, a wider field of view and higher resolution (e.g., HDTV) makes it harder to find the eye, and therefore more difficult to do motion compensation. The effectiveness of any MCI algorithm will depend not only on the ME and MI phases, but also on source video colour precision and scene complexity.

Experimnetation and statistical analysis shows a reproducible and significant advantage of WS-MCI over AF-MCI. For this reason, WS-MCI should be considered as part of any new motion compensation algorithm to produce better motion information and subsequently higher quality interpolated frames.

Future Work

Ultimately, we would like to apply WS-MCI to High-Definition TV (HDTV) signals. These signals present many challenges in terms of motion compensated interpolation: millions of pixels per frame, high colour precision, and encoding (e.g., MPEG-2) for transmission. In addition to these technical issues, HDTV has a wider aspect ratio than typical NTSC TV. This means that more motion per frame is expected due to the fact that most video motion is horizontal.

Other future studies will investigate how well WS-MCI deals with non-linear motion, colour-guided MI, and backward motion vectors.

References


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