Sub-pixel Video Stabilization

Currently TPS Image Enhancement system uses a separate software process to achieve image stabilization. TPS processing lends itself to the incorporation of stabilization due to the fact that many stabilization computation steps are already pre-computed during TPS processing. Eventual incorporation of TPS software and its concepts onto a chip with stabilization will be a breakthrough in sensor-on-a-chip computation. Implementation of a new approach to TPS Video Stabilization Technology in software results in sub-pixel stabilization (up to 1/10 of a pixel), resolution enhancement (double the resolution) and addition of rotational stabilization (3 axis system – roll, pitch and yaw). The approach is explained below.

Normalize the image intensity to compensate for changes in illumination - Target applications require robust performance in the field at night. It's very common to encounter intermittent sources of stray light at night. For example, military and law enforcement must deal with headlights of passing vehicles and the military must deal with exploding ordinance.

Non-directional energy function - This processing step measures image energy at a particular spatial distance. Detected energy corresponds to edges and edges contain more information than uniform areas.

Global featureless image matching - Featureless image matching provides robust performance for scenes with low feature content. Night vision applications often have very large amounts of noise and it is not possible to reliably extract features in the presence of noise. As a result, image matching performance decreases gracefully in the presence of noise.

Global image matching search method - Pseudo-random pattern would be generated in the image plane. Least mean square metric will be employed to measure correlation. Simulated annealing (staged decrease of search distance) will be pixel oriented and should give pixel or sub-pixel performance.

Global Motion model - TPL has chosen a motion model permitting translation and rotation that is sufficient for our intended applications. This provides a good tradeoff of capability and compute requirements. In addition to translational and rotational stabilization a more general model supporting scaling and perspective can be developed, though it is likely to be many times slower.

Local image matching - Global matching yields results that are clear in the center, but blurred at the edges; this blurring is largely due to lens imperfections. Therefore, image matching is performed independently in multiple local regions. This motion model is translation only and the search method uses a fixed pattern. This algorithm is sub-pixel oriented yielding a fractional pixel offset along with a measure of confidence of the match.

Where does the center go? - There are two options; either a one-sided time window or a two-sided time window. While the two-sided window option is smoother it induces more time delay and more memory usage during processing. For either option, a Gaussian weighted average of the center displacement is minimized and the maximum center displacement is constrained to 1/8 of the image size.

End result is a completely new class of techniques that doubles the resolution and produces 3 axissub-pixel stabilization in real time. This approach can be accomplished in software on a Pentium 4 processor.

For detailed information regarding Sub-pixel Video Stabilization specifications, contact:

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